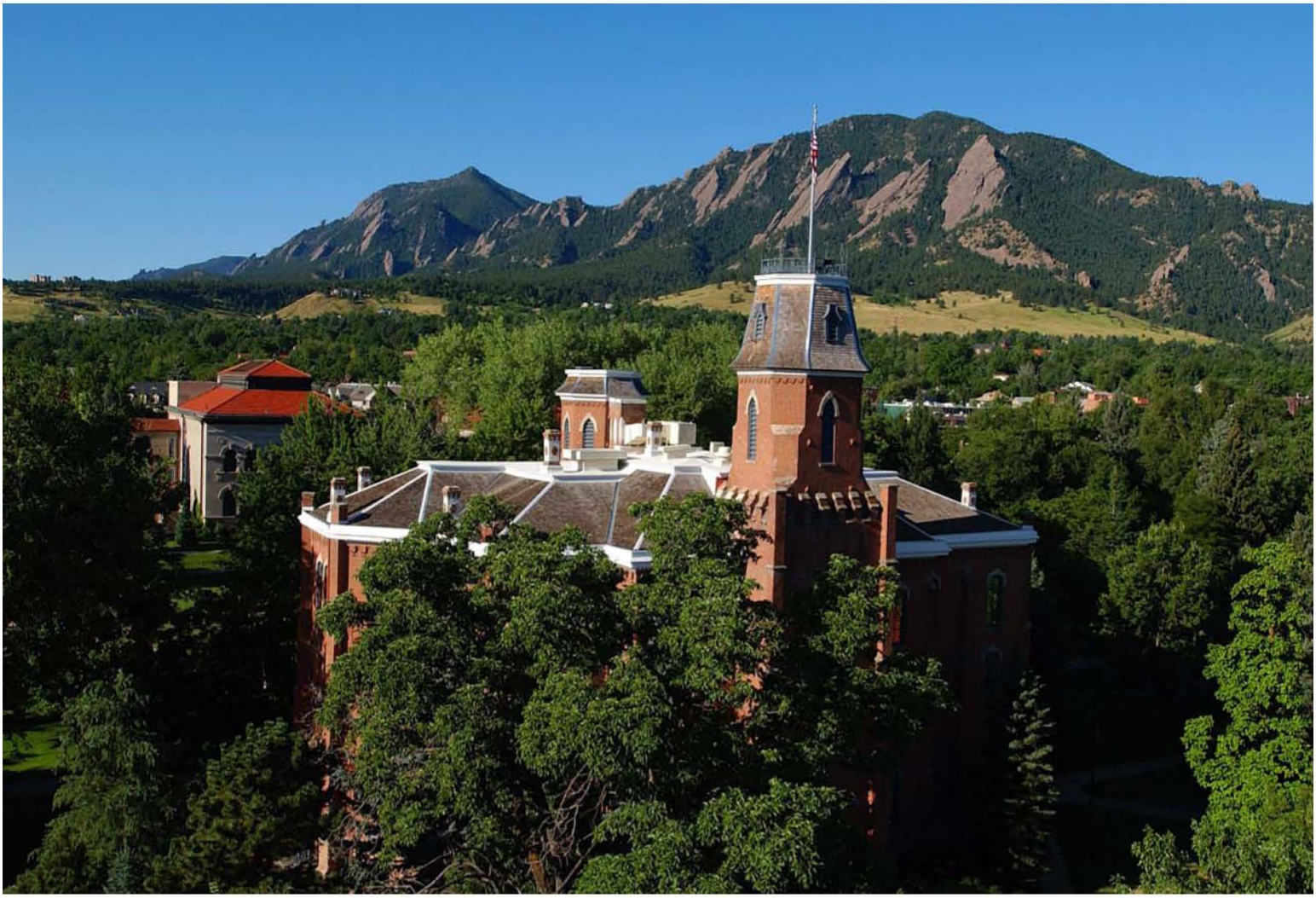


University of Colorado

1985-1986 Catalog

Contents

Explanatory Notes

HOW TO USE THE CATALOG

The *University of Colorado at Boulder Catalog* contains general administrative and academic information; a summary of campus facilities and services; descriptions of colleges, schools, and individual departments; degree requirements; course descriptions; and a listing of administrative officers and faculty. Students should refer to this 1985-86 edition of the *Catalog* for current course descriptions and University policies. In addition, students are responsible for complying with degree requirements published in the *Catalog* edition corresponding to the year of their entry to CU-Boulder.

Because the *Catalog* is compiled well in advance of the academic year it covers, changes in programs and policies may well occur. Students are responsible for being aware of these changes. Up-to-date information may be obtained by consulting departmental advisors, checking departmental bulletin boards, and reading the *Schedule of Courses* and *Registration Instructions* for each semester.

Course Descriptions

Undergraduate courses are classified as lower division and upper division. Courses numbered 100-299 are lower division courses that are introductory in nature and generally intended for first- and second-year undergraduate students. However, they are open to all undergraduates. Courses numbered 300-499 are upper division courses, generally intended for third- and fourth-year students. In order to enroll for some upper division courses, you must be a junior or a senior. Courses numbered 500-599 are primarily intended for graduate students but may be open to qualified undergraduates under some circumstances. Normally, courses numbered 600, 700, and 800 are open to graduate students only; see college and school sections for special provisions. Courses numbered 900 or above are Independent Study courses.

The number following the course number (for example, -2, -3, -4) indicates semester hours of credit offered for the course. The designation of *fall* or *spring* after the course title indicates the semester that the course will be offered. Prerequisites (Prer.) and corequisites (Coreq.) are listed after the course description. In some cases, the instructor of the course is also indicated. Students should consult the *Schedule of Courses* for up-to-date information regarding courses offered.

CU-BOULDER DIRECTORY

Persons seeking information about CU-Boulder programs, services, and activities may call the following offices. For campus telephone numbers not included below, call the campus operator at (303) 492-0111.

Office	Telephone
	Area Code (303)
Admissions	492-6301
Foreign Student Admissions	492-6665
Alumni Relations	492-8484
Athletics, Intercollegiate	492-5161
Bookstore, University Book Center	492-6411
Career Services	492-6541
Continuing Education	492-5148
Counseling Services	492-6766
Disabled Students	492-8671
Educational and Career Transition (Women's Center)	492-6766
Educational Opportunity Program	492-8316
Farrand Residential Academic Program	492-8848
Financial Aid and Scholarships	492-5091
Graduate School	492-7401
Housing	
Residence Halls	492-6673
Family Housing	492-6384
Off-Campus	492-7053
Nontraditional Student Center	492-1536
News Media Relations	492-6431
Police, University	492-6666
Records	492-6170
Registrations	492-6970
Research and Testing	492-7067
Residency Classification	492-6868
ROTC	
Air Force	492-8351
Army	492-6495
Navy	492-8287
Sewall Residential Academic Program	492-6852
Student Health Service, Wardenburg	492-5101
Study Abroad	492-7741
Time Out Program (TOP)	492-6970
Tuition and Fees (Bursar)	492-5381
Veterans Affairs	492-7322

Introduction

THE UNIVERSITY OF COLORADO

At its first session in 1861, the Territorial Legislature of Colorado passed an act providing for a university at Boulder. The University was formally founded in 1876, the same year that Colorado became the Centennial State. Between 1861 and 1876, Boulder citizens donated land south of town and made gifts from $15 to $1,000 in order to match the $15,000 appropriated by the state legislature for construction of the University. The cornerstone for Old Main, the first University building, was laid in 1875. The University opened its doors on September 5, 1877, with 44 students, a president, and one instructor.

Today the University system includes four campuses: the main campus at Boulder and campuses at Colorado Springs, Denver, and the Health Sciences Center in Denver. The campuses have a combined enrollment of almost 35,000 students, and each campus has a special function in Colorado higher education. The 600-acre Boulder Campus offers an educational atmosphere that is exceptional in the breadth of its programs, courses, students, faculty, and facilities and fulfills its role of leadership within the four-campus University system by being generally recognized as the leading comprehensive research university in the Rocky Mountain Region. The University of Colorado at Colorado Springs (UCCS), situated on a 400-acre campus, provides programs and faculty to meet the university-level needs of the Pikes Peak area and southern Colorado. The University of Colorado at Denver (UCD), located in downtown Denver, serves the urban student and community with programs especially sensitive to the needs of the urban population and environment. UCD shares library, laboratory, classroom, and recreation facilities with Metropolitan State College and the Community College of Denver's Auraria branch on the Auraria Higher Education Center Campus. The University's Health Sciences Center (UCHSC) is also located in Denver, on a 40-acre campus. As well as professional schools, the center includes the University Hospitals, the Children's Day Care Center, the Rocky Mountain Development Center, the Children's Diagnostic Center for the evaluation of emotionally disturbed children, and several affiliated health research institutes.

Research and related instructional programs within the University represent annual expenditures amounting to some $80 million. Of this total, the expenditures on the Boulder, Colorado Springs, and Denver campuses are now over $40 million per year. The sponsored research and instruction program of the Health Sciences Center in Denver totals more than $40 million annually. Principal sources of these funds for research and training contracts and grants are various agencies of the federal government. The University's research activity is also supported by appropriations from the state of Colorado, private foundations, and private donors.

University Administration

The University of Colorado is governed by an elected, nine-member Board of Regents, charged by the state constitution with the general supervision of the University and the exclusive control and direction of all funds of and appropriations to the University, unless otherwise provided by law. The president is the chief academic and administrative officer of the four-campus system and is responsible for providing academic leadership to the University and for acting as chief spokesman for and interpreter of University policy. Each campus has a chancellor who serves as the chief academic and administrative officer responsible for the conduct of campus affairs.

Faculty participation in campus governance takes place through the Faculty Senate and the Faculty Assembly. Student participation in governance is achieved through the University of Colorado Student Union (UCSU), which provides student input in academic decisions at the classroom, department, school/college, and campus levels. University Regents, administrative officers, and faculty are listed in the back of this *Catalog*.

Colleges and Schools

To meet the current needs of its students, the University offers numerous fields of study through its 16 colleges and schools. *The Board of Regents of the University of Colorado reserves the right to establish enrollment levels for all academic areas.* Colleges and schools on the four campuses are listed below.

BOULDER CAMPUS

College of Arts and Sciences
College of Business and Administration
College of Design and Planning, Environmental Design Division

College of Engineering and Applied Science
College of Music
Graduate School
Graduate School of Business Administration
School of Education
School of Journalism
School of Law
School of Pharmacy

COLORADO SPRINGS CAMPUS

College of Business and Administration
College of Engineering and Applied Science
College of Letters, Arts and Sciences
Graduate School
Graduate School of Business Administration
Graduate School of Public Affairs

DENVER CAMPUS

College of Business and Administration
College of Design and Planning, Graduate Division
College of Engineering and Applied Science
College of Liberal Arts and Sciences
College of Music
Graduate School
Graduate School of Business Administration
Graduate School of Public Affairs
School of Education

HEALTH SCIENCES CENTER

School of Dentistry
School of Medicine
School of Nursing
Graduate School

THE BOULDER CAMPUS

The mission of the University of Colorado, Boulder (CU-Boulder) is to lead in discovery, communication, and use of knowledge through instruction, research, and service to the public. As a comprehensive university, CU-Boulder is committed to the liberal education of students and to a broad curriculum ranging from the baccalaureate through the postdoctoral levels. The educational experience of the Boulder Campus, therefore, is distinguished by the scope of its programs and course offerings, the notable reputation of its research facilities, the diversity of its student body, and the professionalism and dedication of its faculty.

The Boulder Campus has five colleges and four professional schools that offer more than 3,000 courses in over 140 fields of study. There are approximately 81 bachelor's degree programs, 61 master's programs, and 52 doctoral programs. These programs represent a full range of disciplines in the humanities, the social sciences, the physical and biological sciences, and the professions. CU-Boulder is fully accredited by the North Central Association of Colleges and Secondary Schools. See college and school sections of the *Catalog* for additional accreditation information.

In 1967 CU-Boulder became a member of the Association of American Universities (AAU). AAU membership consists of the 52 leading graduate and research-oriented institutions of higher education in the nation, and the University of Colorado, Boulder is the only institution in the Rocky Mountain Region with this designation.

CU-Boulder is among the top 20 universities in the country in gaining federal research support. Research conducted in the individual academic departments is facilitated and supplemented by a structure of research institutes. These institutes are devoted both to the advancement of knowledge in particular areas and to graduate training. Many of these institutes have developed international reputations. Included among these well-known institutes are the Cooperative Institute for Research in Environmental Sciences (CIRES), the Institute for Behavioral Genetics (IBG), the Institute of Behavioral Sciences (IBS), the Institute of Cognitive Science (ICS), the Institute of Arctic and Alpine Research (INSTAAR), the Joint Institute for Laboratory Astrophysics (JILA), and the Laboratory for Atmospheric and Space Physics (LASP). For a detailed description of important research facilities associated with the University, see the Graduate School section of this *Catalog*.

The University's relationships with national agencies and laboratories located in Boulder are also exceptionally productive. The teaching and research programs of the Boulder Campus are closely integrated with the National Center for Atmospheric Research (NCAR), including the High Altitude Observatory (HAO), the National Bureau of Standards (NBS), and the National Oceanic and Atmospheric Administration (NOAA), among others.

The educational environment of a research university is characterized by a broad range of experiences conducted in many different settings. While the classroom is the location for the majority of instruction, laboratories, seminars, and field work are also principal components of the undergraduate and graduate CU experience. Some programs encourage off-campus internships and training. Students whose interests cross traditional disciplinary lines may choose from a number of interdisciplinary programs. And CU-Boulder students also have the opportunity to participate in a wide range of study abroad programs.

The campus operates year-round on a semester system. Fall and spring semesters consist of 15 weeks each. The campus also offers a summer session that enables those interested to make progress toward their degrees while enjoying Boulder's summer environment and special cultural activities.

The University of Colorado, Boulder is a cosmopolitan campus enrolling students from all 50 states and over 70 foreign countries. With a total enrollment of approximately 20,000 students, CU-Boulder is the largest campus in the four-campus system. Many different ethnic, religious, academic, and social backgrounds are represented, making an interesting and diverse student population that enriches each student's educational experience.

Full-time faculty members number 936 and 91 percent have Ph.D. or equivalent degrees. The faculty includes nationally recognized scholars with many academic honors and awards. Ten of the faculty are

members of the National Academy of Sciences; five are members of the National Academy of Engineering; and eight are included in the membership of the American Academy of Arts and Sciences. Most faculty members, including full professors, teach both undergraduate and graduate classes. Faculty research and creative activities are incorporated directly into the instructional programs.

The Campus Setting

The University of Colorado, Boulder is located at the base of the Rocky Mountains, at an altitude of over 5,000 feet. The climate is temperate, with pleasant days and cool evenings. On the average, the area enjoys 300 days of sunshine each year. The campus covers 600 acres and includes 160 buildings constructed of rough-cut sandstone with red tile roofs. The rural Italian architectural style evolved from a master plan developed by Philadelphia architect Charles Klauder in 1917. The Norlin Quadrangle, including the original Old Main built in 1876, has been named to the State and National Register of Historical Places.

Boulder County encompasses five ecological zones, from 5,000 feet above sea level (plains grassland) to 14,000 feet (alpine tundra). Downtown Boulder is only 20 miles from the Continental Divide and some of the most spectacular scenery in the United States.

The city of Boulder, an attractive community of 80,000 people, is committed to preserving its beautiful natural environment and, therefore, provides its citizens with ample parks and open space. Contemporary environmental design and renovated historical buildings combine to give the city a pleasant, well-planned atmosphere. The same natural beauty that attracted the first pioneers to the area now draws scientists, businesspeople, and professionals, as well as writers, artists, and craftspeople. Consequently, the city is a center of high technology enterprises, scientific research, and cultural activity.

Metropolitan Denver, with a population of 1.6 million, is 30 miles from Boulder. Denver offers the opportunities and resources of a large city and is easily accessible from the Boulder area by traveling U.S. 36, also known as the Denver-Boulder Turnpike. Denver's Stapleton International Airport is served by most major carriers and is located 20 minutes northeast of downtown Denver. Denver and Boulder are connected by a public transportation system.

Campus Tours

Guided walking tours of the Boulder Campus leave from Regent Administrative Center 125 each weekday at 11:00 a.m. and 2:30 p.m. and provide a personal introduction to the campus environment. No advance reservation is necessary.

BOULDER CAMPUS ACADEMIC PROGRAMS

B—Bachelor's Level
C—Certification
D—Doctoral Level
JD—Juris Doctor
M—Master's Level

ARTS AND SCIENCES, COLLEGE OF

African and Middle Eastern Studies	B		
American Studies	B		
Anthropology	B	M	D
Applied Mathematics		M	D
Applied Physics		M	D
Art Education	B	M	
Art History	B	M	
Asian Studies	B		
Astrophysical, Planetary, and Atmospheric Sciences		M	D
Astrophysics			D
Basic Science		M	
Biological Sciences—EPOB	B	M	D
Biological Sciences—MCDB	B	M	D
Biological Sciences—(With Education)	B		
Black Studies	B		
Central and Eastern European Studies	B		
Chemical Physics			D
Chemistry	B	M	D
Chinese	B		
Classics	B	M	D
Communication (Pre-Communication)[1]	B	M[2]	D[2]
Communication Disorders and Speech Science	B	M	D
Comparative Literature		M	D
Computer Science Applications	B		
Creative Arts		M	
Dance	B	M	
Distributed Studies	B		
Economics	B	M	D
English	B	M	D
Environmental Conservation	B		
French	B	M	D
Geography	B	M	D
Geology (Pre-Geology)[1]	B	M	D
Geophysics			D
German	B	M	D[2]
History	B	M	D
Humanities	B		
Individually Structured	B		
International Affairs	B		
Italian	B	M[2]	
Japanese	B		
Latin American Studies	B		
Linguistics	B	M	D
Mathematical Physics			D
Mathematics	B	M	D
Philosophy	B	M	D
Physical Education	B	M	
Physics	B	M	D
Physics for Secondary Schools	B		
Political Science	B	M	D
Pre-Child Health Associate[3]			
Pre-Dental Hygiene[3]			
Pre-Journalism[3]			
Pre-Medical Technology[3]			
Pre-Nursing[3]			
Pre-Pharmacy[3]			
Pre-Physical Therapy[3]			
Psychology	B	M	D
Recreation	B		
Religious Studies	B	M	
Russian	B		

[1]New students must apply as pre-majors; admission to the major is determined by work completed in the freshman and sophomore years.
[2]Admission suspended.
[3]The College of Arts and Sciences offers a preprofessional program in this area in preparation for later application to professional school. Students admitted to a preprofessional area of study are not assured admission to the subsequent professional program and must submit a separate application to professional school at the appropriate time.

Russian and Slavic Languages and Literature		M	
Sociology	B	M	D
Spanish	B	M	D
Studio Arts	B		
Theatre	B	M	D
Women Studies	B		

BUSINESS AND ADMINISTRATION, COLLEGE OF

Accounting	B	M	
Business Administration		M	D
Finance	B	M	
Information Systems	B		
International Business	B		
Management Science		M	
Marketing	B	M	
Minerals Land Management	B		
Organization Management	B	M	
Personnel-Human Resources Management	B		
Production and Operations Management	B		
Public Agency Administration	B		
Real Estate	B		
Small Business Management and Entrepreneurship	B		
Transportation and Distribution Management	B		

DESIGN AND PLANNING, COLLEGE OF

Environmental Design	B		

EDUCATION, SCHOOL OF

Education	C[1]	M	D

ENGINEERING AND APPLIED SCIENCE, COLLEGE OF

Aerospace Engineering Sciences	B	M	D
Applied Mathematics	B		
Architectural Engineering	B		
Chemical Engineering	B	M	D
Civil Engineering	B	M	D
Computer Science	B	M	D
Electrical Engineering	B	M	D
Electrical Engineering and Computer Science	B		
Engineering		M	
Engineering Physics	B		
Mechanical Engineering	B	M	D
Mechanics		M	D
Telecommunications		M	

JOURNALISM, SCHOOL OF

Advertising	B		
Broadcast News	B		
Broadcast Production Management	B		
Journalism		M	
News-Editorial	B		
Public Relations	B		

LAW, SCHOOL OF

Law			JD

MUSIC, COLLEGE OF

Music, Bachelor of Arts in	B		
Music	B	M	
Music Education	B	M	D
Musical Arts			D
Musicology			D

PHARMACY, SCHOOL OF

Pharmaceutical Sciences		M	D
Pharmacy	B		

For further information on the programs listed above, refer to the appropriate *Catalog* sections (references are included in the Index). Additional graduate and professional programs are located on other campuses of the University; see the Graduate School section of this *Catalog*.

DIVISION OF CONTINUING EDUCATION

The mission of the Division of Continuing Education of the University of Colorado, Boulder is to facilitate the dissemination of knowledge to the adult community beyond the campus by providing the University's academic resources in response to local, state, regional, and national needs. In accomplishing its mission, the division offers credit and noncredit courses, seminars, and related services to over 35,000 persons each year.

Learning experiences are provided by University-approved instructors in traditional, nontraditional, and innovative frameworks including the classroom, correspondence study, individualized instruction, and telecommunication programs. Boulder faculty frequently are the primary providers of instruction in the professional fields of real estate, law, business, and engineering.

The division, which is self-supporting through tuition and fees, offers the following certificate programs: Real Estate Education, Childhood Education, Commercial Design, Computer Application, Multi-Media, and Management Development. These programs may offer Continuing Education Units (CEUs), although they do not lead to credit toward a degree. Seminar programs focus on improving professional, technical engineering, and management skills as well as the development of human resources.

The division is responsible for administering, marketing, and coordinating educational activities designed and taught primarily for the benefit of persons who are not enrolled or considered as regular students on any of the University campuses. Clientele consists of governmental, business, and industrial organizations and agencies, students working to fulfill deficiencies, and individuals seeking self-enrichment and alternative learning experiences.

Information is available from the Division of Continuing Education, 1221 University Avenue, Boulder, Colorado 80309, (303) 492-5148, and at the Western Colorado Continuing Education Office, 1170 Elm Street, Grand Junction, Colorado 81501, (303) 242-5731; toll free, call 1-800-332-5839.

CAMPUS FACILITIES

Academic Computing Services

Academic Computing Services (ACS) provides support for instructional and research activities of students, faculty, and staff through a University-wide network of computing facilities. ACS resources include a Control Data Corporation Cyber 170/720, two Digital

[1]Education—Students interested in elementary or secondary school teaching may take programs approved for Colorado certification in connection with most of the undergraduate majors offered.

Equipment Corporation VAX computers (11/780 and 11/750), computing sites throughout the campus that allow general access to batch, time-sharing, and personal computer equipment, as well as access to computational facilities at other institutions. Interactive network access is also available through more than 50 dial-up ports. The software available includes programming languages such as FORTRAN, PASCAL, COBOL, and BASIC, as well as a library of mathematical and statistical packages and other applications programs. Academic Computing Services offers computing assistance through student and professional advisors, seminars and workshops at the beginning of each semester, on-line documentation, and articles in the ACS newsletter, the *Digit*. In addition to the resources of Academic Computing Services, a number of departments support extensive computing facilities for special research and instruction.

Communication Disorders Clinic

The Communication Disorders Clinic has a two-fold purpose: it provides facilities for the training of undergraduate and graduate students, and it provides speech, language, learning, and hearing evaluation and intervention services for persons of all ages in the Boulder community. Any student of the University or any member of the community is eligible for the services offered. Services include evaluation of speech and language skills, training for the improvement of communication skills, evaluation of hearing, instruction in lipreading, evaluation of hearing aid use, and auditory training for the hearing impaired. The Communication Disorders Clinic, as well as the office and classrooms for the Department of Communication Disorders and Speech Science, are located west of the Events/Conference Center.

Events/Conference Center

The Events/Conference Center (ECC) is a multipurpose facility which opened in November 1979. It provides an attractive, efficient, and comfortable setting for a wide variety of activities, offered for the benefit of the students, staff, and faculty of the University and for the community.

The ECC was designed and is utilized for events such as educational conferences, seminars and meetings, convocations, and commencement ceremonies, as well as cultural, entertainment, and athletic activities that enhance and further the objectives of the University of Colorado.

The main arena of the ECC has a seating capacity ranging from 8,500 to 12,000, depending on event configuration. The conference level offers six carpeted and air conditioned meeting rooms, which range in capacity from 40 to 200, depending on the type of activity.

Fine Arts Exhibitions

The Department of Fine Arts organizes exhibitions of painting, graphic arts, photography, and sculpture from its own collections and from those of major museums, collectors, artists, and galleries throughout the country. The exhibitions are shown in the Eve Drewelowe Gallery and the other two University of Colorado Art Galleries, which are all located in the Sibell-Wolle Fine Arts Building.

The Phillips, Brackett, Faye, and Oliver collections and the Department of Fine Arts collections are also located on the campus.

Fiske Planetarium

The Fiske Planetarium on the Boulder Campus is primarily used as a teaching tool in astronomy classes and by other departments of the University. Equipped with a Zeiss VI star projector in a 65-foot diameter dome with 213 seats, the Fiske Planetarium is one of the finest planetarium facilities in the world.

Planetarium shows for school groups and the public are given, as well as star talks and lectures on space-related topics. This year a Space Operations Laboratory, developed by the University's Laboratory for Atmospheric and Space Sciences, will be installed in the lobby of the planetarium with current displays of the University's involvement in the space program.

Libraries

The University Libraries support the academic study, teaching, and research at CU-Boulder. The library collection contains almost 2,000,000 volumes, over 2,000,000 microforms, 20,000 current serials subscriptions, and numerous maps and audiovisual materials. The libraries include the central library (Norlin Library) and branch libraries.

Norlin Library contains the major resources in the humanities, social sciences, and life sciences as well as various special collections and services. Its Government Publications Library serves as a depository for publications of the U.S. government, European Communities, GATT, and the Organization of American States. The Technical Reports Center, housed there, contains research materials published by agencies such as NASA, NTIS, and the Department of Energy.

Norlin Library also contains the Rare Books Room, Western History/University Archives, and the Audiovisual/Microforms Department which provide specialized resource materials. Computer-based reference service is offered to library users with a charge to help offset the cost. There are copying facilities in Norlin and all of the branches.

The branch libraries include Business, Earth Science, Engineering, Mathematics/Physics, and Music.

The Interlibrary Loan Department serves faculty, students, and staff by borrowing research materials from other libraries when those materials are not available in the University Libraries' collection. The University's membership in the Center for Research Libraries further extends the resources available to users.

Information about the law library may be found in the School of Law section of this catalog.

Macky Auditorium

This concert hall seats 2,505. Macky is the focal point for Artist Series concerts by internationally

celebrated soloists and ensembles; community Boulder Philharmonic Orchestra concerts; band, choral, and orchestral performances presented by the College of Music; Program Council-sponsored jazz and rock concerts; lectures, films, meetings, and conferences; and the Macky Auditorium Travelogue Series. The box office telephone is (303) 492-6309 for information on all events.

Modern Language Laboratory

The modern language laboratory facility consists of four language laboratories with a total of 114 record-playback positions, a 30-station audiovisual classroom, a recording studio, a tape library with high-speed duplicator, and two equipment repair rooms. The Colorado Springs campus has a 20-position laboratory. The Denver Campus shares facilities at the Auraria complex.

Museum

The University of Colorado Museum—through its collections in anthropology, botany, geology, and zoology—is a primary resource for teaching and research. It preserves physical evidence of what is known about the Rocky Mountain Region, making it indispensable for faculty and graduate student research. Its extensive program of foreign studies and exchanges of specimens and information has given the museum an international reputation; 1.8 million specimens are available for study.

Through assistantships, the museum gives professional instruction to students in the field and in the laboratory. Museum faculty members teach courses in their specialties including Southwestern archaeology and ethnology, bryology and lichenology, vertebrate paleontology, malacology, entomology, and marine micropaleontology, in addition to museology, museography, and art history. Financial support is provided to selected, qualified students through the Walker Van Riper Fund to encourage participation in museum-related research.

The exhibit halls, open daily to the public, present informative exhibits for education and enjoyment at all levels. The Hall of Earth contains exhibits of minerals, rocks, and fossils, particularly illustrating local geology. The Hall of Life shows highlights of the plant and animal worlds, with emphasis on Colorado and Rocky Mountain forms. The Hall of Humanity exhibits samples of the cultures of widely separated primitive peoples of recent times, as well as synoptic series illustrating the North American Indian cultures, with special emphasis on those of the prehistoric Southwest. The changing exhibit hall is used for four or five temporary exhibitions per year.

Recreation Program

The Boulder Campus recreation program is designed to fulfill a vital educational function and to provide students and other members of the University community the opportunity to participate in a variety of activities for personal enjoyment and satisfaction.

The Student Recreation Center, a service of UCSU (University of Colorado Student Union) provides excellent facilities for instructional programs and individual or group activities ranging over approximately 30 sports activities for current fees-paid students and members. The center contains two swimming pools with an adjoining patio-sun deck; an ice skating rink enclosed by glass windows; squash courts, handball/racquetball courts; tennis courts; a large gymnasium for volleyball, fencing, dance, badminton, etc.; a fitness systems room; exercise rooms; men's and women's locker rooms equipped with showers and hair dryers; a first aid and therapy room; and two dry-heat saunas.

The student-oriented Recreation Department staff gives personal attention to the needs of individual students, faculty, and staff. Detailed information regarding programs and events may be obtained from the various offices within the Recreation Center complex. For further information, students may call Rec. Check: 492-6561.

Theatre and Dance

Facilities for theatrical and dance presentations include Macky Auditorium, the University Theatre, the beautiful outdoor Mary Rippon Theatre, Theatre 300, the Old Main Theatre, and the new Dance Concert Studio.

The Department of Theatre and Dance presents a Major Season bill of six productions each academic year. Other productions are staged under the auspices of the Minor Season and ChoreoLab.

The Colorado Shakespeare Festival, presented each summer in the outdoor Mary Rippon Theatre, is produced by the Department of Theatre and Dance under the sponsorship of the Creative Arts Program. It has had 26 years of distinguished history and is one of seven theatre groups in the world that have completed the entire Shakespearean canon of 37 plays.

Throughout the year, the Department of Theatre and Dance presents various workshop productions, touring companies, story theatre, and dance programs. Also produced is the Colorado Caravan, which sends theatre and dance troupes on tour during the academic year to all parts of Colorado.

University Memorial Center

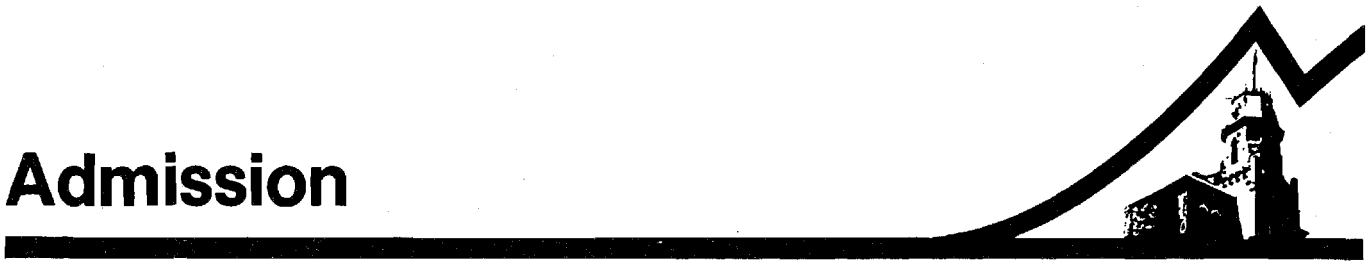
The University Memorial Center (UMC) serves as a focal point for campus nonacademic programs, services, and activities. The UMC houses and provides such special services and facilities as (1) a reception desk which serves as a central campus information point; (2) a fine arts center with an art gallery, browsing room, and music listening rooms; (3) the University Book Center; (4) a conference center and special meeting rooms, including the Glenn Miller Ballroom; (5) a games area with bowling, billiards, and arcade games; (6) a photo lab for individual use; (7) an arts and crafts area; (8) a copy center and sign shop; (9) a computerized ticket service; (10) a flower shop; (11) banking facilities; (12) radio studios; and (13) a travel agency.

A major service of the facility is the UMC Food Service. Many restaurants and cafeterias are offered, providing a wide variety of food outlets. Included are the famed Alferd Packer Grill, Tabor Inn, 1890's, a Mexican cafe, and Pizza Hut. The UMC Food Service also offers a complete catering service with several private dining areas. There are also several satellite snack bars at various locations around campus.

The UMC houses the University of Colorado Student Union (UCSU) and its many boards and operations. Also housed are approximately 50 student organizations, the Ombudsman Office, Off-Campus Housing, UCSU Legal Services, and the Student Organization Finance Office.

The UMC has been designated as the official state memorial to those who died in past wars to preserve our democratic freedoms. It has also been designated as a multicultural center where opportunities are provided for relationships and understanding among all cultures represented in the University and the community. The UMC is partially supported by student fees.

Admission



UNDERGRADUATE ADMISSION

The Office of Admissions welcomes inquiries regarding undergraduate application procedures. Through the admission process, the University seeks to identify applicants who will successfully complete collegiate academic programs. Admission is based on many criteria, such as evaluation of work taken at other educational institutions, graduation from high school or its equivalent through the General Educational Development (GED) Test, results of the Scholastic Aptitude Test (SAT) or the American College Test (ACT), and letters of recommendation from school officials reflecting applicants' motivation and potential for academic growth. In addition, careful attention is given to applicants' written comments concerning their backgrounds and academic goals.

Inquiries relating to undergraduate admission to the University of Colorado, Boulder may be addressed to:

Office of Admissions
Regent Administrative Center 125
Campus Box 7
University of Colorado, Boulder
Boulder, Colorado 80309

Telephone inquiries may be directed to (303) 492-6301.

Visiting the Campus

The Office of Admissions invites prospective students to visit the campus and meet with an admission representative. No appointment is necessary. Admission representatives are available on a walk-in basis in Regent Administrative Center 125, Monday through Friday, from 9:00 a.m. to 4:30 p.m. (8:30 a.m. to 4:00 p.m. during the summer).

While on campus, a guided walking tour can provide a personal introduction to the campus environment. Tours leave from Regent Administrative Center 125 each weekday at 11:00 a.m. and 2:30 p.m. In addition, participation in one of the numerous campus visitation programs specially designed for prospective students is an excellent way to become acquainted with the campus. These programs are described below.

VISITATION PROGRAMS

The "Be a CU Student for a Day" programs offer prospective students the opportunity to visit the campus on a school day, take a tour, attend classes, and have lunch in a residence hall. These programs are held throughout the academic year and are planned for October 11 and 25, November 8 and 20, 1985; February 28, March 14 and 21, and April 4, 1986.

The "CU Sampler" programs, held on selected Saturdays, also introduce prospective students and their parents to the campus and its academic programs. Highlights include a sample lecture, a campus tour, student/faculty panel discussions, lunch in a residence hall, and a chance to meet with financial aid and housing representatives, faculty advisors, and other campus representatives. The programs are planned for October 19, 1985, and February 8 and July 12, 1986.

For the student who aspires to a career in engineering, the "Engineering Open House" is held twice in the fall. Students and their parents are provided the opportunity to meet the dean, tour engineering facilities, explore engineering career options, and have lunch in a residence hall. Dates for 1985 are October 19 and November 16.

Inquiries regarding the above programs should be directed to the Office of Admissions, University of Colorado at Boulder, Regent Administrative Center 125, Campus Box 30, Boulder, Colorado 80309, telephone (303) 492-6301.

Important Information for All Applicants

CREDENTIALS

To be considered for admission, applicants must submit complete and official credentials as required by the desired program of study. Students may not disregard any part of their previous educational background. *Failure to submit transcripts from all institutions previously attended will be cause for cancelling the admission process or for dismissal.* All credentials presented for admission to CU-Boulder become the property of the University and may not be returned to the applicant.

ADMISSION NOTIFICATION

Freshman and transfer applicants will receive mail notification of admission status. Applicants notified of admission eligibility will be sent the appropriate forms to confirm their intent to enroll. Admission eligibility does not guarantee enrollment.

The University reserves the right to deny admission to applicants whose total credentials reflect an inability to assume those obligations of performance and behavior deemed essential by the University and relevant to any of its lawful missions, processes, and functions as an educational institution.

PREPROFESSIONAL PROGRAMS

Admission to a preprofessional area of study does not guarantee future transfer and admission into any professional program, college, or school within the University of Colorado system. For example, a student who is admitted to pre-journalism is not assured future admission to a professional program in journalism. A separate application must be submitted at the appropriate time for admission consideration to a professional program.

Students interested in an undergraduate health sciences program offered at the University of Colorado Health Sciences Center (UCHSC) in Denver (Child Health Associate, Dental Hygiene, Medical Technology, Nursing, and Physical Therapy) may complete preprofessional work on the Boulder Campus where special prehealth advising is available. Admission to the Physical Therapy Program is open only to Colorado residents and students from the Western Interstate Commission for Higher Education (WICHE) states: Alaska, Hawaii, Idaho, Oregon, Nevada, and Wyoming. For all other programs, strong admission preference is given to Colorado residents. Normally, students who are not Colorado residents can obtain at CU-Boulder the preprofessional courses required for entrance to health sciences programs in other states, as well as for entrance to Colorado programs that are open to nonresidents. For more information, see the description of Prehealth Sciences in the College of Arts and Sciences section of this *Catalog*.

TEACHER CERTIFICATION

Through the School of Education, students interested in elementary or secondary school teaching may take programs approved for Colorado certification in connection with most of the undergraduate majors offered at CU-Boulder. Interested students should see an advisor in the School of Education during their first semester at the University.

Persons holding a baccalaureate degree who seek *initial* teacher certification must submit the required application and credentials to the School of Education. Certified teachers with a baccalaureate degree who seek only a *renewal* of the certificate currently held and who do not require institutional endorsement or recommendation may qualify for the University's Special Student classification (see the Special Students section of this *Catalog*).

Refer to the School of Education section of this *Catalog* for further information about teacher certification. Interested students may also write the School of Education, Office of Teacher Education, University of Colorado at Boulder, Campus Box 249, Boulder, Colorado 80309, for application and deadline information.

Freshman Students

WHEN TO APPLY

Early application with complete credentials is encouraged in order to be considered for admission before enrollment levels are reached. Applications for fall semester 1985 may be submitted starting September 1984, and applicants will be notified of admission decisions on a rolling basis beginning approximately November 1.

Fall semester applications received and completed (including all required credentials) by March 1 will be given equal consideration.

Applications for spring or summer 1985 may be submitted starting September 1984.

Applicants for spring semester 1985 will be notified of admission decisions beginning October 1984. Applicants for summer 1985 will be notified beginning February 1985.

HOW TO APPLY

1. The student should obtain an application brochure from the Office of Admissions, University of Colorado at Boulder, Regent Administrative Center 125, Campus Box 7, Boulder, Colorado 80309, telephone (303) 492-6301. Colorado residents may obtain this brochure from their high school counselors. (Students from other countries who are not citizens or permanent residents of the United States must request special application materials from the CU-Boulder Office of Admissions.)
2. A complete application must include the following credentials:
    a. Application for admission.
    b. The nonrefundable $20 application fee made payable to the University of Colorado.
    c. A transcript of all high school work completed which must also include rank-in-class and courses in progress for the entire year.
    d. Required entrance test scores (SAT or ACT).
    e. Copies of GED Test scores and a Certificate of High School Equivalency with an official transcript of any high school work (grades 9 through 12) completed if the applicant is not a high school graduate.
    f. The required audition if the student is entering the College of Music.

Applicants who are currently attending high school should give the completed applications to their counselors. The application must include the $20 fee, transcript, and rank-in-class information in a single mailing packet. An incomplete application may be returned to the student.

3. The fact that college entrance test scores (SAT or ACT) are not available does not mean an applicant should delay sending the application and credentials. However, if final official test scores are available at the time of application, they may be posted on the official high school transcript in lieu of or in addition to being reported directly by the testing service.

CONFIRMATION PROCEDURES

Applicants selected for admission are sent the appropriate forms to confirm their intent to enroll and are encouraged to return them with the designated nonrefundable deposit ($100 to $300) *as soon as they have decided to enroll.* Admission becomes complete when the Office of Admissions receives *and* processes the signed Student Confirmation Form and the deposit. Acceptance of the form and deposit is assured until May 1, 1985. After May 1, confirmations can be accepted only if places are still available. The required nonrefundable confirmation deposit will be returned only if it is received *after* enrollment levels in the desired program have been reached.

COLLEGE ENTRANCE TESTS

National Test Dates for 1984-85 are as follows:

Scholastic Aptitude Test (SAT)

Saturday

November 3, 1984	March 23, 1985[1]
December 1, 1984	May 4, 1985[1]
January 26, 1985	June 4, 1985[1]

American College Test (ACT)

Saturday

October 27, 1984	April 20, 1985[1]
December 8, 1984	June 8, 1985[1]
February 9, 1985	

Prospective students in high school take the college entrance test at the end of the junior year or early in the senior year. *The University of Colorado accepts either the SAT or the ACT for admission.* A student who is not satisfied with the first test score results is urged to retest at the earliest possible date. For admission purposes, the University will consider the highest scores. *Achievement tests are not required.* For further information regarding college entrance tests, consult with a high school counselor, write or call the Office of Admissions, or write to the following:

College Board (SAT)
P.O. Box 592
Princeton, New Jersey 08541

American College Test (ACT)
Registration Department
P.O. Box 414
Iowa City, Iowa 52240

ADVANCED PLACEMENT PROGRAM

The University participates in the High School Advanced Placement Program of the College Board. Students receiving scores of 3, 4, or 5 on Advanced Placement examinations are generally granted college credit. Official scores must be sent to the University directly from the College Board. For detailed information regarding applicability of Advanced Placement credit to CU-Boulder degree programs, write the Office of Admissions, University of Colorado at Boulder, Regent Administrative Center 125, Campus Box 7, Boulder, Colorado 80309.

ADMISSION CRITERIA

Prospective freshmen are considered on an individual basis relative to a prediction of academic success in the college to which they apply. The strongest predictors are the quality of courses taken, grades earned in those courses, rank-in-class, and the results of college entrance tests, either the SAT or the ACT. Admission committees review these and other factors that have a bearing on academic success; only those students for whom success can be predicted are offered admission. Some of the colleges typically have more qualified freshman applicants than there are places. Therefore, admission is competitive, and students with the highest qualifications are selected.

Students who meet the criteria listed below and who have completed or will have completed the suggested high school course units are assured admission as long as space remains available in the college to which they apply. Further, many students whose qualifications are somewhat less than those listed or who have not completed all of the suggested courses may be admitted on an individual basis. Applicants whose records reflect nontraditional grading systems, unusual curricula, no rank-in-class information, or high school equivalency through the GED Test will receive careful consideration and are urged to apply. Applicants are encouraged to include a personal statement describing their educational aspirations, travel and work experience, creative talents, and any other information which might be of use and interest to the admission committees. Prospective freshmen may apply to *one* of the five colleges listed below.

College of Arts and Sciences

Students who rank in the upper 40th percentile of their high school graduating class and who satisfy the suggested high school units and the entrance test score requirement are assured admission. The test score for assured admission is a combined SAT score of 1,000 or above (verbal score of no less than 450) *or* an ACT composite of 23 or above (minimum average of 21 on the English, social science, and natural science portions).

Suggested high school course units:

English (including at least two years of composition)	4
Foreign language (high school level proficiency in a single classical or modern language)	3
Mathematics (college preparatory)	3
Students, especially those considering concentrated work in mathematics and the sciences, are encouraged to take four units of high school mathematics.	
Natural science (laboratory science courses)	3
Social science (including at least one unit in history)	3
Total	16

Additional academic and nonacademic electives should be taken by all students.

[1]These test results may be received too late for applicants who wish to enroll for the following summer or fall terms.

Important Note: In the College of Arts and Sciences, three college semesters of a single foreign language are required for graduation with either the Bachelor of Arts or the Bachelor of Fine Arts degree. If three high school units of a single foreign language have been completed satisfactorily, or other acceptable evidence of Level III proficiency is established, no further language study will be required.

College of Business and Administration

Students who rank in the upper 30th percentile of their high school graduating class and who satisfy the suggested high school units and the entrance test score requirement are assured admission. Test scores for assured admission are a combined SAT score of 1,050 or above with a minimum SAT verbal score of 500 and a minimum SAT mathematics score of 550; *or* an ACT composite score of 25 or above with a minimum ACT English score of 21, a minimum ACT mathematics score of 26, and a minimum average score of 25 on the nonmathematics portion of the ACT.

Suggested high school course units:

English (one year of oral communication and two years of composition are strongly recommended)	4
Mathematics (including *at least* two years of algebra and one year of geometry)	4
Natural science (laboratory science courses)	2
Social science	2
Foreign language (both units in a single language)	2
Academic electives (additional courses in English, foreign language, mathematics, natural, or social sciences; not to include business courses)	2
Total	16

Students with strong mathematics and verbal skills are encouraged to apply even though their test scores and/or rank may vary from the indicated admission criteria.

College of Design and Planning, Environmental Design Division

Students who rank in the upper 25th percentile of their high school graduating class and who satisfy the suggested high school units and the entrance test score requirement are assured admission. The test score for assured admission is a combined SAT score of 1,100 or above *or* an ACT composite score of 25 or above.

Suggested high school course units:

English (composition, literature, grammar)	4
Mathematics (college preparatory)	3
Physics	1
Biology	1
Social studies and humanities (additional units of English, history, and literature are included in the humanities)	2
Foreign language (both units in a single language)	2
Fine arts (studio)	1
Academic electives	2
Total	16

Important Note: Because of the sequentially structured curriculum in environmental design, freshmen may begin this field of study either spring or fall semester but not during summer session. Applicants are strongly encouraged to include a personal statement describing their educational aspirations as related to design, travel/work experiences, and creative talents. Letters of recommendation are desirable. Students with strong graphics, mathematics, and verbal skills are encouraged to apply even though their test scores and/or rank may vary from the indicated admission criteria.

College of Engineering and Applied Science

Students who rank in the upper 20th percentile of their high school graduating class and who satisfy the suggested high school units and the entrance test score requirement are assured admission to the college.[1] The test score for assured admission is a combined SAT score of 1,150 (verbal 500, mathematics 650) or above *or* an ACT composite score of 28 or above (with a mathematics score of 28 or above).

Suggested high school course units:

English (composition, literature, grammar)	4
Algebra	2
Geometry	1
Trigonometry and solid geometry	1
Natural sciences (physics and chemistry recommended)	2
Social studies and humanities (foreign languages and additional units of English, history, and literature are included in the humanities)	3
Academic electives	3
Total	16

Important Note: Supporting statements from mathematics and physics/chemistry teachers are not required but are desirable. Students with strong mathematics and verbal skills are encouraged to apply even though their test scores and/or rank may vary from the indicated admission criteria.

For those young men and women with an interest and aptitude in mathematics and science, a career in engineering offers opportunity, challenge, and reward. Planning for a career in engineering should start early, as it is one of the few professional school programs that students enter at the freshman level. A solid foundation in mathematics and science is essential to successful entry and progress. Freshman engineering students must be prepared to begin their college-level education in mathematics at the level of first-semester calculus and analytical geometry.

College of Music

Students who rank in the upper half of their high school graduating class, who satisfy the suggested high school units and the entrance test score requirement, and who achieve a pass on the music audition are assured admission. The test score for assured admission is a combined SAT score of 1,000 or above *or* an ACT composite score of 23 or above.

Suggested high school course units:

English	4
Mathematics	3
Social science	2
Foreign language and/or physical science	3
Theoretical music, academic electives	4
Total	16

[1] It may be necessary to close admission to some engineering majors before March 1. In such instances, students accepted to the college may select another major.

Important Note: It is expected that all music students will have had previous experience in an applied music area. Two years of piano training are recommended.

Auditions: The College of Music requires an audition of all entering freshmen and all transfer students. Personal audition dates are February 2, February 23, and March 9, 1985. In lieu of a personal audition, applicants may substitute tape recordings (about ten minutes in length on 7½ ips-monaural). Audition applications are available from the Associate Dean for Undergraduate Studies, College of Music, University of Colorado at Boulder, Campus Box 301, Boulder, Colorado 80309, telephone (303) 492-6352.

APPLICANTS NOT GRANTED ADMISSION

An applicant who is not granted admission as an entering freshman may wish to consider transferring to the University after successful study elsewhere. The Office of Admissions urges such students to complete at least one full year of college-level course work at another college or university, with special attention to courses that will be sound academic preparation for future transfer to the University of Colorado, Boulder.

Transfer Students

Applicants are considered transfer students if they have enrolled for any college-level course work, full time or part time, since graduation from high school. College-level course work taken while still in high school does not qualify an applicant as a transfer student. To be considered for admission, transfer students must report all previous college work and have a high school diploma or its equivalent.

Students planning to transfer to CU-Boulder are encouraged to read all of the application materials carefully and to submit all necessary credentials.

WHEN TO APPLY

All prospective transfer students are encouraged to apply as early as possible after October 1, 1984, for the 1985 spring, summer, or fall terms. The Office of Admissions will *begin* making decisions in October 1984.

HOW TO APPLY

1. The prospective transfer student should obtain an application brochure from the Office of Admissions.
2. A complete application must include the following required credentials:
   a. Application for admission.
   b. The nonrefundable $20 application fee made payable to the University of Colorado.
   c. Two official transcripts from each college or university attended.
   d. SAT or ACT scores if appropriate (see College Entrance Tests above).
   e. A student who is claiming exemption from the College of Arts and Sciences foreign language graduation requirement on the basis of satisfactory completion of Level III (third-year high school level) foreign language in high school must submit an official high school transcript directly to the Office of the Dean of the College of Arts and Sciences within the first year in the college.

CONFIRMATION PROCEDURES

Applicants selected for admission are sent the appropriate forms to confirm their intent to enroll and are encouraged to return them with the nonrefundable deposit ($100 to $300) *as soon as they have decided to enroll.* Subject to enrollment levels, admission becomes complete when the Office of Admissions receives *and* processes the signed Student Confirmation Form and the deposit. The required nonrefundable confirmation deposit will be returned only if it is received *after* enrollment levels in the desired program have been reached.

GUARANTEED STUDENT TRANSFER PROGRAM

Colorado residents who are first- or second-year students at Lamar Community College, Otero Junior College, Trinidad State Junior College, Morgan Community College, and Adams State College may inquire at their own Office of Admissions or at the CU-Boulder Office of Admissions regarding the Guaranteed Student Transfer Program approved by the Colorado State Legislature in 1982. Students who wish to contract for upper division placement at CU-Boulder through this program should be aware that academic criteria are established by the faculty of each college and school on the Boulder Campus and will vary according to discipline and year of proposed transfer.

ADMISSION CRITERIA

Transfer students are selected for admission on an individual basis. A good college grade point average is not, by itself, a guarantee of admission because the courses a student has taken in college are as important as the grade point average. Furthermore, grade point average requirements may vary from term to term, depending on the overall quality of the applicant group and the number of transfer spaces available for a given college or school.

All transfer students who have completed fewer than 24 semester hours of college work (or 36 quarter hours) must submit an official high school transcript, and all transfer students who have completed fewer than 12 semester hours of college work (or 18 quarter hours) must submit SAT or ACT scores in addition to a high school transcript. Students who are not high school graduates must also submit copies of a Certificate of High School Equivalency and GED scores in addition to the above documents.

College of Arts and Sciences

Transfer students who have attained a cumulative college grade point average of 2.00 or better will be considered for admission on an individual basis. Work in progress at the time of application cannot be considered in computing the cumulative average.

College of Business and Administration

Transfer students who have attained a cumulative college grade point average of 2.75 or better will be considered for admission on an individual basis. Work in progress cannot be considered in computing the cumulative average. A high school transcript and SAT or ACT test scores must be submitted regardless of the number of hours of college work completed.

Transfer students must have completed 15 semester hours of college-level work prior to applying, and preference will be given to those applicants who will have completed courses (including calculus) equivalent to those taken by CU-Boulder business freshmen and sophomores. These courses are listed in the model degree program in the College of Business and Administration section of this *Catalog.*

College of Design and Planning, Environmental Design Division

Transfer students who have attained a cumulative college grade point average of 2.75 or better will be considered for admission on an individual basis. Work in progress cannot be considered in computing the cumulative average. A high school transcript and SAT or ACT test scores must be submitted regardless of the number of hours of college work completed. Applicants who are considering transfer into the program should complete college-level course work in a physical or life science (with laboratory), expository writing or English composition, calculus or statistics, and a fine arts studio course such as freehand drawing or painting.

College of Engineering and Applied Science

Transfer students who have attained a cumulative college grade point average of 2.75 or better will be considered for admission on an individual basis. Work in progress cannot be considered in computing the cumulative average. A high school transcript and SAT or ACT test scores must be submitted regardless of the number of hours of college work completed.

The College of Engineering and Applied Science expects a transfer applicant to have taken a college-level curriculum which is preparatory for advanced work in engineering. For example, it is expected that before entering CU-Boulder, transfer students will have completed one year of college-level calculus and at least one semester of physics and one semester of chemistry or two semesters of physics. Chemical engineering students should have completed two semesters of chemistry.

College of Music

Transfer students who have attained a cumulative college grade point average of 2.00 or better will be considered for admission on an individual basis. Work in progress at the time of application cannot be considered in computing the cumulative average. In addition, the College of Music requires an audition.

School of Journalism

Applicants must have a minimum of 60 semester (90 quarter) hours of appropriate college-level course work, passed or in progress, with a grade point average of 2.50 or better. Applicants with fewer than 60 hours must apply for the College of Arts and Sciences, pre-journalism major.

School of Pharmacy

Admission consideration is for the fall semester only, and applications must be received by March 1. Applicants must have completed two years of appropriate college-level course work with a grade point average of 2.00 or better by fall 1985. Applicants with fewer than two years of appropriate course work must apply for the College of Arts and Sciences, pre-pharmacy major.

TRANSFER OF COLLEGE-LEVEL CREDIT

The Office of Admissions performs an initial evaluation of transfer credit after all credentials are on file, the applicant has been admitted, and the applicant has confirmed intent to enroll. A complete evaluation of transfer credit cannot be made until all official credentials have been received.

The Office of Admissions evaluates transfer of credit from official transcripts sent directly to the University from each one of the applicant's previous colleges. Official transcripts must exhibit the official seal of the registrar. Transcripts that are marked "Student Copy," "Issued to Student," or "Unofficial" are not accepted as official.

Many times the initial evaluation does not reflect course work that is in progress at the time of confirmation. In order to complete the admission and transfer process, *all* transcripts of attempted work must be received by the Office of Admissions as soon as possible. Transfer students should arrange to have final official transcripts sent directly to the Office of Admissions after completion of the term for which they are enrolled. After an evaluation of transfer credit has been completed, a Statement of Advanced Standing is issued. One copy of the statement is sent to the student from the Office of Admissions, and one copy is sent to the dean's office of the college or school to which the student has been admitted.

There is no guarantee that all transfer credit will apply to a specific degree program. The dean's office has ultimate responsibility for supervision of the student's degree program and for determining how transfer credit applies to specific degree programs. Since graduation requirements at CU-Boulder vary from college to college, a reevaluation of transfer credit is required if a student changes colleges or schools after enrolling in the University.

Listed below are some general guidelines for accepting transfer credit.

Minimum Grades for Transfer

Only courses taken at a college or university of recognized standing with grades of C (2.00) or better will be accepted for transfer. Grades of *pass, satisfactory,* and

honors are accepted for transfer; however, each college and school at CU-Boulder places a limitation on the number of *pass* hours that may be applied toward a degree.

Credit From Two-Year Colleges

Each college and school at CU-Boulder determines the maximum number of semester hours that may transfer from a two-year postsecondary institution. Limits vary from college to college.

Credits for Correspondence Work

Each college and school determines the maximum number of credits taken through correspondence programs that will be accepted toward a baccalaureate degree.

College-Level Work Taken Concurrently With a High School Program

College-level work that does not apply to high school programs will be considered for transfer. Generally, postsecondary work applying toward high school graduation will not transfer.

Advanced Placement Examinations

Credit for College Board Advanced Placement Examinations cannot be evaluated from college or high school transcripts; score reports from the College Board must be submitted directly to the University for evaluation. In general, examinations with a score of 3 or better will be considered for credit. For further information, write or call the Office of Admissions.

College-Level Examination Program

Credit for a limited number of approved College Board Subject Examinations of the College-Level Examination Program (CLEP) may be granted for a score at or above the 67th percentile. This credit will be applied toward degree requirements at the discretion of the student's dean. Not all colleges accept CLEP credit in all subjects. Refer to the appropriate college dean's office for the policy of that college. Credit for CLEP Subject Examinations cannot be evaluated from college or high school transcripts; score reports must be submitted directly from the College Board. CLEP General Examinations are not accepted for credit at CU-Boulder. For information as to which specific examinations may be accepted for credit, write or call the Office of Research and Testing, University of Colorado at Boulder, Willard Administrative Center 128, Campus Box 103, Boulder, Colorado 80309, telephone (303) 492-7067.

Military Credit

Credit for military schooling is evaluated upon receipt of Form DD 214, "Service Separation Certificate." Only work that has received an upper division baccalaureate recommendation by the American Council on Education (ACE) will be awarded credit. This work, however, will be transferred and recorded at the lower-division level. Foreign language credit taken through the State Department, Department of Defense, or Defense Language Institute will be assigned the recommended ACE credit.

Credit by Examination

This option allows students to take an examination in order to earn credit for a course without registering for or taking the course. Students may want to exercise this option if they do not receive transfer credit for a course they have taken at a previous college. An examination fee is charged, and the application for the examination is available at the Office of Records, University of Colorado at Boulder, Regent 125, Campus Box 68, Boulder, Colorado 80309, telephone (303) 492-8611.

Transfer Course Work Not Accepted by the University

The following course work will not transfer and will not count toward a degree at CU-Boulder.

1. Courses identified by CU-Boulder as remedial, i.e., necessary to correct academic deficiencies, such as remedial courses in English, mathematics, reading, science, and developmental reading.

2. Vocational-technical courses that are offered at two-year institutions and proprietary institutions. Exceptions may be granted only by the dean responsible for the student's curriculum. When exceptions appear to be warranted, appropriate department heads make recommendations to their respective deans regarding credit for such courses.

3. Courses in religion that constitute specialized religious training or that are doctrinal in nature.

4. Credits earned for work experience or through a cooperative education program.

Intrauniversity Transfer

A Boulder Campus undergraduate student who wishes to transfer to a different college or school on the Boulder Campus must submit a completed Intrauniversity Transfer (IUT) Application Form to the new college or school before enrollment levels are met or deadlines are passed for the desired semester and field of study. Students should obtain the application from the college or school to which they desire to transfer.

For more information on recommended course work in preparation for Intrauniversity Transfer and other criteria, students should consult college and school sections of this *Catalog* or talk with an academic advisor in the program to which they plan to transfer. It is important to emphasize that admission to a college through the IUT process is competitive, and not all students who apply are admitted. Decisions are based on course preparation, hours completed, grade point average, and other criteria the specific college or school deems appropriate.

Other Applicants

FOREIGN STUDENTS

Foreign students wishing to pursue a degree at the University should write or call the Office of Admissions, University of Colorado at Boulder, Regent Administrative Center 125, Campus Box 65, Boulder, Colorado 80309, telephone (303) 492-6665, to obtain foreign student application forms and instructions. Foreign students are considered to be those applicants who will be applying for or who already have a temporary visa.

Undergraduate students who have established permanent resident status in the United States and have alien registration numbers are *not* considered foreign students. These students should follow undergraduate admission and application procedures as outlined above.

Special Students—Foreign

Students holding temporary visas may not gain admission as Special Students for fall or spring terms without special permission from the Division of Continuing Education, University of Colorado at Boulder, 1221 University Avenue, Campus Box 178, Boulder, Colorado 80309, telephone (303) 492-5148.

Foreign students may apply to enroll as Special Students for the summer session provided they are in the United States in appropriate nonimmigrant status that extends their lawful stays through the summer. The Foreign Student and Scholar Office will determine the Special Student eligibility of all foreign students for summer session. Admission as a Special Student is for the summer only and does not constitute admission to a degree program or permission to continue enrollment beyond the summer.

The University of Colorado, Boulder does not issue Forms I-20 or assume any immigration responsibility for Special Students. Foreign students should complete the Application for Special Student Admission and send it to the Foreign Student and Scholar Office, University of Colorado at Boulder, Campus Box 124, Boulder, Colorado 80309.

Foreign students applying for summer session must send with their application:

1. A letter from the foreign student advisor or dean of the school they currently attend, certifying that they are in good standing and that they intend to and are eligible to return to the school for the fall term.
2. A photocopy of both sides of their Forms I-20 ID copy, I-94, or other documentary information regarding their immigration status.
3. Documentary evidence of their financial support for the summer.

Foreign students who are outside the United States are not encouraged to come to the United States for the purpose of attending summer school as Special Students at the University of Colorado, Boulder. Foreign students who wish to seek degrees at the University of Colorado, Boulder should *not* apply for admission as Special Students. These students should write or call the Office of Admissions.

FORMER BOULDER CAMPUS STUDENTS

CU-Boulder degree students who are not currently enrolled at the Boulder Campus and wish to be readmitted are considered to be former students. Former students must complete the application and report all college-level work. Students who have attended any college or university since their last attendance at CU-Boulder should refer to the Transfer Students section of this *Catalog*.

A nonrefundable $20 application fee is required of all former students. If the student is changing from a previous college or school, the change should be noted on the application. Otherwise, it will be assumed that the student is returning to the same field of study. If a college or school change is requested for which the student is not eligible, the student will be automatically considered for his or her previous program.

CAMPUS-CHANGE STUDENTS

Former or continuing degree students who wish to transfer to the Boulder Campus from another University of Colorado campus (Colorado Springs, Denver, Health Sciences Center), from CU Study Abroad, or from CU Continuing Education should refer to the Transfer Students section of this *Catalog*. Campus-Change students must report all college-level work attempted and have two official transcripts from each college or university attended (outside the University of Colorado system) sent to the Office of Admissions.

SECOND UNDERGRADUATE DEGREE APPLICANTS

Each college and school at the University maintains its own admission guidelines for second undergraduate degrees. Students who have (or will have) completed a bachelor's degree and are considering a second undergraduate program of study should write the Office of Admissions for further information *before* they apply. Students who do apply for a second undergraduate degree program follow the application procedures explained under the Transfer Students section of this *Catalog*.

SPECIAL STUDENTS

The Special Student classification meets the needs of those students who wish to take University courses but who do not currently intend to work toward a degree at the University of Colorado. With the exception of high school students who have the approval of the Office of Admissions, Special Students must be 18 years of age or older and have a high school diploma or its equivalent in order to qualify for admission. Except for summer session, students who have attended a college or university must be in good standing at all collegiate institutions attended.

Permission to register for regularly scheduled Boulder Campus courses is contingent upon availability of space. Special Students are not permitted to enroll in College of Business and Administration courses during the regular academic year. However, summer session

Special Students are allowed to take business courses subject to completion of appropriate prerequisites.

Special Students may take course work through the Colorado Consortium for Independent Study. Students register for this option through the Division of Continuing Education.

Special Students may register for courses on a pass/fail basis. However, such courses will be counted in the hours of pass/fail permitted according to the rules of the college or school to which the student is admitted if he or she changes to degree status.

Special Students who have completed 6 semester hours of credit must have and must maintain a 2.00 cumulative grade point average. Failure to maintain the required average will result in suspension.

For fall and spring semesters, Special Students are usually registered through the Division of Continuing Education. For further information, prospective Special Students should write or call the Division of Continuing Education, University of Colorado at Boulder, Campus Box 178, Boulder, Colorado 80309, telephone (303) 492-5148.

Prospective Special Students for the summer session may obtain further information from Summer Admission and Registration Information, University of Colorado at Boulder, Campus Box 7, Boulder, Colorado 80309, telephone (303) 492-7424. High school juniors who are interested in attending CU-Boulder the summer prior to their senior year are encouraged to apply for summer session as Special Students. High school records will be reviewed to determine the student's readiness to enroll in college-level courses.

Foreign students who want to apply to the University as Special Students should read the Foreign Students section above. Students interested in teacher certification should refer to the School of Education section of this *Catalog.*

SPECIAL STUDENTS TRANSFERRING TO A DEGREE PROGRAM

Students who are currently enrolled or have been enrolled at any CU campus as Special Students may apply for admission to an undergraduate degree program by submitting an undergraduate admission application to the Office of Admissions with complete credentials and the nonrefundable $20 application fee. Admission as a degree student is subject to enrollment levels.

Applicants must have earned a high school diploma or its equivalent, and all previous college-level work must be reported on the application. Two official transcripts from all colleges and schools attended (outside the University of Colorado system) must be sent directly from any previously attended institutions to the Office of Admissions. Special Students planning to transfer to a degree program should also refer to the Transfer Students section above.

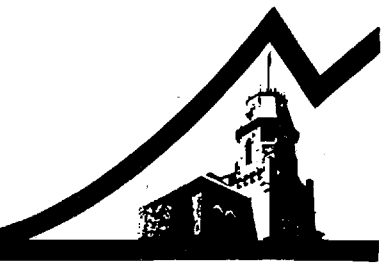
A degree-seeking applicant may transfer a maximum of 12 semester hours taken as a Special Student with the approval of the appropriate dean's office. It is extremely important that Special Students who wish to transfer credits to a Boulder Campus degree program actively seek academic advising from the appropriate dean's office. Acceptance of credit toward degrees at the University changed in 1970. Special Students enrolled before that date may transfer credit in accordance with provisions in effect between January 1969 and August 1970. Transfer of credit to another college or university is within the discretion of the degree-granting institution.

Students wishing to transfer to a graduate degree program should refer to the Graduate School section of this *Catalog.*

GRADUATE ADMISSION

For admission requirements to the Graduate School, see the Graduate School section and individual college and school sections of this *Catalog.*

General Information



EXPENSES AND FINANCIAL AID

Expenses

ESTIMATE OF EXPENSES, PER ACADEMIC YEAR

Expenses for students attending the University of Colorado, Boulder, may vary according to programs of study, personal needs, and individual interests. Tuition and fees may also vary substantially for students attending the Denver Health Sciences Center professional health service programs, the Denver Campus, or the Colorado Springs Campus.

It is difficult, therefore, to provide exact statements of total expenses. The following costs *per academic year* are established for undergraduate students attending the University of Colorado, Boulder Campus in 1984-85; however, the Board of Regents reserves the right to change the costs for tuition and fees and room and board at any time.[1]

	Resident	*Nonresident*
Tuition and fees	$1,470[2]	$5,500[2]
Room and board (on campus)	$2,606 to $2,998	$2,606 to $2,998
Total	$4,076 to $4,468	$8,106 to $8,498

The cost of attending a single fall or spring semester would be one-half of the amount shown. Students planning to attend the optional summer sessions would add the appropriate amount as stipulated in the *Summer Session Bulletin.* Additional costs would include transportation, books, supplies, special laboratory or departmental fees, special residential program fees, entertainment, any added health insurance, and any other personal needs or interest items or services. Many students are able to work part time on- and off-campus to earn room and board and pay for other miscellaneous expenses, substantially reducing the amount of outside financial help needed.

ENROLLMENT CONFIRMATION DEPOSIT

All first time and/or returning former undergraduate, graduate, and law applicants are encouraged to confirm their intent to enroll *immediately* after receiving their admission notification and confirmation form. Admission must be confirmed by returning the completed confirmation form and the designated nonrefundable deposit *before* enrollment levels are reached. Students must submit the deposit ($100 to $300) regardless of any financial aid that may be received. The deposit will be returned only in the event that it is received *after* enrollment levels are reached. Confirmation deposits are nontransferable.

MATRICULATION FEE

There is a one-time nonrefundable matriculation fee of $15 for new degree students. This fee will be assessed at the time of initial registration. Charges then will not be made for adding or dropping courses or for official transcript orders. A special student who is admitted to degree status will be assessed a $15 matriculation fee at the time of the student's first registration after the change has been made.

TUITION, PER SEMESTER, BOULDER CAMPUS[3]

Tuition and fees for 1985-86 have not yet been set. The rates per semester for the 1984-85 school year are as follows:

Undergraduate

	RESIDENT			NONRESIDENT		
Credit Hours of Enrollment	*Engineering*	*Pharmacy*	*Other*	*Engineering*	*Pharmacy*	*Other*
0.0-3.0	$230	$232	$217	$1,236	$2,820	$1,211
3.1-4.0	299	311	286	2,663	2,820	2,638
4.1-5.0	368	390	355	2,663	2,820	2,638
5.1-6.0	437	469	424	2,663	2,820	2,638
6.1-7.0	622	637	597	2,663	2,820	2,638
7.1-8.0	622	637	597	2,663	2,820	2,638
8.1-9.0	622	637	597	2,663	2,820	2,638
9.1-10.0	622	637	597	2,663	2,820	2,638
Over 10.0	622	637	597	2,663	2,820	2,638
Each Credit Hour Over 17[4]	69	79	69	300	320	300

Graduate

	RESIDENT			NONRESIDENT			
Credit Hours of Enrollment	*Pharmacy, Law, Business*	*Engineering*	*Other*	*Business, Law*	*Engineering*	*Pharmacy*	*Other*
0.0-3.0	$245	$233	$220	$ 895	$ 860	$ 937	$ 847
3.1-4.0	327	308	295	1,195	1,144	1,251	1,131
4.1-5.0	410	383	370	1,495	1,428	1,565	1,415
5.1-6.0	493	458	445	1,795	1,712	1,879	1,699
6.1-7.0	576	545	520	2,095	2,008	2,193	1,983
7.1-8.0	659	620	595	2,395	2,292	2,507	2,267
8.1-9.0	745	678	653	2,701	2,580	2,820	2,555
9.1-10.0	745	678	653	2,701	2,580	2,820	2,555
Over 10.0	745	678	653	2,701	2,580	2,820	2,555
Each Credit Hour Over 17[4]	83	75	75	300	284	320	284

[1] It is expected that rates will be increased for 1985-86.

[2] Includes $20 per year athletic fee. The Regents have assessed a $10 per semester fee *for all students registered* for 4 or more credit hours on the Boulder Campus to provide support for Women's Intercollegiate Athletics.

[3] The Board of Regents reserves the right to change tuition and fees without prior notice.

[4] A surcharge of 1/15 of the full-time rate is assessed for each credit hour per semester in excess of 17 credit hours.

FEES

Mandatory fees are charged as follows:

Students enrolled in *one* class of 1-5 credit hours will be charged the base fee of $15.70.

Students enrolled in *more* than one class, regardless of the number of credit hours, will be assessed a maximum fee of $119.35.

All students being charged for the optional student health insurance will be assessed the maximum fee of $119.35 plus the cost of the student insurance.

Approved doctoral students requesting student insurance will be assessed $64.09 fees for use of the Wardenburg Health Service only.

Tuition and Fee Regulations

All students registered will be assessed a fee for a computerized student information system. This fee ranges between $2.50 and $4.00 per semester. Students registered for 4 or more hours will be assessed a $10 fee for intercollegiate athletics.

1. Students making separate registrations on more than one campus of the University for a single term pay tuition and fees to each campus at the rate appropriate to the number of credits for which they are registered on that campus. Students qualified to use the Concurrent registration option to take courses on more than one campus for a single term will pay the applicable tuition and fee rates of the student's home campus for the total hours enrolled at all campuses.

2. Any permanent employee may enroll for not more than 6 semester hours of credit and any permanent part-time employee for a proportionate number of hours of credit in any year without payment on a *space available basis* beginning on Drop/Add day. Time taken to attend classes during normal working hours shall be made up and shall be limited to one course during any term. Persons appointed for less than full time are not eligible for release time during assigned hours. For details, contact the Bursar's Office.

3. Students admitted as "Approved Doctoral Candidate" will register for and be charged for 10 hours of credit for each full-time term of doctoral dissertation work. For each term of part-time enrollment, students will be charged for 7 hours of credit, except that students not making use of campus facilities may petition the Graduate School for 3-credit-hour status. Continuous registration during the academic year (fall and spring) will be required until completion of the dissertation defense. Doctoral dissertation rates will be charged at the graduate resident and nonresident rates. Nonresident doctoral dissertation students pay 1/15 the applicable full-time rate for each credit hour of enrollment.

4. Nonresident students enrolled as master's "candidate for degree" only to take a comprehensive examination for a master's degree will pay for 3 credit hours at the rate prescribed for graduate resident students.

5. No credit *(NC)* courses are *not* free of charge. Tuition for courses taken for no credit is the same as for courses taken for credit.

6. Zero or fractional credit is regarded as 1 hour in assessing tuition and fee charges.

7. Summer term tuition and fees are listed in the *Schedule of Summer Courses,* available from the Office of Registrations after March 1.

8. Some courses carry laboratory or other fees for practical activities. Consult the *Schedule of Courses* for special fees.

AUDITING CLASSES

All persons attending regularly scheduled classes must be registered or must have obtained an auditor's card. There is no auditor status in summer. Auditors, whether resident or nonresident, pay resident tuition for 3 credit hours per fall or spring semester for class instruction and library privileges only.

To qualify as an auditor for fall or spring semester, an individual must be 21 years of age or older. Persons may not be registered for any other University of Colorado courses during the time they are auditing and are not eligible to audit courses if they are under suspension from the University. The Records Office does not keep any record of courses audited; therefore, credit for these courses cannot be established. Auditors may attend as many courses as they wish (except those courses with laboratories or where equipment is used), provided they have received permission from each instructor. Auditor's cards are issued after classes begin at the Bursar's Office in Regent Administrative Center. This card should be presented to the instructor when requesting permission to attend a class.

PAYMENT OF TUITION AND FEES

1. *Payment of Fees.* Students enrolling at the University of Colorado, Boulder are responsible for full payment of tuition, fees, and University dormitory charges. A student's initial bill will include the following charges: tuition, student fees, and University dormitory charges (when applicable). The bill will include the following credits when applicable: financial aid awards, teaching assistant tuition adjustments, and advance payments or deposits. (Current deposits include confirmation deposits, tuition deposits, and housing deposits.) *Housing deposits are not applied to the student bill until the spring semester.* Failure to receive an official University billing *will not* relieve the student of responsibility of payment by the established due date. To avoid assessment of late charges ($5-$50), service charges (1 percent per month) and possible disenrollment, the student must see that payment of tuition and fees is *received* at the University by the due date published in the *Schedule of Courses.*

2. *Registration Deposit.* Whether or not students pay their fees just prior to the beginning of classes or mail in an advance payment, *all continuing* students are required to pay a minimum registration deposit by July 1 in order to guarantee their fall registration. (The registration deposit for the spring semester is due by a specified date in December.) New students, returning former students, and transfer students guarantee their registration through their nonrefundable confirmation deposits. The Board of Regents reserves the right to

revise the deposit policy and amount without prior notice.

3. *Deferred Payment Plan.* Students may enroll in this plan by filling out a Tuition Deferment Agreement, which will be available at the Bursar's Office. The form must be completed and turned in at the Bursar's Office by 4 p.m. on the tuition due date each semester. Students should consult the *Schedule of Courses* for specific instructions relating to deferred tuition application and related deadlines. Tuition and fee balances of less than $100 are not deferrable. This plan will allow the student to pay tuition and fees in two installments. At least one-half of the obligation must be paid in the first installment. The deferred balance will be subject to a finance charge computed at a periodic monthly rate of 1 percent per month on the unpaid balance (equal to a maximum annual percentage rate of 12 percent) beginning the first day of class. Payments under the deferred tuition plan are due *approximately* the second and sixth week of classes. If either portion of the deferred payment is not received by the due date published, the unpaid balance will be subject to late and/or service charges. The Board of Regents reserves the right to revise or eliminate this program at any time. The deferred payment plan is not available for summer session.

4. *Enforcement.* Failure to make the required payment on *any due date* will result in the following action:

a. The student may be disenrolled from the University, becoming ineligible for all University services;
b. No grades will be issued for courses in progress;
c. No transcripts, diplomas, certification, or preregistration materials will be issued for the student until the bill is paid in full;
d. A late payment charge in addition to the service (1 percent per month) charge on the unpaid balance will be assessed according to the following schedule:

Balance Due	*Late Charge*
$ 1- 99.99	*$ 5*
$100-299.99	*$10*
$300-499.99	*$20*
$500-699.99	*$30*
$700-899.99	*$40*
$900 and over	*$50*

5. *Personal Checks.* Any student giving a check not acceptable to the bank will be subject to disenrollment. Any student paying a registration deposit with a check not acceptable to the bank may not be sectioned for classes. Any student paying tuition with a check not acceptable to the bank may be subject to disenrollment from the University, a $15 returned check charge, late charges, and service charges. Any check presented to any department of the University which is returned from the bank unpaid will require payment of the amount due plus a $15 returned check charge. The student may also be liable for collection costs and prosecution under one of the following Colorado Criminal Statutes: 18-4-401, Theft by deception; 18-5-205, Fraud by check; 18-5-512, Issuance of a bad check. The University of Colorado at Boulder is a member of the Boulder Credit Bureau. Specific inquiries concerning reporting should be directed to the Collections Department of the Bursar's Office.

6. *Withdrawal Policy Regarding Tuition and Fees.* No change of program or withdrawal is valid without completion of the withdrawal process in the Office of Registrations. Payment of the registration or confirmation deposit *and* submission of registration materials obligates the student to pay the full amount of tuition and fees for the semester. If a student withdraws from the University, his/her obligation will be as follows:

a. Full amount of tuition deposit through the third Friday of instruction.
b. Forty percent of the full tuition and fees from the third Friday of instruction through the fifth Friday of instruction or the tuition deposit, whichever is greater.
c. Sixty percent of the full tuition and fees from the Monday of the sixth week of instruction through the Friday of the seventh week of instruction or the tuition deposit, whichever is the greater; no refund thereafter. Students who do not pay tuition and fees in full at the time of withdrawal must contact the Collections Department to arrange for payment. Students should refer to the current *Schedule of Courses* for any changes, as the Board of Regents reserves the right to revise this schedule at any time.

It is the responsibility of students to have all optional fees removed at the time of withdrawal. Otherwise fees for Student Health Insurance, the *Coloradan,* etc., will become a financial obligation.

7. *Drop/Add Tuition Adjustment.* Complete adjustment of tuition and fees will be made on drop/add changes as published in the *Schedule of Courses.*

8. *Late Registration Fee.* A late registration fee may be charged students who are authorized to register after their regular registration period. The late registration fee is $20 for the first working day, $25 for the second working day, and a maximum of $30 beginning the third working day and thereafter. The late registration fee is separate and distinct from any penalty that may be assessed for late payment of tuition and fees.

STUDENT RESPONSIBILITY FOR PAYMENT

1. Students will be responsible for payment of their bills.

2. Bills are produced for all students. However, *failure to receive the bill(s) does not relieve the students of the obligation to know, and to pay by, the due dates(s) published.*

3. Students who are disenrolled and who fail to be reinstated remain liable for full payment of all unpaid charges, including any unpaid tuition and fees.

DISENROLLMENT POLICIES AND PROCEDURES

When students default on payments, official notifications will be mailed by the Office of Registrations to the students' address of record. The letter will inform students that their accounts are overdue and that they

have been disenrolled. Students will also be informed of the appeal and reinstatement procedures.

Disenrollment

Students who fail to meet their tuition and fee obligations by published due dates will be subject to *immediate disenrollment.* A student who is disenrolled will:

1. Not receive grades for courses in progress.
2. Not be issued transcripts, diplomas, certification, or preregistration materials.
3. Still owe full tuition and fees, including late and service charges.

Reinstatement

Students who are disenrolled may have to petition for reinstatement. Petitions must be received within the deadlines stated in the disenrollment letter. Only extraordinary circumstances beyond the student's control will be considered as a basis for petition. Lack of financial planning is not a basis for petition.

Registration for Subsequent Semesters After Disenrollment

Disenrolled students may have to reapply for admission to the University of Colorado, Boulder, in order to resume attendance. Any outstanding financial obligation must be paid prior to registration.

In-State and Out-of-State Classification for Tuition Purposes

New students are classified as in-state or out-of-state for tuition purposes on the basis of information provided on the application for admission and other relevant information. Applicants may be required to submit evidence substantiating their claim of in-state eligibility. Applicants who feel their initial classification is incorrect may address inquiries to the tuition classification coordinator.

To be eligible for in-state classification, applicants or their parents (if the applicant is an unemancipated minor) must maintain legal residence in Colorado for the 12 months preceding the term for which in-state status is claimed. Students normally lose in-state eligibility if they or their parents (if the student is an unemancipated minor) maintain domicile outside Colorado for one year or more. Such students are responsible for notifying the tuition classification coordinator of the loss of their in-state eligibility.

PETITIONING FOR IN-STATE CLASSIFICATION

Applicants and students who feel their classification is incorrect or who have become eligible for a change to in-state status must submit a petition with documentation in order to have their status changed. Detailed instructions as to the procedure to follow, the necessary petition forms, deadlines for submission, and an explanation of the Colorado tuition classification statute are available from the Tuition Classification Coordinator, University of Colorado at Boulder, Regent Administrative Center 125, Campus Box 68, Boulder, Colorado 80309, telephone (303) 492-6868. Students at other campuses should address their inquiries to the appropriate Office of Admissions and Records.

CLASSIFICATION NOTES

1. In-state classifications become effective as of the first term that begins one year after legal residence in Colorado has been established. Changes of classification never take effect mid-term.
2. Students who willfully give false information to evade payment of out-of-state tuition or who fail to provide timely notice of their loss of in-state eligibility are subject to retroactive assessment of out-of-state tuition, as well as disciplinary and legal action.
3. Tuition classification is governed by Colorado statutes and by judicial decisions that apply to all state-funded institutions in Colorado and is subject to change without notice.

Financial Aid

The purpose of the financial aid program at the University of Colorado, Boulder is to provide assistance to students who need help in meeting the cost of their education. Students who believe they will require financial aid to enroll are encouraged to submit aid applications. Approximately 12,000 students, or about 60 percent of the student body, annually receive need- and nonneed-based financial aid from federal, state, University, or private sources. In most cases, grants are supplemented by part-time employment (Work-Study) and/or long-term loans to meet the demonstrated need of recipients.

Financial aid counselors are available to talk with prospective students and their parents regarding the financing of an education at CU-Boulder. Students who are unable to visit the office in the Environmental Design Building may call (303) 492-5091. Office hours are Monday-Friday from 9 a.m. to 4 p.m. (8:30 a.m. to 3:30 p.m. in the summer).

It is recommended that students who wish to apply for need-based financial aid submit a 1985-86 Family Financial Statement (FFS) to the American College Testing (ACT) Service or a 1985-86 Financial Aid Form (FAF) to the College Scholarship Service (CCS). These applications should be available through local high school counselors or the CU-Boulder Office of Financial Aid around December 15, 1984. The filing deadline for summer 1985 and the fall and spring semesters (1985-86 academic year) is March 1, 1985. Aid applications received by the need analysis service after March 1 will be processed on a rolling basis according to availability of funds, but it is unlikely that students who miss the filing deadline will receive any CU-Boulder awarded financial aid.

The Office of Financial Aid expects to begin making award/denial announcements in April 1985 for incoming freshmen and new transfer students who meet the March 1 filing deadline and whose files are complete. Award/denial announcements for continuing CU-Boulder students will be mailed in early May 1985. Students should note that financial aid applications will not be processed unless they have been officially ad-

mitted to or are currently enrolled in a degree-granting academic program at the University of Colorado, Boulder. Prospective students should *not* wait for formal verification of acceptance to CU-Boulder to apply for financial aid, however. Meeting the filing deadline of March 1, 1985, is paramount.

In order to comply with Office of Financial Aid satisfactory academic progress policy, financial aid recipients must complete (pass) a minimum of 12 semester hours (5 hours for graduates) each semester (6 hours for summer undergraduates, 3 hours for graduates in summer) of Boulder Campus course work. Half-time students (minimum of 6 semester hours for undergraduates, 3 semester hours for graduates) may apply for Guaranteed Student Loans and Pell Grants (Pell Grants are for undergraduates only). Course work taken through the Division of Continuing Education or as a Special Student *cannot* be counted toward the minimum number of semester hours necessary to maintain satisfactory academic progress for financial aid purposes.

It is unlikely that the Office of Financial Aid will be able to provide the total amount of aid necessary to meet the full financial need demonstrated by most students because of funding limitations. However, creative financial aid packaging techniques are utilized at CU-Boulder in order to award as many eligible students as possible.

STUDENT EMPLOYMENT

The Office of Financial Aid assists students in obtaining part-time employment while attending CU-Boulder. Job opportunity information is posted on the job boards located in the office. The office provides information about part-time hourly on-campus employment, regular Work-Study, and Full-Time Summer Work-Study.

The Job Location and Development (JLD) Program is located within the Office of Financial Aid. This program provides individualized job counseling and emphasizes locating and developing part-time off-campus employment opportunities for students. A financial aid application is not necessary for hourly employment but is required to be considered for Work-Study.

HOUSING

Single Students

Living quarters are an important part of the college student's life. The residence halls provide a wide range of facilities and services which are designed to support the physical well being and the intellectual, cultural, social, and personal growth of single student residents. There are 21 residence hall units housing approximately 6,000 single students.

Subject to availability of space, freshman men and women are required to live in the University residence halls for two academic-year semesters (a summer term does not count as an academic semester), unless they are married or live with parents or relatives in the Boulder area and have permission to commute. Requests from freshmen for permission to reside off campus for other reasons will be considered on their merit, taking into account the individual circumstances of the petitioner.

Note: Application for housing does not guarantee admission by the University nor does admission by the University guarantee that University housing accommodations will be available. Application for and confirmation of admission to the University and application for housing are two separate transactions.

Room and board rates per person, per semester for the 1984-85 academic year have been established as follows, subject to Board of Regents approval:

Board and single room	$1,499
Board and double room	$1,303

Note: A modest rate increase may be expected for the 1985-86 school year.

An advance payment ($100 in 1984-85), which will be applied toward spring semester room and board, is required to reserve residence halls accommodations. All contracts are for the two-semester academic year. Only students entering the halls at midyear are granted one-semester contracts. A liquidated damage fee is charged if the student withdraws from the residence halls during the period of the contract.

Single students desiring more information about University housing or about the various residential programs which are offered should correspond with the Supervisor, Residence Halls Reservation Center, 80 Hallett Hall, Boulder, Colorado 80310. All new students receive, at the time they confirm their admission, an information booklet on student housing and a housing application form. This material will include current information on facilities, services, and rates.

Family Housing

The University offers a wide variety of apartment units for married students and single parents with dependent children. A day care center for the children of family housing tenants is also available. Family Housing information may be obtained from the Manager of Family Housing, 1350 20th Street, Boulder, Colorado 80302.

REGISTRATION AND CLASS SCHEDULING

Students should refer to the Academic Calendar and detailed information in each *Schedule of Courses* or *Summer Session Bulletin* for specific details on dates and deadlines that apply to the registration process. Specific registration procedures are sent to new students and returning former students when they have confirmed their intent to enroll. Continuing students are notified by mail and on-campus information of times, places, and requirements for registration. The following registration policies are intended to serve as general guidelines. In addition, students should consult college and school sections of this *Catalog* and individual deans' offices for information on special requirements and procedures. *The University of Colorado, Boulder does not guarantee that a student will be enrolled in all courses requested.*

Registration generally involves three steps: requesting courses, paying a deposit toward tuition and fees, and picking up a completed schedule and bill. The schedule and bill are picked up immediately prior to the first day of classes. At the same time, the student secures a validation sticker for the current semester to affix to the CU-Boulder Photo ID. The ID is required of all students on campus and is obtained at the beginning of the semester.

For further information, call the Office of Registrations, (303) 492-6970.

Drop/Add

Special Note: Deadlines for each semester will be announced in the *Schedule of Courses* for that semester and in the instructions that are available at every registration.

1. Students will be allowed to drop and add courses, including independent study and thesis courses, by the announced deadline with no signatures required on the Drop or Add form. Adds are not allowed after this day. Individual colleges and schools may have further restrictions on this time period. Students will be charged for courses not dropped by this date.
2. After this first deadline, the instructor's signature is required on the Drop form, and students must be passing a course at the time it is dropped. Courses dropped after this deadline will appear on the transcript with a grade of *W*. No tuition adjustment is made for courses dropped after this deadline.
3. There will be a second drop deadline after which a course may not be dropped unless there are documented circumstances clearly beyond the student's control (for example, accident or illness). In addition to the instructor's signature, the student must petition the dean's office for approval to drop the course. Petitions normally will not be approved after the drop deadline.
4. Dropping all courses requires an official University withdrawal form. Students should refer to the Withdrawal section below for further information.

Credit/No Credit

Students who wish to take course work for no credit must inform the Office of Registrations by the drop/add deadline announced in the *Schedule of Courses* for that semester. *No* changes in credit registration will be permitted after this date. Tuition is the same whether or not credit is received in a course.

Pass/Fail (P/F)

1. Any student who wishes to register for a course on a pass/fail basis should do so during regular registration procedures. (Up to 16 semester hours of regular course work may be taken on a pass/fail basis and credited toward the bachelor's degree.) Changes to or from a pass/fail basis may be effected only during the first Drop/Add period.
2. Academic deans and faculty will not be informed of pass/fail registration. All students who register on a pass/fail basis appear on the regular class roster, and a normal letter grade is assigned by the instructor. When grades are received in the Office of Registrations, those courses that require a *P/F* designation are automatically converted. Grades of *D-* and above convert to grades of *P*. Grades of *F* will equal a letter grade of *F*.
3. Only 6 hours of course work may normally be *P/F* in any given semester.
4. Exceptions to the *P/F* regulations are permitted for certain courses that are offered only on a *P/F* basis.
5. Students should refer to college and school sections for special requirements or procedures.

Withdrawal

Students should refer to Fee Regulations for further information on charges and refunds.

1. Failure to withdraw makes a student liable for the full amount of tuition and fees assessed for the semester of enrollment.
2. Failure to withdraw may also result in a failing grade being recorded for every course in which the student was enrolled.
3. A student must withdraw in the Office of Registrations, Regent Administrative Center 125. Before classes start, a student may send a letter to the Withdrawal Coordinator, Office of Registrations, University of Colorado at Boulder, Campus Box 7, Boulder, Colorado 80309. Students should be sure to include complete name and student number.
4. Undergraduate students who fail to pick up their class schedules by the end of the third Friday of classes will be withdrawn automatically from school.
5. Students who want to drop their only or last class must complete a formal withdrawal. A drop form should not be completed. An administrative withdrawal will be processed if these procedures are not followed. See number 1 above.

Faculty/Staff Registration

APPLICATION AND SET-UP PROCEDURES

All faculty and staff who wish to enroll in courses must take a copy of their PAF and a consent card signed by their department head or supervisor (as applicable) to the Accounts Receivable section of the Bursar's Office. Consent cards are available at the Bursar's Office, Regent 150.

Special Students and new degree students must pick up an application from the Information Window, Regent 125, complete it, and take it with the other materials to Accounts Receivable.

REGISTRATION PROCEDURES

To take advantage of the free credit hours (6 per year for full-time faculty and staff), faculty and staff must wait until drop/add day to register; instructions and authorization to register may be picked up at Regent 125 after 8:30 a.m. Add forms must then be obtained from departments, and all completed materials must be turned in to Accounts Receivable by the drop/add deadline.

Faculty and staff who have used their free credit hours for the year may register early with continuing

students and pay appropriate tuition and fees for the course(s).

Intercampus Registration Procedures

OPTION I

Boulder Campus students who wish to take course work on another campus of the University of Colorado may be able to register on that campus independent of their home campus registration. However, the students must apply separately and follow the registration procedures established by the other campus. Students should check with their dean's office for approval. Arts and Sciences students may not register at the University of Colorado, Denver (UCD) or the University of Colorado, Colorado Springs (UCCS) except in the summer.

OPTION II

Boulder Campus students who are unable to obtain courses required for their degree programs on the Boulder Campus may exercise the Concurrent Registration option. Students enrolled for a minimum of one course on the Boulder Campus may be allowed to register for up to two courses or 6 semester hours, whichever is greater, on another campus provided the course work is required for their degree program, they have their dean's permission, and enrollment levels have not been reached.

Boulder students exercising this option will pay tuition for their total credit hours at Boulder Campus rates. Concurrent Registration forms and instructions are available at the Information Window of the Office of Registrations, Regent Administrative Center 125.

Time Out Program (TOP)

The Time Out Program is a planned leave program for currently enrolled University of Colorado, Boulder students who are in good standing in their college or school and whose dean approves their leave for a minimum of one semester or a maximum of one year to pursue academic or nonacademic interests. (Example: after completing a fall semester in December, the student returns the following September or a year later in January.) With prior approval from their dean, students may take courses at another campus of the University of Colorado or at another college or university while in TOP.

TOP will guarantee participating students a place in their current college or school and in their current major when they return to classes. Certain restrictions do apply, however, for some colleges and schools.

TOP participants may register for classes by mail, and reapplication to the University is not necessary. Additional information and TOP applications can be obtained from the Office of Registrations, Regent Administrative Center 125. A nonrefundable program fee is required at the time of application to TOP.

Commencement

Graduation ceremonies are currently held in May, August, and December and are open to the public with no tickets required. The August Commencement is held outdoors, weather permitting, and the May and December ceremonies are held in the Events/Conference Center on campus. The ceremonies include the awarding of honorary degrees, the delivery of commencement addresses by the president of the University and the chancellor of the Boulder Campus, other featured speakers, and the conferring of degrees. Details are sent to graduating students approximately one month prior to Commencement. For further information, call the Commencement Office, (303) 492-7205.

RECORDS

Credit by Examination

Degree-seeking students who wish to earn credit by examination, without otherwise registering for or taking a course, should obtain an Application for Credit by Examination from the Office of Records, Regent Administrative Center 125. The application specifies procedures to be followed and provides spaces for the signatures required for approval. The fee for each examination is assessed at a fixed rate that is equivalent to the minimum resident tuition rate charged for 0-3.0 credit hours for the current semester. The fees are payable in advance and are nonrefundable.

Course Load Definitions

The following are the most widely used general definitions of full-time course load. For further information and guidelines, students should see specific college and school sections of the *Catalog*. Students receiving financial aid, receiving veterans' benefits, or living in University housing should check with the appropriate office regarding course load requirements for eligibility purposes.

UNDERGRADUATE

A full-time undergraduate student is one who is enrolled for 12 or more semester hours in the fall or spring semester or at least 5 semester hours in the summer term.

GRADUATE

A full-time graduate student in the fall or spring semester is one who is enrolled for 5 semester hours in course work numbered 500 or above, or at least 8 semester hours in a combination of undergraduate/graduate/professional course work acceptable for graduate credit, or any number of thesis hours. A full-time graduate student in the summer term is one who is enrolled for at least 3 semester hours in course work numbered 500 or above or 4 semester hours in a combination of course work. The maximum number of graduate credits that may be applied toward a degree during the summer session is 6 semester hours per 5-week term and 10 semester hours per 10-week sum-

mer session, not to exceed 10 semester hours for the total summer session.

Uniform Grading System

The following grading system is standardized for all colleges and schools of the University. The addition of plus/minus grades was approved for the colleges and schools to implement at their discretion with the spring of 1984. Each instructor is responsible for determining the requirements for a course and for assigning grades on the basis of those requirements.

Standard Grades	*Credit Points Per Each Hour of Credit*
A = superior/excellent	4.0
A− =	3.7
B+ =	3.3
B = good/better than average	3.0
B− =	2.7
C+ =	2.3
C = competent/average	2.0
C− =	1.7
D+ =	1.3
D =	1.0
D− = minimum passing	0.7
F = failing	0.0

Grade Symbols

IF = incomplete - regarded as F if not completed within one year

IW = incomplete - regarded as W if not completed within one year

IP = in progress - thesis at the graduate level or School of Medicine courses

H = highest achievement for School of Medicine courses or for Honors Department

P = passing - under the pass/fail option, grades of *D−* and above convert to a *P*. Other specified courses may also be graded on a pass/fail basis.

NC = indicates registration on a no-credit basis

W = indicates withdrawal or drop without discredit

Y = indicates the class grades were not submitted by the time the final grades were processed

EXPLANATION OF *IF* AND *IW*

An *IF* or *IW* is an incomplete grade. Policies with respect to *IF/IW* grades are available in the individual college and school dean's offices. Use of the *IF* or *IW* is at the option of the academic dean's office.

The student must ask for the incomplete grade. An incomplete grade is given only when students, for reasons beyond their control, have been unable to complete the course requirements. It is understood that a substantial amount of work must have been satisfactorily completed before approval for such a grade is given.

If an instructor decides to grant a request for *IF* or *IW*, the instructor sets the conditions whereby the course work will be completed. The instructor may set less time than one year for completion. The student is expected to complete the requirements within the established deadline and not retake the entire course.

However, the instructor, with approval of the department, determines if the course should be retaken. If a course is retaken, the student must reregister for the course and pay the appropriate tuition.

The final grade (earned by completing the course requirements *or* by retaking the course) does not result in deletion of the *IF* or *IW* grade symbol from the transcript. A second entry is posted on the transcript to show the final grade for the course.

At the end of one year, *IF* and *IW* grades for courses that are not completed or repeated will be regarded as *F* or *W*, respectively. Requests for an extension of time to complete the course beyond the one-year deadline will normally not be approved by the academic dean's office.

GRADE POINT AVERAGE

The grade point average is computed by multiplying the credit points per hour by the number of hours for each course, totaling the hours and the credit points for all courses and dividing the total credit points by total hours. Grades of *P, H, NC, Y, W, IP, IW,* and *IF* are not included in the grade point average. *IFs* that are not completed within one year are calculated as *F* in the GPA at the end of the one year grace period.

It is University of Colorado policy that the undergraduate GPA is calculated separately from the graduate GPA.

If a course is repeated, all grades earned are used in determining the University GPA.

Students should refer to their academic dean's office for individual grade point average calculations as they relate to academic progress and graduation from their college or school.

Academic Probation

Good academic standing in most colleges and schools requires a 2.00 grade point average (GPA). Students should consult the appropriate dean's office regarding college or school minimum GPA requirements and probationary policies.

Grade Reports

Grade reports are normally available for students to pick up from their dean's office within two to three weeks after the end of the semester. Grade reports are not automatically mailed; however, a self-addressed, stamped envelope may be supplied to the dean's office by individual students.

Official Transcripts

The official transcript includes the complete academic record, undergraduate and graduate, taken at all campus locations or divisions of the University of Colorado. It contains the signature of the director of records and the official, embossed seal of the University. Primary usage of the official transcript is for application for transfer to other academic institutions and for employment purposes.

Transcripts of academic record at the University of Colorado (all campuses) may be ordered in person or by

mail from the Office of Records, Transcript Section, University of Colorado at Boulder, Regent Administrative Center 125, Campus Box 68, Boulder, Colorado 80309. Official transcripts will not be available until approximately five weeks after final examinations. A transcript that is to have a degree recorded will not be available until approximately eight weeks after final examinations. Requests should include the following:

1. Student's full name (include maiden or other name if applicable).
2. Student number.
3. Birthdate.
4. The last term and campus the student attended.
5. Whether the current semester grades are to be included when a transcript is ordered near the end of a term.
6. Full names of the recipients of the transcripts, whether they are agencies, colleges, or individuals. Complete mailing addresses should also be included. Transcripts sent to students are labeled "issued to student."
7. Student's signature. (This is the student's authorization to release the records to the designee.)

There is no charge for official transcripts. Transcripts are prepared only at the student's request. A student having financial obligations to the University that are due and unpaid will not be granted a transcript. Copies of transcripts from other institutions cannot be furnished.

Unofficial Transcripts

The unofficial transcript is also the complete academic record at the University of Colorado; it is primarily used for advising and counseling within the offices on campus and within the offices at other University of Colorado campus locations. The unofficial copy does not carry the embossed seal of the University.

Whenever an unofficial transcript is needed, the student may pick up a copy at the appropriate academic dean's office with the following exceptions:

1. Graduate students pick up their copy at their major department office.
2. Arts and Sciences, Business, and Special Students pick up their copy at Regent Administrative Center 125.

A charge of $.50 is made for immediate service. There is no charge for copies delivered at the student's request to other University of Colorado offices.

Family Educational Rights and Privacy Act

Periodically, but not less than annually, the University informs students of the Family Educational Rights and Privacy Act of 1974. This Act, with which the institution intends to comply fully, was designed to protect the privacy of education records, to establish the right of students to inspect and review their education records in all offices, and to provide guidelines for the correction of inaccurate or misleading data through informal and formal hearings. Students also have the right to file complaints with the Family Educational Rights and Privacy Act (FERPA) Office concerning alleged failures by the institution to comply with the act.

Local policy explains in detail the procedures to be used by the institution for compliance with the provisions of the act. Copies of the policy can be found in the Government Publications Office in Norlin Library, the Law Library, or the Office of Records on the Boulder Campus. Copies of the policy are also located in the libraries or offices of Admissions and Records on the other campuses.

The director of records on the Boulder Campus and the registrars on the other University campuses have been designated by the institution to coordinate the inspection and review of student education records located in various University offices. *Students wishing to review their education records must complete a request form in the office of the director of records or registrar for the appropriate campus. Requests should list the item or items of interest.* Records covered by the Act will be made available within 45 days of a request.

Students *may not* inspect the following as outlined by the Act: (1) financial information submitted by their parents, (2) confidential letters that they have waived their rights to review, or (3) education records containing information about more than one student, in which case the institution will permit access *only* to that part of the record that pertains to the inquiring student. Records that may be inspected include *admissions, academic, and financial files and cooperative education and placement records.*

The following items of student information have been designated by the University of Colorado as public or directory information: name, address, telephone number, dates of attendance, registration status, class, major field of study, awards, honors, degree(s) conferred, past and present participation in officially recognized sports and activities, physical factors (height, weight) of athletes, date and place of birth. Such information may be disclosed by the institution for any purpose, at its discretion.

No other information regarding students' education records may be disclosed to anyone without the written consent of students, *except* (1) to personnel within the institution, (2) to officials of other institutions in which students seek to enroll, (3) to persons or organizations providing students financial aid (this includes the parents upon whom students are financially dependent), (4) to accrediting agencies carrying out their accreditation functions, or (5) to persons in an emergency to protect the health or safety of students or other persons.

The University requests that parents who would like a copy of their child's transcript have the student obtain one for them.

Currently enrolled students may withhold disclosure of directory information under the Family Educational Rights and Privacy Act of 1974. To withhold disclosure, students should inquire at the appropriate campus office prior to the eleventh day of classes each term. The University of Colorado assumes that failure on the part of any student to specifically request the withholding of directory information indicates individual approval for disclosure.

Boulder Campus students should request the form that describes the Family Educational Rights and Privacy Act from the Office of Records, University of Colorado at Boulder, Regent Administrative Center 125. Students on other campuses should inquire at their respective office of admissions and records.

CAMPUS POLICIES

Academic Integrity

A university's intellectual reputation depends on the maintenance of the highest standards of intellectual honesty. Consequently, commitment to those standards is a responsibility of every student and every faculty member at the University of Colorado.

Breaches of academic honesty include cheating, plagiarism, and the unauthorized possession of exams, papers, or other class materials that have not been formally released by the instructor.

PLAGIARISM

In all academic areas, it is imperative that work be original or that explicit acknowledgment be given for the use of other persons' ideas or language. In a term paper, for example, failure to use quotation marks, even if a footnote source is provided, is plagiarism.

Students should consult with their instructors regarding specific standards or procedures appropriate in each given field.

CHEATING

Cheating takes place in different ways, but basically, it involves dishonest behavior, such as copying from another person or obtaining any form of unauthorized help or assistance from any person or source.

SANCTIONS

Breaches of academic honesty will result in disciplinary measures. These can include:

1. A failing grade for a particular assignment.
2. A failing grade for a particular course.
3. Suspension for various lengths of time from the college or school in which the student is enrolled.
4. Permanent expulsion from the college or school in which the student is enrolled.
5. Suspension or permanent expulsion from the University.

Breaches of academic honesty are under the purview of each college and school pursuant to the *Laws of the Regents*, Article V, Section C. For further information, students should consult their associate dean's office.

Final Examination Policy

It is the policy of the University of Colorado, Boulder to adhere to the final examination schedule as published in the *Schedule of Courses* each semester. While it may be appropriate not to give a final in some cases, such as laboratory courses, seminars, and colloquia, final examinations should be given in all other undergraduate courses.

Exceptions to this policy should be agreed upon by the faculty member and the chairman of the department no later than the beginning of the semester in which an exception is requested. The resulting decision should be announced in writing to students in the class during the first week of classes.

In addition to the principles stated above, the following guidelines should be followed by all faculty members and administrators. In order to assure fairness and the best possible educational experience for students:

1. The scheduled final examination period should be considered an important part of the course and used as a final examination period or for additional instruction.
2. The final examination in a course should be given as scheduled and not at other times even if the faculty member and all students in a course agree to such a change.
3. The week of classes preceding the scheduled final examination period should be used primarily for continued instruction and may include the introduction of new material. No hourly examinations are to be given during the week preceding final examinations.
4. Individual students may be granted a variance from these policies provided the instructor is satisfied that (a) the exception is based on good and sufficient reasons (such as religious observances), and (b) such an exception for an early or late examination will not prejudice the interests of other students in the course.
5. When students have three or more examinations on the same day, they will be entitled to arrange an alternative examination time for the last exam or exams scheduled on that day. Such arrangements must be made no later than the end of the tenth week of the semester (i.e., at the end of the drop period). Students will be expected to provide evidence that they have three or more examinations in order to qualify for exceptions.
6. This policy applies to all undergraduate students, including seniors. Graduating seniors should not be exempted from final examinations. Such exceptions are inappropriate on both procedural and academic grounds.

Personal Safety on Campus

The University of Colorado, Boulder is a community of scholars, students, and staff who support the learning process and academic freedom in an environment characterized by civility and respect for others. Harassment of an individual or a group could interfere with the freedom to pursue academic goals and is inconsistent with the mission of the University. Harassment is defined as behavior which ranges from intentional verbal abuse to physical assault. Students, faculty, and staff are encouraged to preserve the personal safety, freedom, and well-being of those who study, teach, or work at the University.

Students, faculty, and staff have the responsibility to refrain from, prevent, and report behavior which threatens or harms their colleagues and to assist victims. Campus resources are available to aid victims in a confidential and sensitive manner. At the same time, action will be initiated against anyone found guilty of harassment, with due process provided for the accused.

Students, faculty, and staff are encouraged to report any incident of harassment to the administrator closest to the situation and/or the University Police. Other resources include the Office of Student Conduct, the Ombudsman Office, and the Affirmative Action Office.

Student Conduct

The Standards of Conduct and the procedures for implementing them have been developed by a committee composed of students, faculty, and staff. In establishing these standards the University has taken into account students' rights as individuals as well as the general welfare of the University community. The University would be remiss in its responsibility to students and the community if it ignored behavior which violates the rights of others. It is also essential that everyone shares in the commitment to protect the integrity and personal safety of each member of the University community.

The intent of these standards is not for use in incidents involving trivial or minor matters. Rather, they are intended for use in incidents threatening the basic functioning of the University or the personal safety of its members. As members of the University community, students are held accountable not only for civil and criminal laws but University Standards as well. University sanctions can be imposed when policies are violated. The sanctions include, but are not limited to, warning, probation, suspension, and permanent expulsion.

Listed below are Standards of Conduct for which action may be taken if a violation occurs:

1. Intentional obstruction, disruption, or interference with teaching, research, disciplinary proceedings, or other University activities, including its public service functions or other authorized activities on the University premises.

2. Willful obstruction or interference with the freedom of movement of students, school officials, employees, and invited guests to all facilities of the University.

3. Physical abuse of any person on property owned or controlled by the University or at functions sponsored or supervised by the University, or conduct that threatens or endangers the health or safety of any such person.

4. Harassment and/or hazing in all forms, which includes, but is not limited to, striking, laying hands upon, treating with violence, or offering to do bodily harm to another person with intent to punish or injure, or other treatment of a tyrannical, abusive, shameful, insulting, or humiliating nature.

5. Prohibited entry to or use of University facilities, defined as unauthorized entry or use of University property or facilities for illegal purposes or purposes detrimental to the University.

6. Forgery, alteration, or use of University documents, records, or instruments of identification with intent to defraud the University.

7. Theft or damage to University property and the private property of students, school officials, employees, and invited guests when such property is located upon or within University buildings or facilities.

8. Possession of firearms, explosives, or other dangerous weapons within or upon the grounds, buildings, or any other facilities of the University. This policy shall not apply to any police officer or other peace officer while on duty authorized by the University, or others authorized in writing by the Chief of the University of Colorado Boulder Police or his designee. (A dangerous weapon is an instrument that is designed to or likely to produce bodily harm. Weapons may include, but are not limited to, B-B guns, slingshots, martial arts devices, brass knuckles, bowie knives, daggers or similar knives, or switchblades. A harmless instrument designed to look like a firearm, explosive, or dangerous weapon which is used by a person to cause fear in or assault another person is expressly included within the meaning of a firearm, explosive, or dangerous weapon. Weapons may be stored with the University Police Department.)

9. Sale, distribution, use, possession, or manufacture of illegal drugs within or upon the grounds, buildings, or any other facilities of the University.

10. Off-campus: physical abuse of any person, or conduct that threatens or endangers the health or safety of any person, or conduct which interferes with the public or private rights of citizens, when it is determined that the continued presence of the student would clearly constitute a threat or danger to the University community.

Any time questions arise regarding the application of University standards or students feel that another person has subjected them to behavior which interferes in any manner with their rights, public or private, students are encouraged to talk with the staff member closest to the situation. Further information is available from the Office of Student Conduct, Willard Administrative Center, Room 223, Campus Box 132, Boulder, Colorado 80309, (303) 492-5550.

Substance Abuse

Substance abuse is the use of legal and illegal substances, such as alcohol and other drugs, in a manner or volume, or both, that affects an individual's ability to function effectively in the University community, the general health and safety of the campus community, or the accomplishment of that community's goals as an institution of higher education.

The University is deeply concerned about substance abuse not only because much of it is against the law but also because:

1. Substance abuse detracts from an individual's ability to obtain an education.

2. Certain involvements with illegal substances, such as cocaine, often bring considerable danger to the University community.

The Boulder Campus has a Substance Abuse Program Task Force to develop specific activities to address this important social and health issue. For information about the Task Force or campus policies and programs for substance abuse, please call the Office of the Assistant Vice Chancellor for Academic Services (Student Support Services), (303) 492-5323, or write Campus Box B-20, University of Colorado, Boulder, Colorado 80309.

SERVICES

Career Services

Career Services is the central campus unit offering career planning, cooperative education/internships, and career placement assistance. Located on the ground floor of Willard Administrative Center, Career Services is open year-round and serves University alumni as well as students. Specific services include the following:

CAREER PLANNING

Individual Career Counseling. Individual career counseling is available to help students make informed career plans and decisions, and to develop strategies for conducting a job search. Counselors are available on an appointment basis.

Career Resource Library. Information about thousands of occupations, educational institutions, and apprenticeship/internship opportunities is located in the library. Many other career-related books and resources are also available, including job vacancies, job market studies, employer directories, job search literature, and employer information (recruiting brochures, annual reports, etc.). The library is open Monday through Friday, from 8:00 a.m. to 5:00 p.m.

Workshops. Workshops are held throughout the year to sharpen students' job-hunting and career-planning skills. Topics include skills/interests analyses, resume writing, job search strategies, and interviewing, as well as high employment occupations, choosing a graduate school, and what to do with a liberal arts major. Students are encouraged to attend the appropriate workshop(s) before seeing a counselor.

Alumni Career Network. Hundreds of CU alumni have volunteered to assist students and fellow alumni with their careers. These alumni offer informational interviews, internships, job leads and referrals, "shadow experiences," and other forms of personalized career assistance. The alumni file is located in the career library and students are welcome to look through it at any time.

COOPERATIVE EDUCATION/INTERNSHIPS

Through our Co-op program, students are given the opportunity to gain professional-level employment that complements their academic studies. The intent of Co-op is to provide academically relevant work experiences that enhance students' career potential while still in school.

The Co-op Process. Co-op counselors help students through all the details of gaining a Co-op placement: counseling, interviewing, and referring them to internship positions, and following up with placement evaluations once the students have been placed. Readmission procedures are taken care of as well by the counselors. All students are required to attend a two-hour orientation session to familiarize themselves with Co-op philosophy and procedures.

The Co-op office will coordinate on-campus interview schedules with prospective Co-op candidates. Students who apply to employers not interviewing on campus are referred by mail.

Co-op Opportunities. Students are kept informed of Co-op internships through weekly listings in the *Job Vacancy Bulletin* and posting notices. Current positions are also on file in the career resource library.

The Cooperative Education program is open to students from all colleges, at both the undergraduate (sophomore and above) and graduate level. To be eligible for Co-op, a student must be enrolled full-time in a degree program at the University's Boulder Campus and must have a grade point average of 2.00 or better.

PLACEMENT SERVICES

These services are available to all graduating students.

On-Campus Interviewing. Many employers come on campus to interview candidates for career positions throughout the country. They are interested in students from all areas of study, but focus largely on business and engineering graduates. Students are encouraged to come in early in their senior year to take advantage of this opportunity.

Computerized Job Match. A computer system is available to help refer seniors, graduate students, and alumni to prospective employers who list vacancies. The procedure matches applicants with jobs in all areas and gives a broader exposure to employers.

The Job Vacancy Bulletin is printed weekly and lists jobs in business, industry, government, and education throughout the country. It also lists Co-op internship opportunities and articles of interest to job seekers. The *JVB* is distributed to campus departments and to individuals through subscription.

Placement Credentials. Students can place letters of recommendation on file with the credentials service and have them sent out when needed to support their applications for graduate/professional schools and for educational employment.

Career development should be an integral part of a student's higher education. Students are encouraged to utilize these services throughout their university experience. Fees are charged for Co-op and Placement Services. Telephone (303) 492-6541.

Counseling Services

The University Counseling Services, located at 134 Willard Administrative Center, is available, free of

charge, for any enrolled University of Colorado, Boulder student. The following services are provided.

Individual Counseling. Students who are experiencing concerns in some area of their personal, social, or educational lives may go to the Counseling Services for individual assistance. Career counseling and testing are also available to students through the Counseling Services. All student concerns may be discussed openly, frankly, and privately with one of the staff psychologists or counselors.

Group Counseling. Group counseling is often one of the most effective approaches for working on personal problems. Students are able to receive feedback, help, and support from each other under the direction of a counselor or psychologist. Some of the groups are designed to help students gain skills in specific areas (assertiveness, communication skills, stress management, academic improvement), while other groups are unstructured and ones in which any issue or problem can be discussed.

The Center for Educational and Career Transition (Women's Center). The Women's Center offers individual and group counseling, academic and career planning, and testing services to students, faculty, and staff. In addition, these services are available, for a nominal fee, to any community person who wishes to resume an academic program or change a career path. The Women's Center also serves as a resource for the nontraditional and older returning CU-Boulder student.

Peer Counseling. Peer counselors (undergraduate paraprofessionals) provide academic assistance in the College of Arts and Sciences and assist in various workshops offered by Counseling Services. The unique role served by the peer counselor is to assist students on a student-to-student basis.

Consultation and Community Development. A team psychologist is available to consult with faculty, staff and students who want their organizations to be more effective, or who want to resolve specific difficulties within their offices, departments, or committees. Counseling Services works with students on group dynamics issues, developing workshops, or other interventions appropriate to specific needs and goals.

Testing and Assessment. Counseling Services uses achievement, interest, and personality tests as an aid to counseling with students. All test batteries which are assigned or administered are interpreted for students by one of the Counseling Services staff.

Orientation. The mandatory orientation program for the College of Arts and Sciences is coordinated through Counseling Services. All questions about the program should be directed to the orientation coordinator in this office.

Academic Skills Center. Located in Willard Administrative Center, Room 201, the center is staffed by learning assistance specialists and reading and writing instructors. It offers a course in critical reading and study management skills which includes procedures that aid students in effective learning, time management, and application of knowledge. In addition, one-hour workshops in reading strategies, time management, note taking, listening skills, and memory development are offered. The staff of the Skills Center will also assist individual students in the diagnosis and assessment of reading and study skills which enhance independent learning.

For further information about any of Counseling Services' programs, students may call (303) 492-6766 or inquire at 134 Willard Administrative Center.

Day Care Center

The University Family Housing Day Care Center, which includes a preschool compatible program, is located adjacent to the Boulder Campus. It is professionally staffed and state-licensed and serves primarily the children of University Family Housing residents. The center is open from 7:30 a.m. to 5:30 p.m. five days a week. Further information and rates may be obtained by calling (303) 492-6185.

Services to Disabled Students

The Office of Services to Disabled Students (OSDS) provides academic support to students with disabilities. The purpose of OSDS is to assist students to take part in the academic, social, and cultural life of the University. Services are provided on an individual basis. The needs of each student are identified and then OSDS works with that student to meet those needs.

Attendant assistance for the physically disabled students is available. Reader services for blind students and interpreters for deaf students are provided. A special program to serve students with learning disabilities has been established. A van operates to provide on-campus transportation for permanently and temporarily disabled students. Assistance with admissions, registration, career planning, and other personal needs is available.

For further information contact Homer Page, Director of the Office of Services to Disabled Students at (303) 492-8671. The OSDS address is 18 Willard Administrative Center, Campus Box 133, University of Colorado, Boulder, Colorado 80309.

Educational Opportunity Program

The Educational Opportunity Program (EOP) has provided, since 1968, access and educational opportunity to students from ethnic minority backgrounds (e.g., Asian-American, Black, Chicano, American Indian), migrant backgrounds, and educationally or financially disadvantaged backgrounds. Today EOP offers a comprehensive educational support program which includes admissions and financial aid information; freshman core academic courses; tutorial services; academic, personal, and career counseling; and cultural activities. Student populations served by EOP include ethnic minority students, students with minimal academic deficiencies, student athletes, and students referred by academic departments and other student support service units. This multicultural support program consists of four service delivery units: Academic Affairs, Access and Recruitment, Educational Development Program, and Counseling.

Academic Affairs. EOP Academic Affairs offers a comprehensive academic support program designed to ensure the academic competency expected of all University students. This retention effort includes an innovative academic program which includes accredited introductory freshman courses; a math and science, writing, reading, and study skills center; individualized and small group tutoring; video and computer assisted instruction; and weekly skills workshops.

Access and Recruitment. EOP conducts special recruitment efforts which provide minority and educationally underprepared students from Colorado information about the educational opportunities available to them at the University. Interested students receive admission and financial aid advising to help ensure that their applications to the University are processed both efficiently and fairly.

Counseling. EOP Counseling offers services that are tailored to meet the individual student's educational, career, and personal goals. This student-centered counseling philosophy focuses on providing guidance and strategies to developing young adults who are in the process of defining and enhancing their academic and personal lives. Individualized and small group interactions, designed to improve the student's quality of life on the campus, are offered throughout the academic year.

Educational Development Program. This program offers a variety of precollegiate academic programs to minority junior and senior high school students from Colorado and throughout the Southwest. These programs provide minority students with early access to the University and with opportunities to develop and excel in basic academic areas, as well as to experience life at a major university during intensive summer programs. Additionally, this unit is helping to provide programs of computer-assisted instruction and computer literacy for pre-collegiate and collegiate populations.

For more information about the Educational Opportunity Program, prospective students should call the EOP Access and Recruitment Office, (303) 492-8316.

Ombudsman Office

The Ombudsman Office provides an informal grievance procedure for students who have difficulty resolving conflicts with faculty or staff. The ombudsman is an unbiased mediator who helps students to document their cases, advises them of current policy, and facilitates communication between both parties in a dispute. The office reviews policy and makes recommendations to revise policies when necessary. The office offers an information and referral service including information on University organizational structure and deadline dates. Procedural information is published regularly.

Students are encouraged to stop by or call the office if they have any questions or don't know where to go for help. The Ombudsman Office is located in UMC, room 328; telephone, (303) 492-5077.

Parking Regulations, Motor Vehicles, and Bicycles

Students who wish to park a vehicle in a parking lot on campus must purchase a permit at the Parking Management Office, 1511 University Avenue, (303) 492-7384. Parking rates range from $16 to $32 per semester.

All bicycles operated or parked on University property must be registered with the Parking Management Office. The fee is $2 for two years. All valid city licenses will be honored, provided the owner reregisters the bicycle with the Parking Management Office at no charge. Any unregistered bicycle parked on campus is subject to impoundment.

Since parking and traffic regulations are frequently revised, all students should obtain copies of the latest regulations to avoid possible fines and/or impounding of their vehicles. Further information may be obtained from the Parking Management Office.

Retention Services

The Retention Services Office utilizes the findings of Boulder Campus studies and national retention research to find out why students leave or persist in order to plan action programs which will contribute to student satisfaction with the University.

In this capacity, Retention Services staff members work with the faculty and staff of campus academic programs, residence halls, student organizations, campus services, and the administration to plan policies, procedures, and programs which promote an improved campus environment and the retention of capable students to graduation. The director is also available for consultation with individual students.

The Retention Services Office is located in 222 Willard Administrative Center. For further information students may write to Campus Box 132, University of Colorado, Boulder, Colorado 80309, or call (303) 492-7933/5601.

Office of Research and Testing

The Office of Research and Testing is located in 128 Willard Administrative Center. This office handles qualifying tests for undergraduate and graduate school admissions, College-Level Examination Program (CLEP), faculty course questionnaires for student ratings of courses and instructors, and institutional research on attracting and serving students. An optical scanning machine is available to score course examinations, research surveys, and other standard answer forms. For information call (303) 492-7067.

Student Health Service

The Wardenburg Student Health Service is a 22-bed infirmary and outpatient clinic located on the Boulder Campus. It provides inpatient, outpatient, and emergency services. There are no facilities for major surgery or intensive care. Services available to students are described below.

Outpatient Services: General Medical Clinic, Psychiatry, Gynecology, Minor Surgery, and Wellness Center. Subspecialty clinics available through referral are Allergy, Dermatology, Orthopedics, and Neurology. The service is generally open from 8:00 a.m. to 5:00 p.m. Monday through Friday and 8:00 a.m. to 1:00 p.m. Saturdays.

Emergency Services. A physician and the infirmary staff are at the Health Service after clinic hours and on weekends, except during academic breaks and summer session. The Psychiatric Department has a physician on call for psychiatric emergencies. The emergency entrance is on the south side of Wardenburg Student Health Service.

Ancillary Services. Laboratory, X-ray, and physical therapy services are available.

Pharmacy Services. Prescriptions may be filled at reduced rates in the Apothecary which is operated by the University of Colorado School of Pharmacy.

Vacation Periods. The outpatient clinics are open during some University holidays, academic breaks, and summer session. However, the infirmary, emergency room, and subspecialty clinics are closed. If a student requires medical care not available from the Health Service, the care may be received elsewhere at the student's own expense.

Medical History. All students entering the University for the first time are requested to complete a medical history form which will be mailed with registration materials or is available at new student orientation or the Student Health Service.

Fee-for-Service. Students will be required to pay fees for some services. These fees are established by the Student Health Board and are subject to revision. For a current outline of charges, contact the Health Service.

Student Health Insurance. WSHS offers a $10,000 major medical insurance plan designed to provide, with the Student Health Service, comprehensive health coverage. The cost of this policy is very reasonable and often provides better coverage less expensively than that obtainable from family plans. The insurance program will pay for most fee-for-service charges at Wardenburg. Students who have no medical insurance are strongly urged to participate in the Health Insurance plan. Parents should check their own policies to determine at what level and to what age their college student is covered.

The University of Colorado Administration and health officials have complied with the recommendation of the Colorado State Health Department requiring college students to show proof of immunity to rubeola (measles) and rubella (German measles). All new students will receive an Immunization Card in their admission confirmation packet which must be completed and returned to Wardenburg Student Health Service. Students who need vaccinations may receive them at the health service at no charge. Failure to comply with this policy will result in a medical hold on registration for the following semester. Students who prefer to sign a waiver for medical, religious, or personal reasons may be suspended from classes during an outbreak/epidemic as determined by campus health officials.

Veterans Affairs

The Veterans Affairs Office, located in Willard Administrative Center, assists veterans and veteran dependents in receiving Veterans Administration Educational Benefits. Prospective students are always welcome at this office. Telephone (303) 492-7322.

Veterans Educational Benefits, Chapter 34 (G.I. Bill). In order to complete application materials for benefits, the student must be accepted to the University of Colorado, Boulder, or admission must be imminent. If the student was discharged from the military before July 1, 1979, a *certified DD 214* is required (certified copies of discharges can be obtained from any County Courthouse without charge); if the student was discharged after this date, *Copy 4 of the DD 214* is required. An application for veterans benefits is completed and a statement of the tentative number of credit hours the veteran expects to take is completed. This and other necessary information allows the Veterans Affairs Office to enroll the student with the Veterans Administration Regional Office (VARO) in order to generate the appropriate monthly payment. Promptness is imperative because it affects the time of the student's payment.

Advance payment may be received at the start of a term if the application materials are submitted to the VARO by the Veterans Affairs Office approximately 60 days preceding the term. (*Note:* Federal legislation was introduced in 1983 to eliminate the Advance Pay Program. Students should contact the Veterans Affairs Office for current information about advance pay.)

Veterans Contributory Educational Program, Chapter 32. The veteran must have participated in this program while in the service in order to receive benefits. Please read the above paragraph for instructions about the DD 214 and materials required for application.

Dependents' Educational Assistance Act, Chapter 35. Students between the ages of 18 and 26 who are eligible to receive educational benefits because of the death of a parent in active military service or because of a service connected disability should establish their eligibility with their Veterans Administration Regional Office. Children and wives of 100 percent disabled veterans may also qualify. This office needs the *claim number* that the Veterans Administration assigns to the student in order to complete the paperwork. At each registration each dependent must complete paperwork with this office as described above.

The Veterans Affairs Office has a counselor on the staff for providing assistance to students in planning academic schedules in relation to VA regulations. This service is free and confidential. The student is encouraged to stop by this office at any time.

SPECIAL PROGRAMS

Alumni

The Alumni Office maintains records of alumni; arranges alumni events at Homecoming, at Commencement, and with local alumni groups throughout the

United States; plans class reunions and awards programs; sponsors an undergraduate alumni support group, alumni programs, and services for recent CU alumni; and offers a variety of other alumni-related programs, including a scholarship program, alumni involvement in attracting quality students to the University, a continuing education program for alumni, travel opportunities, a program of involvement for parents of current CU students, and information on career opportunities for CU undergraduates.

By working with the Boulder Campus chancellor, faculty members, staff, and students, the CU-Boulder Alumni Association creates better communication between the Boulder Campus and the total alumni body.

The alumni program is maintained by alumni support and by University funds. There are three categories of Alumni Association dues: $15 per year for the first five years after graduation, $25 per year until retirement, and $12.50 per year for retirees. Dues-paying members of the alumni association receive all editions of the *Colorado Alumnus*, published six times each year, *Summit* magazine, published three times each year, the association's full-color calendar, and special announcements for programs and services.

All former students are encouraged to keep their addresses current with the alumni office in order to receive communications and notification of alumni activities, programs and services.

Artist Series

The Artist Series brings to campus internationally known solo recitalists, touring orchestras, and opera and ballet companies. Jean-Pierre Rampal, Beverly Sills, Isaac Stern, and the Royal Winnipeg Ballet are just a few of the many stars who have come to Boulder in recent years.

Students are an important part of the Artist Series audience and are offered substantial savings on season subscriptions with a variety of easy payment plans. Additional information may be obtained at the Artist Series Box Office, Macky 107, (303) 492-8008.

Fraternities and Sororities

Currently at the University of Colorado, Boulder there are 29 social fraternities and sororities. There are over 2,500 students in these organizations. Even though there are no legal ties between the Greeks and the University, there is a relationship of mutual cooperation and support, recognizing that the Greek system can make a valuable contribution to campus student life. It is the intent of the University to find specific ways in which the Greeks may be assisted in providing an educational, growth-oriented environment for their members in addition to integrating them more totally into the campus community. Additional information may be obtained by contacting the Panhellenic/Interfraternity Council Office, (303) 492-6359, or the University-Greek Liaison, (303) 492-5323.

International Education

The Office of International Education serves as a liaison among academic departments, administrative units, foreign universities and governments, and U.S. governmental agencies and foundations. This liaison stimulates and provides administrative support for students and faculty members who desire to study or to conduct research overseas, and to assist foreign students, faculty members, and visitors who come to the University of Colorado.

Specific functions include expediting the exchange of students and faculty, arranging the programs of foreign visitors, promoting special relationships with foreign universities, and acting as an advisor for international scholarships.

The Office of International Education maintains a small resource library on foreign study, travel, and work opportunity, including temporary summer jobs, volunteer internships, and career opportunities abroad. International Student Identification Cards and Eurail and Britrail passes are also available through the office.

STUDY ABROAD

The Study Abroad Office, a branch of the Office of International Education, offers over 30 different study abroad programs around the globe. Some of these programs are of the traditional junior year abroad variety, which places a student directly in a foreign university for an academic year. Such programs are available at the Universities of Lancaster, East Anglia, and Reading, England; the University of Bordeaux, France; the University of Costa Rica, San José; the American University in Cairo, Egypt; the Universities of Regensburg, Stuttgart, and Tübingen, Germany; the Hebrew University in Jerusalem, Israel; Konan University, Japan; the University of Seville, Spain; and Linköping University, Sweden. Engineering and commercial Spanish students may be particularly interested in programs at Instituto Tecnológico y de Estudios Superiores in Monterrey, Mexico. Generally students need to have completed a minimum of two years college work with a *B* average or better and have studied two years of the appropriate language.

For students unable to spend an academic year abroad, programs for a single semester are available with various emphases. Students may study beginning/intermediate intensive language in Chambéry, France, during the spring semester of each year. Students who wish the experience of a foreign institution may attend a single-semester program in San José, Costa Rica; Rennes, France; Seville, Spain; and Linköping, Sweden. Special summer and interim programs, e.g., art history in Italy; intensive language in Mexico, Germany, and Italy; and international finance in London are organized with specific departments upon request.

All participants in University of Colorado study-abroad programs remain enrolled at the University and all credit earned while abroad is considered resident credit. Most study abroad credits are recorded on a pass/fail basis, but are exempt from all pass/fail restrictions in the College of Arts and Sciences and most

other colleges and schools. Financial aid from the University can be applied to program costs in most cases. Special study abroad scholarships are available to program participants.

More information about study abroad programs is available at the Office of International Education or by calling (303) 492-7741.

FOREIGN STUDENT ADVISOR

The University of Colorado has welcomed foreign students for many years. Currently more than 600 students from over 70 foreign countries are enrolled. The foreign student advisor, a member of the staff of the Office of International Education, provides information and assistance to foreign students regarding University regulations, legal requirements, financial matters, and personal affairs. All foreign students are urged to visit the foreign student advisor as soon as they arrive on campus and to maintain contact with him during their stay at the University. For further information concerning foreign students, one should call (303) 492-8057.

International English Center

The University's International English Center (IEC) provides full-time instruction in English as a second language to international students from all parts of the world. The year-round program is designed to prepare adult learners for college or university study in Colorado or elsewhere in the United States. Each eight-week session offers intensive daily instruction at all levels of English-language proficiency, with attention given to all the language skills: listening, speaking, reading, writing. Orientation to academic customs and to life in the United States is an integral feature of the comprehensive curriculum. The center also conducts short-term programs for special-interest groups of adults and young people seeking a combination of cross-cultural learning and semi-intensive study of the English language. Full information may be obtained from the International English Center by mail to Campus Box 63, in person at the IEC building at 889 17th Street, or by telephone, (303) 492-5547.

Orientation

Orientation activities are important in introducing new freshmen to campus programs and services. Students are given the opportunity to meet faculty, staff, and other students; to receive academic advising; and to obtain information on student services and recreational activities.

In addition, each fall entering freshmen, transfer students, and graduate students are invited to participate in New Student Welcome, a program of events especially planned to help new students familiarize themselves with the campus. A feature of the program is the Chancellor's Convocation, a ceremony officially honoring the entering freshman class.

Reserve Officers Training Corps

The Air Force and Navy Reserve Officers Training Corps (ROTC) units at the University of Colorado operate in the fall and spring semesters only, while Army ROTC offers courses in the fall and spring semesters and the summer session. Enrollment in the ROTC programs is open to both women and men, and courses are open to all students on campus whether or not they are enrolled in ROTC. All services provide undergraduate and selected graduate students with the opportunity to combine academic study with a military officer's educational program. The three services conduct courses in their respective areas leading to regular or reserve commissions upon graduation. The Navy also offers a program leading to regular or reserve commissions in the Marine Corps. Scholarships paying full tuition, mandatory fees, required book costs, and a monthly stipend to assist in defraying living expenses are available to qualified ROTC enrollees on a competitive basis. Flying instruction, which can lead to a private pilot's license, is provided to qualified Air Force ROTC cadets in their senior year.

For further information concerning these programs see the ROTC sections of this catalog or call or write to the following at the University of Colorado, Boulder, Colorado 80309:

Air Force: Professor of Aerospace Studies, Campus Box 371; (303) 492-8351

Army: Professor of Military Science, Campus Box 370; (303) 492-6495

Navy: Professor of Naval Science, Campus Box 374; (303)492-8287

Senior Auditor Program

During fall and spring semesters, the University of Colorado, Boulder offers a Senior Auditor Program to residents of the state who are 55 years of age or over. Senior auditors attend classes on a tuition-free, space-available basis. No record is kept of attendance; no examinations are taken for credit; and class participation is at the discretion of the instructor. Senior auditor privileges include the use of the library. For information call 492-8484.

Summer Session

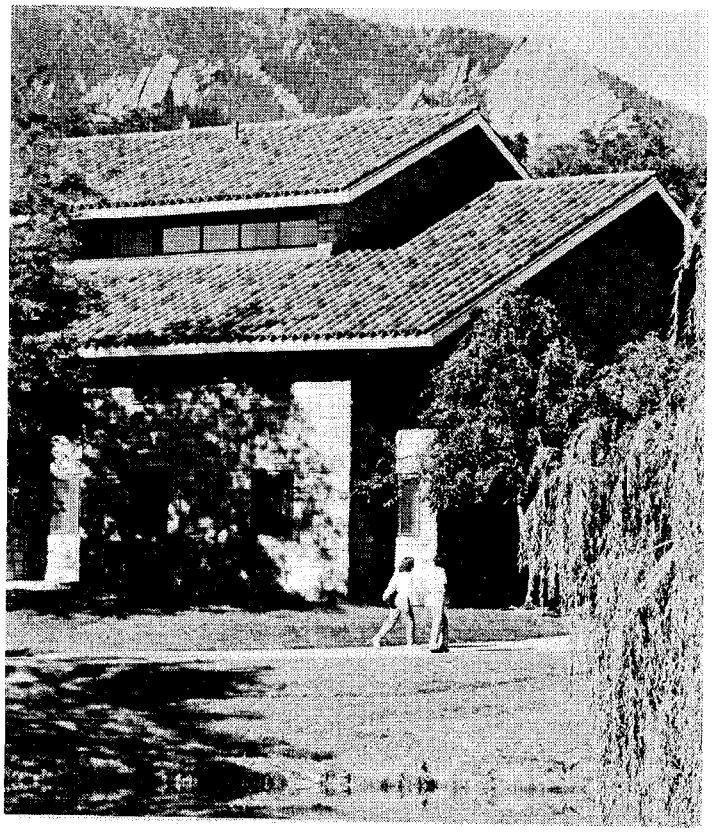
The principal summer session is 10 weeks. Courses that meet for shorter terms (1 to 4, 5, or 8 weeks) are scheduled within the 10-week session.

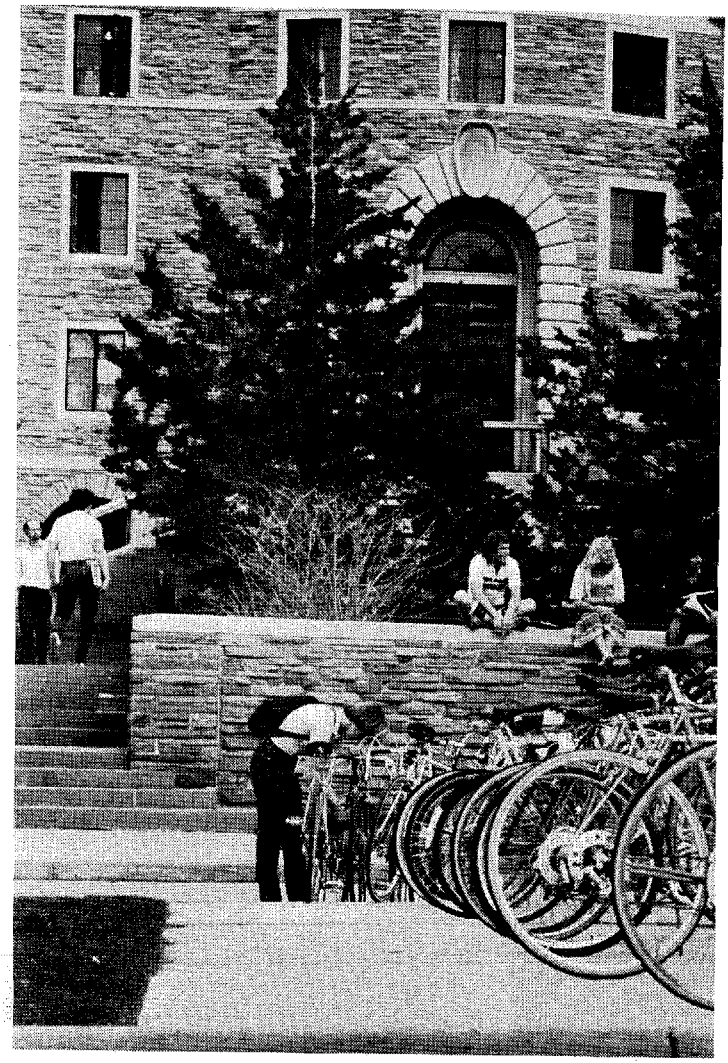
Undergraduate and graduate students can choose from well-balanced, broadly based curricular offerings during the summer session and may make progress toward degree programs in almost all areas of study.

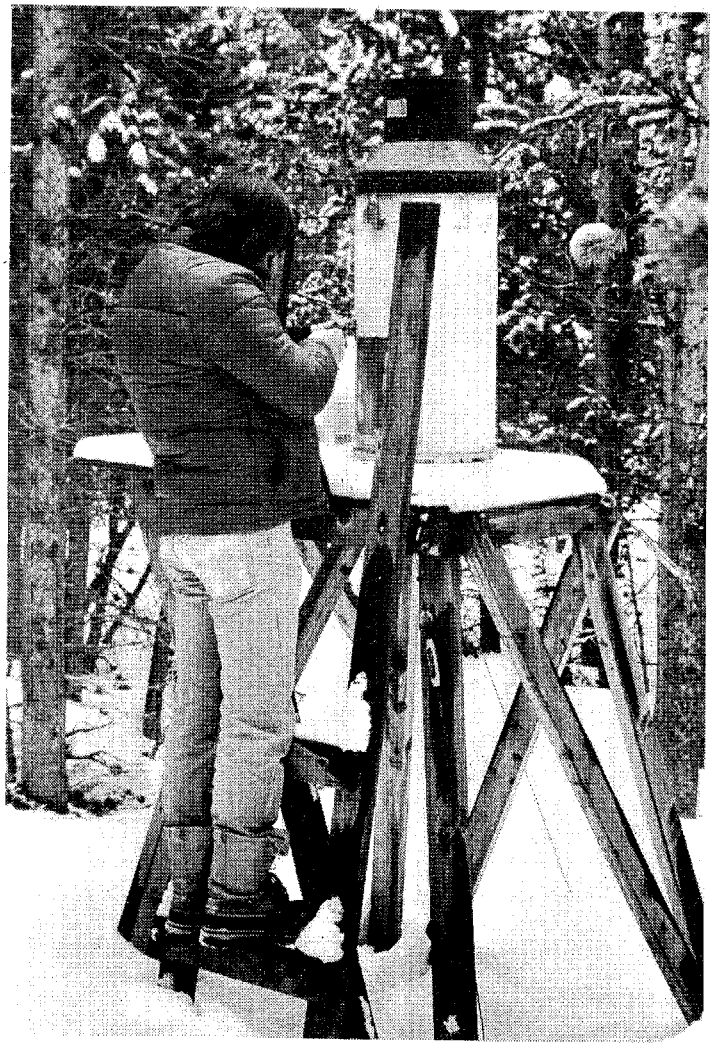
In addition to the resident faculty of the University, many of the leading scholars of the nation and the world teach, lecture, and participate in seminars and forums throughout the summer.

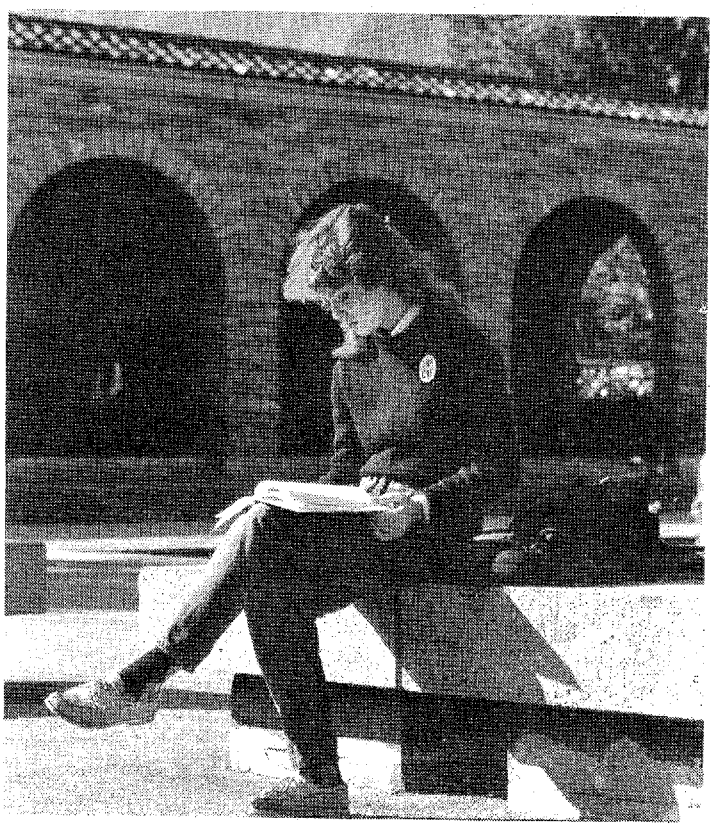
Supplementing this program of studies is a rich calendar of cultural events, including lecture series, dramatic and musical events, and varied recreational activities.

Further information may be obtained by calling (303) 492-7424.









College of Arts and Sciences

INFORMATION ABOUT THE COLLEGE

Everly B. Fleischer, Dean

History and Purpose

Incorporated by an act of the First Territorial Legislature of Colorado in 1861, the University of Colorado enrolled its first students in September 1877. The College of Arts and Sciences is the oldest academic division of the University, dating to 1878.

The College of Arts and Sciences provides a broad range of educational opportunities in the liberal arts and the sciences. The college recognizes the fact that its students have a wide variety of educational objectives, ranging from a highly specialized interest to a desire for the broadest and most general education.

The objectives of the college are based on the belief that all students, no matter how specific and professional their aims, should have sufficient knowledge of other areas to be able to see their own disciplines in the proper perspective. At the same time, all students, no matter how broad and general their educational objectives, should have sufficient grasp of at least one field to enable them to deal with its problems in depth and with sophistication.

Pursuant to these beliefs, the college requires all of its students to undertake work in the areas of the humanities, the social sciences, and the natural sciences. Students are also required to present a considerable body of work in at least one major field of study.

Liberal education cannot, however, be conceived solely in terms of courses taken and proficiency attained. Contact with members of the faculty outside the classroom and with other students in informal discussion, independent study and research, and participation in the broader intellectual and cultural life of the academic community are factors that significantly enrich the student's education. It is hoped that all students in the College of Arts and Sciences will avail themselves of such opportunities to enhance their university experience.

Academic Advising and Orientation

The College of Arts and Sciences maintains an advising staff located in the Office of the Dean of Arts and Sciences. Staff is available all year for consultation. *Students in the college are expected to assume the responsibility for planning their academic programs in accordance with college rules and policies and departmental major requirements.* However, they are urged to consult with advisors in the dean's office and in their major department concerning their academic progress and objectives. All freshmen and all transfer students who have completed fewer than 30 hours of transfer work by published deadlines are required to attend an orientation and advising program prior to matriculation. All other transfer students are expected to attend transfer advising activities held at the beginning of each semester.

DEGREES AND DEGREE REQUIREMENTS

General Requirements for the Bachelor's Degree

1. A total of 124 semester hours passed.
2. A 2.0 *(C)* grade average on all University of Colorado work.
3. Forty semester hours of upper division work (courses numbered in the 300s and 400s). Note that all courses transferred from junior colleges carry lower division credit.
4. Completion of the last 30 hours in University of Colorado courses on the Boulder Campus as a degree student in the College of Arts and Sciences. Courses taken at Colorado Springs or at Denver (excluding Metropolitan State courses) *in the summer* are resident credit.
5. Not more than 45 semester hours in a single department, except for B.F.A. and B.S. degrees.
6. Completion of a major (see Majors and Major Requirements below).

For specific information concerning the B.F.A. degree, see the departmental listing for Fine Arts or Theatre and Dance. Information regarding the B.S. degree may be found under the Physical Education and Recreation Department. Students are subject to the general degree requirements in effect at the time they first enter the College of Arts and Sciences.

Area Requirements

Candidates for liberal arts degrees are expected to be literate in their own language, to have at least a minimal acquaintance with a language other than their own, and to be familiar with the subject matter and the methodology of the three broad areas of learning repre-

sented by the humanities, the natural sciences, and the social sciences. These expectations generate the requirements of the college.

Each student pursuing a Bachelor of Arts or a Bachelor of Fine Arts degree in the College of Arts and Sciences is required to complete the area requirements listed below. A student pursuing a Bachelor of Science degree must complete all of the area requirements with the exception of the foreign language requirement.

Each student seeking the B.A., the B.F.A., or the B.S. degree must present two 2-semester course combinations in each of the following areas:

1. Humanities
2. Natural science
3. Social science

The faculty of the College of Arts and Sciences has authorized a set list of courses to be used in fulfilling the College Area requirements. This list is known as the College List.

The College List from which those course combinations may be chosen is printed each semester in the *Schedule of Courses.* Prospective Arts and Sciences students may obtain a copy of the *Schedule of Courses* by writing to the Office of Registrations, Campus Box 7, Boulder, Colorado 80309. The cost for the copy is $1.00 sent by second class mail and $2.00 for first class mail. Make checks payable to the University of Colorado. Students may satisfy the area requirements in one of two ways:

1. By taking a first-year combination of courses from those designated in the College List followed by two second-year courses for which the first combination is prerequisite. Both sets of courses must normally come from the same department; exceptions are printed in the list.

2. By taking one first-year combination in one department and a second first-year combination in a different department.

Completion of a Level III high school course in any modern or classical foreign language is recommended for entrance to the College of Arts and Sciences for those students seeking the B.A. or B.F.A. degree. Students failing to meet this expectation must complete it in one of the following ways:

1. Completion of an appropriate third-semester college course in any foreign language.

2. Demonstration of third-semester proficiency or its equivalent by examination in any foreign language.

Questions about placement should be referred to the appropriate foreign language department. Students who elect to enroll in a foreign language course below their placement level may be denied credit for the course.

Students are strongly urged to start their college-level language study immediately upon enrollment in the college, either by continuing a language previously studied or by beginning a new language.

Students planning to go on to graduate work are advised to complete the fourth semester of a foreign language in preparation for the language requirements of graduate schools.

Students may not use the pass/fail option for courses taken to fulfill the College of Arts and Sciences area requirements, including the courses taken to complete the foreign language requirements (101, 102, 105, 211).

College Expository Writing Program (CEWP)

The College of Arts and Sciences offers two levels of expository writing courses. Students who have not demonstrated adequate proficiency in writing are required to enroll in a special section of A.S. 100. See listings under Arts and Sciences for details.

Limitations on Course Work

1. Students may take not more than 45 hours in any one department. Note exceptions for the Bachelor of Fine Arts degree and the Bachelor of Science degrees.

2. Students may count toward the fulfillment of requirements for the Bachelor of Arts and Bachelor of Fine Arts degrees a total of 30 hours in the following categories, subject to the maxima specified:
   a. Up to 30 hours in curricula leading to degrees other than the B.A. (e.g., physical education, recreation, business, education, ROTC, and the other professional schools and colleges).
   b. Up to 8 hours in activities courses (physical education, applied music, and ensembles).

3. Students must complete the last 30 hours of their course work on the Boulder Campus in the College of Arts and Sciences. Course work taken in the summer at Colorado Springs and Denver (excluding Metropolitan State courses) are also counted as resident credit.

Work from accredited institutions of higher education which has been completed with a grade of *C* or better may be transferred to the University of Colorado. All courses transferred from junior colleges carry lower division credit. A maximum of 72 hours taken at junior colleges may be applied toward the bachelor's degree in the College of Arts and Sciences. No courses taken at a junior college will be credited toward graduation at the University of Colorado after a student has completed a total of 72 hours of course work at all institutions attended.

Bachelor's Degree Programs

The College of Arts and Sciences offers the following degrees:

BACHELOR OF ARTS

Majors

African and Middle Eastern studies
American studies/women studies
Anthropology
Asian studies
Biological sciences
Black studies
Central and East European studies
Chemistry
Chinese
Classics
Communication
Communication disorders and speech science
Computer Applications
Dance
Distributed Studies
Economics
English
Environmental conservation
Fine Arts
French
Geography
Geology
German
History
Humanities
Individually structured
International affairs

Italian
Japanese
Latin American studies
Linguistics
Mathematics
Philosophy
Physics
Political science
Psychology
Religious studies
Russian
Sociology
Spanish
Theatre
Women studies

BACHELOR OF FINE ARTS

Majors

Studio arts
Art history
Art education
Dance
Theatre

BACHELOR OF SCIENCE (PHYSICAL EDUCATION)

BACHELOR OF SCIENCE (RECREATION)

The requirements for the Bachelor of Science degree in physical education and the Bachelor of Science degree in recreation will be found in the narrative section for the Department of Physical Education and Recreation.

The College of Arts and Sciences also has the following programs that do not offer undergraduate majors:

Astrophysical, planetary, and atmospheric sciences
Bibliography
Chicano Studies
Comparative literature
Conflict and peace studies
Experimental studies
Film studies
History and philosophy of science
Honors
Interdisciplinary studies
Medieval studies
Museum

Majors

All Arts and Sciences students pursuing a B.A. or B.F.A. degree must declare a major by the end of their sophomore year (i.e., in the semester in which they are completing their 60th hour of work, including transfer work). Formal application must be made to the department or program in which the student intends to major. Admission to certain majors may be limited, and students are advised to consult with departmental advisors regarding criteria for admission.

Departments are responsible for advising their majors and also for certifying the completion of the student's major program for graduation. The college will assume no responsibility for difficulties arising out of the student's failure to establish and maintain contact with the major department or program.

Major Requirements

1. A minimum of 30 semester hours in the major area (for the B.F.A. a minimum of 50 hours).
2. Thirty hours of *C*– grade or higher in the major area.
3. A 2.0 *(C)* grade point average in all major work attempted.
4. Eighteen hours of upper division courses in the major, all with grades of *C*– or higher.
5. Special requirements as stipulated by the major department.
6. No more than 8 hours of independent study may be credited toward the minimum requirements in the major.
7. Students are subject to those major requirements in effect at the time the student formally declares a major.

Comprehensive Examinations

Departments may require candidates for degrees to pass comprehensive examinations in their major during the senior year.

Cross-listed Courses

Students who matriculated in the College of Arts and Sciences during the summer of 1981 and thereafter and who take courses which are cross-listed in two or more departments will receive credit in the department in which they have the most hours, irrespective of the department in which they formally took the course.

Double Majors

Students pursuing either the B.A. or B.F.A. degrees may graduate with more than one major (e.g., biological sciences and French) within the degree by completing all requirements for both majors. No more than 124 total hours are required for double majors provided all other requirements are fulfilled.

Double Degrees

Two degrees may be earned from the University of Colorado at Boulder (e.g., B.A. and B.S.) if the following conditions are fulfilled:

1. The student presents a total of at least 150 hours passed.
2. For the B.A. and B.F.A degrees, the student presents a total of 94 hours of liberal arts course work.
3. The student has completed at least 30 hours of liberal arts course work at the University of Colorado.
4. The student has completed all area and major requirements of the College of Arts and Sciences.
5. Both degrees must be awarded at the same time.
6. In the event that the student decides not to complete a double degree program, and instead seeks a single degree in the College of Arts and Sciences, the following will apply:
   a. The student must see an advisor in the Dean's Office of the College of Arts and Sciences immediately, as all previous advising may or may not now apply.
   b. If enrolled in another school or college, the student must immediately submit an Intra-University Transfer form for transfer into the College of Arts and Sciences.
   c. The student's degree requirements will then be determined by the date the student was first accepted as a degree student in the College of Arts and Sciences. Specifically, the student should be aware of the college residency requirement (the

last 30 hours of the degree must be taken on the Boulder Campus with the student being registered as a degree student in the College of Arts and Sciences).

7. Students who wish to earn two degrees should notify the office of the dean as soon as they have decided on this degree option. Specific graduation requirements will be determined on the basis of when *formal* notification of double degree status occurs.

Second Baccalaureate Degrees

A student who has been awarded a baccalaureate degree, either from this college or elsewhere, may be granted a second baccalaureate degree provided the following conditions have been fulfilled:

1. All general requirements for the degree to be awarded by the College of Arts and Sciences have been met. (See General Requirements for the Bachelor's Degree).
2. The major in the B.A. or B.F.A. is different from the major in the first degree earned. In addition, students whose second degree is a B.S. (P.E.) or a B.S. (Rec.) must have earned a major in another field. Subject areas for the B.S. degree must be different from the first degree earned.
3. At least 30 hours of passing work in the new major or subject field, including 18 hours of upper division work, are taken in this college after admission to a second degree program. Courses taken as a special student will not count in these minimum requirements.

Graduate Degree Programs

Curricula leading to advanced degrees are offered by most of the departments in the College of Arts and Sciences. Students should consult the Graduate School section of this catalog for admission and degree requirements of the Graduate School. Curricula for graduate programs are listed alphabetically in this section. For information regarding submatriculation, see Seniors at the University of Colorado in the Graduate School portion of this catalog.

ACADEMIC STANDARDS

Grade Point Average

The grade point average is computed by multiplying the credit points per hour by the number of hours for each course, totaling the hours and the credit points, and dividing the latter by the former. Effective in the spring semester of 1984 all student averages will be calculated on the plus/minus grading system. See General Information section of this catalog under Uniform Grading System.

The grades received at another institution will not be used in computing the student's grade point average at the University of Colorado.

Repetition of Courses

When a student takes a course for credit more than once, all grades are used in determining the grade point average. In determining the number of hours completed for graduation requirements, however, the hours which are earned in a course for which there are two or more passing grades are counted only once unless a course description specifically states that it can be taken more than once for credit.

Graduation With Distinction

Students who do not graduate with honors from the College of Arts and Sciences may graduate with distinction if they have taken at least 30 hours at the University of Colorado at Boulder and if their cumulative grade point average is 3.75 or higher, both at the University of Colorado and in all collegiate work completed. The average includes all grades except *P*.

Graduation With Honors

The award of honors at graduation (*cum laude, magna cum laude, summa cum laude*) is determined by the Honors Program of the college and is based on several criteria. Honors are not conferred on a graduate simply by virtue of high grades in courses. Students should consult the Honors Program listing in this catalog or contact the Honors Program, Norlin Library.

Attendance

Successful work in the College of Arts and Sciences is dependent upon regular attendance in all classes. Students who are unavoidably absent should make arrangements with instructors to make up the work missed. Students who, for illness or other good reason, miss a final examination must notify the instructor or the Office of the Dean no later than the end of the day on which the examination is given. Failure to do so may result in an *F* in the course.

Probation

Students whose cumulative grade point average falls below 2.0 will be placed on probation and will have one semester to raise their cumulative grade point average to 2.0 or be dismissed from the college.

If students who have been placed on probation elect to remain out of school for a full calendar year, they may return to the University in good standing, but will be placed on probation again at the end of the semester in which they return if their cumulative grade point average is still below 2.0 at that time.

Scholastic Dismissal

Good academic standing in the college requires a grade point average of 2.0 (*C*) on all University of Colorado work. Grades earned *at another institution* are not used in calculating the grade point average at the University of Colorado. This provision applies as well to Metropolitan State College courses taken by enrolling on the Denver Campus of the University. However, grades earned in another school or college *within the University of Colorado* will be used in determining the student's scholastic standing and progress toward

the degree in the College of Arts and Sciences. Students whose cumulative average falls below 2.0 are placed on probation. Those students who enroll in any term, excluding summers, in the calendar year after being placed on probation are expected to raise their grade point average to a 2.0 overall at the end of that term. Students who are still below a 2.0 cumulative average after exercising their semester of probation will be *dismissed* and will not be able to register for University of Colorado daytime courses on any campus during the regular academic year, August to May.

Students *dismissed* from the college shall be eligible for *reinstatement* when they have achieved a cumulative 2.0 average by virtue of work done in the University of Colorado's summer session and/or Division of Continuing Education. They may also return as transfer students when they have overcome their deficiencies by enrolling at another institution (i.e., by achieving an overall 2.0 average in the University of Colorado work *plus* all work taken elsewhere *since dismissal*). Dismissed students pursuing this option will have two semesters after re-enrollment to bring their University of Colorado average up to 2.0 or they will be dismissed again.

It should be noted that CU-Boulder's summer session does not count as a probationary semester, nor are students dismissed as a result of summer work. It should also be noted that students reinstated following dismissal will be eligible to re-enroll only if the enrollment quotas have not been filled (i.e., reinstatement does not necessarily guarantee re-enrollment).

Academic Ethics (Dishonesty, Cheating)

See Academic Integrity statement in the General Information section of this catalog.

REGISTRATION IN COURSES: CREDITS AND ENROLLMENT

The University operates on the semester system. The term "course" as used in the catalog means a one-semester course. Except for laboratory and studio courses, the credit-hour value assigned to a course is roughly equivalent to the number of hours per week of class work involved in the course (a 3-semester-hour course normally meets 3 hours per week). The normal course load is 12-18 hours.

Course Numbering

Courses numbered 100 and 200 or 910-929 (independent study courses) are designed principally for freshmen and sophomores. Courses numbered 300 and 400 or 930-949 (independent study courses) are designed principally for juniors and seniors.

Undergraduate students may not normally enroll in graduate courses (500, 600, 950-969), unless they have permission of the instructor and the department in which the course is offered.

Advanced Placement Program

See the General Information section of this catalog.

College Level Examination Program (CLEP)

The College of Arts and Sciences accepts a maximum of 30 hours of CLEP credit from *subject* (not general) examinations toward its bachelor's degree programs. CLEP credit may not be used in the final 30 hours, which must be completed in the College of Arts and Sciences residence. For information as to what subject examinations have been approved for credit, students should contact the College of Arts and Sciences dean's office or the testing office, Willard 130. More detailed information regarding the College Level Examination Program may be found in the General Information section of this catalog.

Credit by Examination (Challenging Courses)

Students in the College of Arts and Sciences may obtain credit in courses taught by the college by taking advanced standing examinations. See the General Information section of this catalog under Advanced Standing Examinations. The fee for taking such an examination is assessed at the lowest resident tuition charge currently in effect for the Boulder Campus.

Independent Study

With the approval of the department, students may register for independent study only within the first 12 days of instruction in the semester. No more than 8 hours of independent study may be credited toward the major and no more than 16 hours may be credited toward the degree.

A student may not use independent study projects in partial fulfillment of the college's area requirements.

Students may not register for more than 8 hours of independent study credit during any term. All independent study courses are numbered in the 900 series. Lower division credit is assigned 910 through 929. Upper division credit is assigned 930-949.

Correspondence Study

With the approval of the dean of the College of Arts and Sciences, students in the college may take work in correspondence study offered by the University's Division of Continuing Education. A maximum of 30 hours of correspondence work may count toward the degree. Arts and Sciences courses offered by the University's Boulder Division of Continuing Education carry resident credit.

Senior Thesis

A senior student may register for as many as 6 hours of Senior Thesis (investigation paper) in the major with the approval of the departmental honors committee and the chairperson of the department. The title of this project and the credit hours awarded will be entered on the student's transcript. The hours awarded for Senior Thesis will count toward the major and must be included in the maximum 45 hours allowable toward the degree.

Students pursuing the Individually Structured Major must complete a Senior Thesis. For further information see the section on the Individually Structured Major.

Pass/Fail

Students in the College of Arts and Sciences *may not* use the pass/fail option for courses taken to fulfill the area requirements, courses used to satisfy the foreign language requirement, or the minimum requirements for the major.

Students exercising the pass/fail option may take up to 16 hours of elective credit on a *P/F* basis; for transfer students, the limit is 1 hour in every 8 attempted at the University of Colorado. Students may take only 6 hours maximum of pass/fail each semester, including the one before graduation.

Drop Procedure

A detailed description of the drop procedure may be found in the General Information section of this catalog. Note: *students may not drop courses which they are failing.*

Add Procedure

A detailed description of the add procedure may be found in the General Information section of this catalog.

Credit/No Credit

Credit/no credit changes must occur within the first 12 days of instruction.

Withdrawal Procedure

See the General Information section. Students who are permitted to withdraw after the 10th week of a fall semester will normally not be allowed to register for the following spring semester. Students who are permitted to withdraw after the 10th week of a spring semester will not normally be allowed to register for the following summer and fall semesters. Students may not withdraw after the last day of class (i.e., the day before the final examination period begins).

Students who withdraw two semesters in a row will have a dean's stop placed on them and may not register until one academic year (August to May) has elapsed.

Appeals

Students are advised that they have the right to appeal decisions of academic dishonesty and to petition for exceptions to the academic policies stated in this catalog. Appeals should be directed to the Committee on Academic Ethics. Petitions should be submitted to the Appeals Committee on Academic Rules and Policies. Both committees are lodged in the Office of the Dean of the College of Arts and Sciences.

SPECIAL ACADEMIC PROGRAMS

Residential Academic Programs

FARRAND: A RESIDENTIAL PROGRAM IN THE LIBERAL ARTS

The Farrand Program offers 400 freshmen and sophomores the opportunity to combine some of the advantages of a small liberal arts college with the benefits of a major research university. Small classes offered in the residence hall, informal contact with faculty and campus visitors, academic advising and personal counseling services, and special programs addressed to the students' interests, make Farrand an academic as well as a residential program, with a community atmosphere created by living and learning together.

Farrand students are required to take certain courses. These provide the core of the academic experience shared by all of the students. During the freshman year the Farrand curriculum develops the basic skills of writing, logical analysis, and critical thinking, while providing a comprehensive survey of Western art and culture through such courses as introduction to the humanities, mathematics, and a freshman seminar designed especially for Farrand. The focus of the second year is on social issues, cultural differences, and foreign affairs.

The Farrand courses constitute about one-third of a student's course work during the first two years. The remaining two-thirds is comprised of courses selected from the regular on-campus offerings. Most of the Farrand courses may also be used to fulfill requirements in the College of Arts and Sciences. Students who complete the Freshman Seminar (A.S. 160) and Sophomore Seminar (A.S. 260) will satisfy one-half of their social science sequence requirement in the College of Arts and Sciences.

While the academic component comes first, the Farrand Program is not an honors program. Farrand students participate in all the usual student activities: intramurals, intercollegiate athletics, fraternities and sororities. In addition, Farrand offers the opportunity to participate in a very active student government group.

The program is sponsored jointly by the College of Arts and Sciences and the Boulder Campus Housing Administration. It is administered by codirectors: an academic director selected from the faculty of the College of Arts and Sciences and a hall director experienced in the operation of a large residence hall.

There is a charge for the program which is in addition to regular tuition, fees, room, and board.

The program is designed for students in the College of Arts and Sciences. Freshmen admitted to other colleges should select some other residence hall.

Freshmen accepted for the Farrand Program may wish to begin in the Farrand Summer Program. More information on the Summer Program is also available through the academic director.

Inquiries concerning any aspect of the academic program may be directed to the Academic Director,

Farrand Program, Campus Box 180, University of Colorado, Boulder, Colorado 80310.

SEWALL HALL

The Residential Academic Program in Sewall Hall provides qualified academically committed freshmen with the opportunity to participate in a unique residential community experience at the University of Colorado, Boulder. Limited to 320 students, this coeducational program combines many of the advantages of a small liberal arts college with the vast resources of the University.

Students who live in Sewall take one Sewall seminar each semester. These seminars are limited to 20 students; vary in content with emphasis on the natural sciences, social sciences, humanities, and fine arts; and stress critical enquiry and creative participation. In addition to the seminars, many of the large lecture classes at the University offer special laboratory and recitation sections for Sewall students.

The director of the Sewall program, who is a member of the University faculty, provides academic assistance to the students in planning their individual programs, in choosing courses, and in making contact with their major departments. The director also offers personal counseling and helps students find the proper University resources to help them with their problems.

Participants in the Residential Academic Program are centrally involved in regular campus life, take the majority of their classes with the rest of the University, and are encouraged to join in all-University activities. The major emphasis at Sewall is participation—in classes, in student government, in special programs and performances, and in creative projects. Students, faculty, administrators, and staff enjoy close working relationships.

All entering freshmen accepted at the University of Colorado, Boulder, are welcome to apply for the Residential Academic Program. Students entering the Colleges of Business or Engineering may have some difficulty in selecting and fitting into their schedules a Sewall class because of the specific requirements demanded by these colleges. This does not mean these students should not participate in the Sewall Program or be discouraged from applying, as most students are able to work something out. Applications will be included in the housing materials sent to all freshmen upon admission. Applications will be considered in the order in which they are received; prompt application is recommended. There is an extra charge for participation in the program in addition to regular tuition and room-and-board fees. Students who have academic questions should address them to the Director, Residential Academic Program, Sewall Hall, Campus Box 353, Boulder, Colorado 80309.

Study Abroad

For information regarding study abroad programs available to students in the College of Arts and Sciences, see the General Information section of this catalog under the topic International Education.

AFRICAN AND MIDDLE EASTERN STUDIES

Office in Ketchum 5-C
Professors Gottfried Lang and Ragaei El Mallakh, Co-Chairmen

The University of Colorado, through its various departments and the African and Middle Eastern Studies Committee, offers a broad interdisciplinary undergraduate major in African and Middle Eastern Studies. Within the framework of the requirements, students have considerable latitude to shape their studies in the areas and disciplines which most interest them. In addition to the courses listed below, other courses may be taken to meet the requirements with the approval of either of the chairmen. Information may be obtained from either of the professors.

BACHELOR'S DEGREE REQUIREMENTS

1. Satisfaction of the regular college requirements for the Bachelor of Arts degree.
2. Completion of at least 48 hours in courses pertaining to Africa and the Middle East, all with a grade of *C* or better.
3. Second-year (college) competence in a language appropriate to Africa or the Middle East.
4. Completion of the senior seminar in African and Middle Eastern Studies, included in the 48 hours specified in item 2.
5. The specific courses that may be counted to meet these requirements are to be determined by the advising committee for African and Middle Eastern Studies and the dean of the College of Arts and Sciences.

Students are encouraged to seek courses, seminars, and independent studies (including appropriate ones from black studies) deemed relevant upon consultation with their advisors and to submit these to one of the chairmen for consideration as fulfilling requirements.

Anthropology	*Semester Hours*
Anth. 226. Old World Archaeology	3
Anth. 310. Africa: Peoples and Societies in Change	3
Anth. 426. Biblical Archaeology	3
Anth. 432. Archaeology of Ancient Egypt	3
Anth. 451. Applied Cultural Anthropology	3
Anth. 483. Egyptian Hieroglyphics I	3
Anth. 484. Egyptian Hieroglyphics II	3
Black Studies	
Bl.St. 260. Introduction to African Literature	3
Bl.St. 480. The African Novel	3
Economics	
Econ. 456. Agricultural and Rural Economics	3
Econ. 458. Comparative Agricultural Systems and Development	3
Econ. 477. Economic Development: Theory and Problems	3
Econ. 478. Policies of Economic Development	3
Econ. 489. The Economics of Africa and the Middle East	3
Fine Arts History	
F.A. Hist. 404. The Art of the Ancient Near East	3
F.A. Hist. 406. The Art of Islam	3
F.A. Hist. 407. Byzantine Art	3
F.A. Hist. 461. The Art of Ancient Egypt	3
F.A. Hist. 470. Art of Africa and Oceania	3

History

Hist. 103. Introduction to Asian History: The Middle East and India 3
Hist. 104. Introduction to Asian History: China and Japan 3
Hist. 488. The Medieval Middle East, A.D. 500-1600 3
Hist. 489. The Modern Middle East, 1600 to Present 3
Hist. 491. The Arab-Israeli Problem 3

Political Science

P.Sc. 222. Introduction to International Relations 3
P.Sc. 415. Political Systems of the Middle East and North Africa. 3
P.Sc. 419. Political Systems of Sub-Saharan Africa 3
P.Sc. 473. The Middle East and World Affairs 3
P.Sc. 511. Seminar: Political Development 3
P.Sc. 519. Seminar: Comparative Politics of Sub-Saharan Africa.. 3

Religious Studies

R.St. 260. World Religions: Western 3
R.St. 410. Biblical Judaism 3

AMERICAN STUDIES/WOMEN STUDIES

The College of Arts and Sciences, through its various departments and its American Studies Committee, offers a broad interdisciplinary program of courses relating to American thought and culture. American Studies also includes a major track in Women Studies.

Major Requirements—American Studies

1. Satisfaction of the regular college requirements for the Bachelor of Arts degree.
2. Completion of 6 upper division credit hours in three of these primary fields:

Anthropology	History
Art history	Journalism
Economics	Political science
English	Sociology

3. Completion of the two-semester Senior Seminar in American Studies, Am.S. 495-496.
4. Completion of 6 upper division credit hours in the history, culture, or language of a non-American civilization.
5. Completion of 6 credit hours in architecture, black studies, geography, interdisciplinary studies, music, philosophy, or 4 credits in independent study and 3 credits in the above.

Major Requirements—Women Studies

See listing under Women Studies.

ANTHROPOLOGY

Office in Hellems Building, Room 90
Campus Box 233
Associate Professor Paul Shankman, Chairman

BACHELOR'S DEGREE REQUIREMENTS

Majors in anthropology must take Anth. 103 and 104, Principles of Anthropology; Anth. 201, Introduction to Physical Anthropology; Anth. 210, Frontiers of Cultural Anthropology; and Anth. 220, Introduction to Archaeology.

GRADUATE DEGREE PROGRAMS

Prerequisites. To be admitted as regular degree students, applicants should have a minimum undergraduate grade point average of 3.0 (4.0=*A*) or a Master of Arts degree. Graduate Record Examination scores for verbal and quantitative aptitude tests are required. Letters of recommendation and evidence of previous anthropologically oriented experience and work are carefully considered. Students with less than 18 semester hours of previous course work in anthropology are considered deficient and will be asked to present a correspondingly greater number of hours for a degree.

Application. Inquiries concerning applications should be directed to the graduate secretary. Completed applications are reviewed twice each year, in February and in April. Students who wish to be considered for financial aid (fellowships and teaching assistantships) must have their applications completed by the February deadline. Students with no previous graduate work should apply for entrance into the M.A. program which, if successfully completed, will prepare them for the Ph.D. program. Students who have or will have completed an M.A. degree in anthropology by the time of their admission may apply for direct admission into the Ph.D. program.

Course Requirements

All entering graduate students must have had the equivalent of Quantitative Methods in Anthropology (Anth. 405/505) or take it during their first semester in residence.

To qualify for a graduate degree all students must complete at least three seminars, one each from any of the following four categories: cultural anthropology, physical anthropology, archaeology, or anthropological linguistics.

Other specific course requirements will be established through a qualifying interview and consultation with the department chairman and an academic advisor.

M.A. students are normally expected to write a thesis (Plan I); exceptions to this (Plan II) require approval of the chairman.

Students may have prime specialties in any of the major subfields of anthropology: archaeology, cultural, physical, and linguistic anthropology as well as medical anthropology. In addition students may develop as a specialty the archaeology of the ancient Middle East. Students interested in pursuing this as a specialty should write the chairman of the department for additional details.

In general, no matter what the student's special interests, the department expects graduate students to retain a breadth of competence in anthropology through the master's degree with specialization intensifying with progress toward the Ph.D. degree.

Additional information about other specific areas of specialization and other requirements for the degree may be obtained by writing directly to the Department of Anthropology.

ARTS AND SCIENCES

College Expository Writing Program (CEWP)

Office in Hellems Building, Room 115
Campus Box 226

The College Expository Writing Program is designed to teach University students the skills of written discourse essential to a successful college and professional career. The program is composed of expository writing courses on two levels: beginning (A.S. 100) and advanced (A.S. 110). Certain sections are controlled enrollment. This pair of courses may be used to fulfill one year of the humanities area requirement.

ASIAN STUDIES

Office in Ketchum 226
Campus Box 331
Associate Professor Paul W. Kroll, Chairman

The Asian Studies Committee, an affiliate of the Center for Interdisciplinary Studies (Ketchum 128) offers a broad interdisciplinary undergraduate major in Asian studies. In addition, a number of departments (i.e., fine arts, history, philosophy, political science, and theatre and dance) offer graduate training with an emphasis on Asia.

Students planning to major in Asian studies are encouraged to consider study abroad in Asia. The University offers year-long programs in Kobe, Japan, and Taipei, Taiwan. Short-term programs are also available on a regular basis in India and Nepal.

BACHELOR'S DEGREE REQUIREMENTS

A student majoring in Asian Studies may choose one of two options:

Option 1: Complete a total of 44 hours consisting of 20 hours (two years) of Chinese or Japanese language and 24 hours of other courses, at least 18 of which are upper division. Six of those 18 may be upper division Chinese or Japanese language courses.

Option 2: Complete a total of 36 hours of Asian Studies courses, at least 24 of which are upper division credits.

Under either option, the student must fulfill the following general requirements:

1. Satisfy the general requirements for the B.A. degree in the College of Arts and Sciences.
2. Take Asian Studies 499, Senior Project in Asian Studies.
3. Receive a grade of *C* or higher in all courses taken to fulfill major requirements.
4. Take at least two courses each in the social sciences (anthropology, history, economics, political science) and in the humanities (fine arts, literature, philosophy, religious studies, theatre and dance) on Asia.

Honors. A student with an outstanding record (minimum grade point average of 3.3 overall and 3.5 in Asian Studies courses) may petition for graduation with honors in Asian Studies. Students should see the student advisor for more details.

Courses that may be counted toward fulfillment of degree requirements are determined by the Asian Studies Committee and the dean of the College of Arts and Sciences. Not all courses listed below are offered every academic year. An advanced student may be allowed by the instructor to enroll in one of the graduate offerings listed here.

Anthropology	*Semester Hours*
Anth. 314. Ethnography of China, Japan, and Korea	3
Anth. 315. Culture and Society in South Asia	3
Asian Studies	
Asian Studies 499. Senior Project in Asian Studies	3
Asian Studies 920. Independent Study	1-3
Asian Studies 930. Independent Study	1-3
Asian Studies 940. Independent Study	1-3
Fine Arts History	
F.A. Hist. 284. Introduction to Asian Arts	3
F.A. Hist. 405. Art of India and Southeast Asia	3
F.A. Hist. 474. The Arts of Japan	3
F.A. Hist. 475. The Arts of China	3
F.A. Hist. 560. Graduate Seminar: Selected Topics in Art History (Asian Arts)	3
History	
Hist. 103. Introduction to Asian History: Middle East and India	3
Hist. 104. Introduction to Asian History: China and Japan	3
Hist. 270. History of Japan Through Cinema	3
Hist. 271. Asian-American History	3
Hist. 318. Selected Readings in Japanese History	3
Hist. 320. Selected Readings in Recent Chinese History	3
Hist. 400. Women in Asian History	3
Hist. 472. History of Modern Chinese Intellectual Thought	3
Hist. 473. History of Traditional China	3
Hist. 474. Rise of Revolutionary China	3
Hist. 475. Ancient and Medieval Japanese History	3
Hist. 476. Modern Japanese History	3
Hist. 478. History of Modern India	3
Hist. 671. Readings in Chinese History	3
Music	
Mus. 277. World Music	3
Oriental Languages and Literatures	
Chin. 101. First-Year (Beginning) Chinese	5
Chin. 102. First-Year (Beginning) Chinese	5
Chin. 211. Second-Year (Intermediate) Chinese	5
Chin. 212. Second-Year (Intermediate) Chinese	5
Chin. 311. Third-Year (Advanced) Chinese	3
Chin. 312. Third-Year (Advanced) Chinese	3
Chin. 321. Introduction to Classical Chinese	3
Chin. 322. Readings in Classical Chinese	3
Chin. 411. Readings in Modern Chinese Literature I	3
Chin. 412. Readings in Modern Chinese Literature II	3
Chin. 481. Chinese Poetry in Translation	3
Chin. 482. Chinese Fiction in Translation	3
Chin. 483. Chinese Drama in Translation	3
Chin. 499. Seminar: Classical Chinese	3
Jpn. 101. First-Year (Beginning) Japanese	5
Jpn. 102. First-Year (Beginning) Japanese	5
Jpn. 211. Second-Year (Intermediate) Japanese	5
Jpn. 212. Second-Year (Intermediate) Japanese	5
Jpn. 221. Language and Patterns of Thinking and Behavior in Japanese Culture	3
Jpn. 311. Third-Year (Advanced) Japanese	3
Jpn. 312. Third-Year (Advanced) Japanese	3
Jpn. 411. Readings in Classical and Modern Japanese	3
Jpn. 412. Readings in Classical and Modern Japanese	3
Jpn. 483. Classical Japanese Literature in Translation	3
Jpn. 484. Modern Japanese Literature in Translation	3

Philosophy

Phil. 310. Chinese Philosophy 3

Political Science

P.Sc. 203. Introduction to Asian Politics 3
P.Sc. 416. Political Systems of China, Japan, and Korea 3
P.Sc. 460. Governments of South Asia 3
P.Sc. 476. International Relations of China, Japan, and Korea 3
P.Sc. 548. Seminar: Comparative Human Rights: Asia and the U.S. 3

Religious Studies

R.St. 262. World Religions: Eastern 3
R.St. 320. Hinduism 3
R.St. 330. Indian Buddhism 3
R.St. 340. Japanese Religions 3
R.St. 360. Islam 3
R.St. 385. Chinese Religion 3
R.St. 420. Topics in Hinduism 3
R.St. 485. Taoism 3
R.St. 489. Sufism 3

Theatre and Dance

Thtr. 472. Theatre of Asia 3
Thtr. 572. Problems in Asian Theatre 3
Thtr. 672. Seminar: Asian Theatre 3

ASTROPHYSICAL, PLANETARY AND ATMOSPHERIC SCIENCES

Office in Duane E 226
Campus Box 391
Professor Peter S. Conti, Chairman

Although an undergraduate major is not offered, APAS courses may be used in a distributed studies major program. A list of courses recommended for a distributed studies major may be obtained in the departmental office.

GRADUATE DEGREE PROGRAMS

The curriculum and research in the department emphasize three major areas: astrophysics, atmospheric and planetary sciences, and plasma physics.

The department offers both M.S. and Ph.D. degrees. During the first two years of graduate study, before specializing, students generally obtain a broad background through courses regarded as basic to all three areas. Many students take graduate-level courses in the Physics Department (e.g., electromagnetism and quantum mechanics). In their second semester, first-year students are required to register for a one-unit reading and research course, under the supervision of a faculty member. Depending upon the student's preparation and interests, the basic courses are chosen from the following list:

APAS 511. Internal Processes in Gases
APAS 515. Introductory Plasma Physics
APAS 516. Intermediate Plasma Physics
APAS 540. Fluid Dynamics I
APAS 541. Fluid Dynamics II
APAS 554. Mathematical Methods
APAS 555. Radiative Transfer
APAS 750. Reading and Research

Descriptions of more specialized courses in the three major areas follow. Students interested in applying to this program are invited to write to the Chairman, Department of Astrophysical, Planetary, and Atmospheric Sciences, Campus Box 391, University of Colorado, Boulder, Colorado 80309.

Astrophysics (Including Solar Physics)

The department offers a broad range of courses and research in this area. Graduate-level courses are offered in the following subjects:

APAS 530. Introduction to Magnetospheres
APAS 533. The Sun
APAS 560. Introduction to Astrophysics
APAS 562. Stellar Interiors
APAS 563. Physics of the Interstellar Medium
APAS 566. Galaxies and Cosmology
APAS 583. Solar Physics
APAS 614. Astrophysical Fluid Dynamics
APAS 640. Radio Astronomy
APAS 661. Stellar Atmospheres
APAS 665. Observational Astronomy
APAS 667. High Energy Astrophysics

Research in observational and theoretical astrophysics is conducted in the following areas:

Stellar atmospheres, radiative transfer, and stellar winds
Solar physics
Interstellar medium
Stellar interiors, pulsations, and neutron stars
Cosmic X-ray sources
Galactic evolution, quasars, and intergalactic medium
Radio astronomy
Plasma astrophysics
Astrophysical fluid dynamics
Laboratory and atomic astrophysics
UV and X-ray space astronomy
Instrument and detector development

The department operates a 24-inch Cassegrain-Coude and an 18-inch Cassegrain telescope, available for photographic, photometric, and spectrographic observations, as well as for instrument and detector development. Opportunities for graduate research also exist with the University's Laboratory for Atmospheric and Space Physics (LASP) and Joint Institute for Laboratory Astrophysics (JILA). (See descriptions under the Graduate School section.) Research also is carried out with national laboratories and international collaborators: High Altitude Observatory (HAO) in Boulder (solar physics), Kitt Peak National Observatory in Tucson (optical astronomy), National Radio Astronomy Observatory (NRAO) in Virginia, the Very Large Array (VLA) in New Mexico, the NASA International Ultraviolet Explorer satellite (IUE), and Boulder-Sydney Agreement in Astrophysics in Sydney, Australia (solar physics and radio astronomy).

Students from the Physics Department may, with appropriate approval, complete Ph.D. degrees in the Astrophysics Program.

Atmospheric and Planetary Sciences

Research and courses related to the physics and dynamics of the Earth's atmosphere, planetary

atmospheres of other planets, and planetary interiors are available in programs leading to the M.S. and Ph.D. degrees. Graduate-level courses in these areas are:

APAS 505. Atmospheric Physics I
APAS 506. Atmospheric Physics II
APAS 520. Meteorology of the Upper Atmosphere
APAS 530. Introduction to Magnetospheres
APAS 533. The Sun
APAS 540. Fluid Dynamics I
APAS 541. Fluid Dynamics II
APAS 542. Geophysical and Astrophysical Turbulence
APAS 556. Radiative Processes in Planetary Atmospheres
APAS 581. Geomagnetism (offered only occasionally)
APAS 596. Theories of Climate and Climate Variability
APAS 613. Geophysical Fluid Dynamics
APAS 624. Physics of Planetary Airglows
APAS 630. Advanced Magnetospheric Physics

Research in observational, laboratory, and theoretical atmospheric and planetary sciences is conducted in the following areas:

Structure and composition of planetary atmospheres (Earth, Venus, Mars, Jupiter, Saturn)
Planetary aeronomy, including atmospheric photochemistry, airglow and aurora, UV and IR spectroscopy, upper atmosphere ozone and trace constituents, and noctilucent clouds
Atmospheric dynamics (small- and large-scale), wave motions, hydrodynamic instabilities, experimental geophysical fluid dynamics, and ocean dynamics
Energetics of the Earth's atmosphere, including radiative transfer and radiative/photochemical coupling, and climate modeling
Magnetic probing of the Earth's core
Planetary magnetospheres (spacecraft observations and theory)

Graduate research opportunities and assistantships are available with individual department faculty members as well as through research programs of various institutes on campus (e.g., the Laboratory for Atmospheric and Space Physics [LASP] and the Cooperative Institute for Research in the Environmental Sciences [CIRES]). Research support also is available through cooperative arrangements with the National Center for Atmospheric Research (NCAR) and various laboratories of the Environmental Research Laboratory of the National Oceanic and Atmospheric Administration (NOAA). The department has its own Apple II minicomputer for data reduction and theoretical modeling, as well as access to a VAX 750, the larger University computer (CYBER 172) and the two high-speed CRAYs at NCAR. There is a well equipped laboratory for studies in geophysical fluid dynamics, and the department operates a weather facsimile system for daily weather analyses.

Plasma Physics

A complete program of courses and research is available for students specializing in theoretical or experimental plasma physics leading to M.S. or Ph.D. degrees in APAS or physics or a Ph.D. in astrophysics. Courses offered are:

APAS 440. Introduction to Controlled Fusion
APAS 514. Experimental Plasma Physics
APAS 515. Introductory Plasma Physics
APAS 516. Intermediate Plasma Physics
APAS 517. Advanced Plasma Physics
APAS 615. Magnetohydrodynamics

Research in theoretical and experimental plasma physics is carried out in the following areas:

Fundamental processes in plasmas
Kinetic theory of plasmas
Plasma turbulence
Plasma diagnostics
Nonlinear optics of plasmas
Laser-plasma interactions
Radar propagation through the ionosphere
Solar plasmas, radio emission from the sun

Collaborative research is pursued with the Mathematics and Physics departments, with major institutions in Boulder and the U.S., and with international research organizations. These include the National Center for Atmospheric Research (NCAR), with access to the CRAY computers; the Los Alamos Scientific Laboratory; and several University groups. A departmental plasma laboratory is equipped with modern diagnostic instrumentation and a variety of plasma research devices.

Graduate assistantships and postdoctoral positions are available.

DEPARTMENTAL REQUIREMENTS

Those wishing to pursue graduate work in APAS leading to candidacy for an advanced degree should read carefully Requirements for Advanced Degrees in the Graduate School section of this catalog. The following are special departmental requirements.

Master's Degree

Prerequisites. A thorough undergraduate preparation in physics and mathematics. Courses should include thermodynamics, mechanics, electricity and magnetism, atomic physics, and mathematics at least through differential equations.

Qualifying Examination. The Graduate Record Examination aptitude tests and advanced test in physics are used in place of a qualifying examination, and this examination normally is taken before the time of entry into Graduate School.

Preliminary Examination. Students in the Department of Astrophysical, Planetary, and Atmospheric Sciences will be given a written preliminary examination prior to the beginning of the spring semester of their first year. This examination will test fundamental knowledge in physics and mathematics. Students are required to overcome any academic deficiencies within a year in order to remain in the program.

Course Requirements. Under Plan I, a student must present a thesis plus 24 semester hours of course work, at least 12 of which must be in APAS courses numbered 500 or above. The remaining graduate-level hours will normally be in physics and mathematics. Under Plan II, additional hours of approved graduate courses must be presented for a total of 30 semester hours of which at least 16 must be in APAS courses numbered 500 or above. The master's examination under Plan I covers the thesis and related topics. Under Plan II the examination, which is more comprehensive, may be either written or oral or both. Master's examinations are given after other degree requirements have been completed,

but may be given during the last semester of residence if the student is making satisfactory progress on required courses. Students are encouraged to follow Plan I except under special circumstances.

Doctor's Degree

Prerequisites. See prerequisites above.

Qualifying Examination. See above.

Preliminary Examination. See above.

Course Requirements. A minimum of 30 semester hours of work in courses numbered 500 or above is required; however, the emphasis is on independent study and research, not on the fulfilling of course requirements.

Language Requirement. Graduate school language requirement.

Examinations. Students in a Ph.D. program are required to pass the preliminary examination described under Master's Degree, pass a comprehensive examination which is designed to test the student's scientific judgment and initiative as well as mastery of the knowledge and skills necessary for research, and satisfactorily defend the thesis before a faculty committee. Students entering the department are supplied with a detailed description of these examinations.

BIBLIOGRAPHY

Office in Norlin Library, Room N 233
Campus Box 184
Mildred Nilon, Assistant Director for Public Services

Several courses in bibliography (see College of Arts and Sciences in Course Description section of this catalog) are offered to students who wish to develop competence in the use of information tools for their study and career needs.

BIOLOGICAL SCIENCES

The Division of Biological Sciences consists of the Department of Environmental, Population, and Organismic Biology and the Department of Molecular, Cellular, and Developmental Biology. Several programs leading to the B.A. degree with a major in biological sciences are available. Each department defines and administers its own programs separately.

Biology—Environmental, Population, and Organismic

Office in Ramaley Building, Room 122
Campus Box 334
Associate Professor Michael Grant, Chairman

BACHELOR'S DEGREE REQUIREMENTS

The department offers a major in environmental, population and organismic (EPO) biology, distributed studies major, and a joint computer science and biology major. Students must report to the departmental office for assignment to an academic advisor. Courses in mathematics, chemistry, and physics are required of all EPOB majors (except for distributed and joint majors). All transfer students must take at least 12 hours in regular EPO biology courses on the Boulder Campus.

The following courses are required:

EPOB Courses (38 hours)	*Semester Hours*
1. *General Biology*—EPOB 121, 122 and EPOB 123, 124. MCDB 105-106 can be substituted. NASC 123, 124 (formerly BSCI 103 and 104) will not carry credit toward the 38 hours required for the EPOB major but will fulfill the requirement of completing General Biology.	8
2. *Genetics*—EPOB 320 (MCDB 384 will not substitute)	3
3. *Principles of Ecology*—EPOB 302	3
4. *Plant Sciences—One* of the following courses is required: Plant Kingdom—EPOB 350-4 Plant Anatomy and Development—EPOB 351-4 Flowering Plant Systematics—EPOB 352-4 Plant Physiology—EPOB 353-4	4
5. *Animal Science—One* of the following courses is required: Comparative Vertebrate Anatomy—EPOB 372-5 Embryology—EPOB 374-3 *and* 375-2 Comparative Animal Physiology—EPOB 385-5 Students who have taken *both* Human Anatomy *and* Human Physiology are exempted from the animal science requirement. Students may not present both Human Anatomy (EPOB 342) and Comparative Vertebrate Anatomy (EPOB 372) *or* both Human Physiology (EPOB 343) and Comparative Animal Physiology (EPOB 385) to fulfill the requirement of 38 hours for an EPOB major. They may, however, use both anatomy courses or both physiology courses as electives, provided they do not have more than 45 EPOB credits.	5
6. *Additional EPOB courses* should be chosen in consultation with a faculty advisor. They must include *at least 6 hours at the 400 level or above.*	
7. Certain courses taken in other departments may be counted toward the 38 hours required for the EPOB major. Such courses should be strongly related to the student's vocational goals. Not more than 12 semester hours of courses taken in other departments may be presented (if MCDB 105-106 are used to fulfill the general biology requirement those 8 hours will be counted as part of the 12-hour limit for courses taken outside the department). A listing of the only acceptable courses may be obtained from the EPOB Office, Ramaley 122. A minimum of 12 hours in EPO Biology courses on the Boulder Campus is required.	

Required Courses in Ancillary Sciences

All majors are required to complete one year each of college chemistry and physics and one semester of calculus in addition to the 38 hours of EPOB courses. *A grade of C or better is required for each course.* For a list of specific courses, students should contact the department.

GRADUATE DEGREE PROGRAMS

The Department of Environmental, Population, and Organismic Biology offers degree programs leading to the M.A. and Ph.D. in a wide range of areas of biological inquiry. Offerings include animal behavior, plant and animal physiology, plant and animal systematics, ecology, aquatic biology, population biology, population genetics, neurobiology, microbiology, and behavioral genetics. Modern laboratory facilities for graduate study are in the newly constructed Ramaley biology building. In addition the department has strong ties with the Institute of Arctic and Alpine Research (INSTAAR) and

with the Institute of Behavioral Genetics (IBG). INSTAAR operates the Mountain Research Station, an alpine field laboratory 20 miles from campus. Certain specialized facilities, such as scanning and transmission electron microscopes, are available through the Department of Molecular, Cellular, and Developmental Biology. Graduate research support is available in the form of fellowships, teaching assistantships, and research assistantships. The department has a small endowment (the Alexander Fund and the Kathy Lichty Fund) to help defray field research expenses of graduate students.

Graduate Admissions

Admissions materials may be obtained from the departmental office. Completed applications are due in the departmental office by February 1 for consideration for fall semester admissions. A complete application includes a statement of intent, letters of recommendation, transcripts, and GRE scores. Applications for spring semester admissions are discouraged. Although there are no formal course prerequisites for admission, background and training in biology are expected. Students admitted without a sufficient background in chemistry, physics, or mathematics are expected to make up those deficiencies during their first year of graduate study.

The M.A. I Program

A master's degree with thesis is offered for students interested in continuing training as professional biologists after completion of the degree. For some students the M.A. I provides a basis for work on a Ph.D. at the University of Colorado or at another institution, although the M.A. is not required for admission to the Ph.D. program. Prospective students are urged to consult with the faculty member who would be their advisor concerning whether application for the M.A. I or Ph.D. program is appropriate. Applicants should communicate with potential advisors before February 1. Applications for the M.A. I program are considered on a competitive basis; the department has a policy of limiting the number of admittees to those for whom financial support is available. Twenty-four hours of course work, including 6 hours of thesis credit, are required for the degree. In addition to a thesis based on original research, students are required to take comprehensive examinations, as described for the M.A. II.

The M.A. II Program

A nonthesis master's degree program is offered for students interested in obtaining a greater knowledge of biology but not interested in degree work beyond the M.A. This program is suitable for secondary school teachers and others whose career choices do not require a research thesis. Applications for the M.A. II program are considered on a noncompetitive basis; students with records indicative of an ability to do master's level course work are accepted. A faculty sponsor is also required before admission can be granted; applicants are encouraged to communicate with potential sponsors before February 1. In addition to 26 hours of course work the student must complete 4 hours of independent study or research leading to a paper to be presented to the faculty sponsor. Before completion of the degree the student must take a comprehensive examination, which consists of four half-day written examinations; one of these examinations will be in general biology. The other three may be chosen from (1) biology of special taxa; (2) anatomy, morphology, and physiology; (3) genetics and evolution; (4) taxonomy and systematics; (5) animal behavior; and (6) ecology. Financial support is not guaranteed for M.A. II students.

Doctoral Program

The Ph.D. is a research degree, involving the production of a major piece of original research (the thesis). Most recipients of the Ph.D. from EPO Biology go on to teach in a university setting or to do research in private or government laboratories. Since the area of work chosen for the Ph.D. is likely to determine the student's career options, applicants are urged to communicate directly with potential thesis advisors and to visit the department before completing the application. Applications are considered on a competitive basis and financial support in the form of fellowships or assistantships is made available to Ph.D. students. Ph.D. students are expected to form an advisory committee of five faculty members (including one from outside EPO Biology) soon after beginning their studies. This committee will aid the student in designing a research program and in making choices concerning course work. By the end of the third semester of graduate work, the Ph.D. student takes preliminary examinations which are similar to the M.A. comprehensive (see above). If these are successfully completed, the comprehensive examination should then be scheduled as soon as possible. The comprehensive is over the student's area of research and is based in large part on a proposal for thesis research prepared by the student. Upon completion of the thesis a final examination is administered by the advisory committee.

The only specific course work requirement for the Ph.D. is four 600-level graduate seminars. A total of 30 hours of course work must be taken, although independent study credit may be included in this total. Ph.D. students are required to teach at least one year; this is generally done by serving as a departmental teaching assistant.

Biology—Molecular, Cellular, and Developmental

Student Office in Porter Biosciences Building, Room 131
Campus Box 347
Professor Mark W. Dubin, Chairman

BACHELOR'S DEGREE REQUIREMENTS

	Semester Hours
MCDB 105-106 or EPOB 121-123, 122-124	8
DB 312	4
MCDB 384	4
MCDB 465-466	5
Chem. 103-106 or Chem. 107-108	10

Chem. 331-332-333-334 or Chem. 335-336-337-338	8-10
Chem. 481-482	6
Phys. 111, 112, 114 or Phys. 301, 302	8-10
Math. 130, Math. 230	8-10
Electives in MCDB	9

Students interested in MCD biology should consult with an advisor in the department. Recent changes in the list of available courses and other pertinent information for majors are described in a brochure available from the departmental office.

GRADUATE DEGREE PROGRAMS

Opportunities for graduate study and original research are available in a variety of areas:

Molecular Biology: Gene regulation, virology, bacteriophage control mechanisms, chromosome structure and function, chromosome replication, control of bacterial replicons, protein synthesis in cultured cells, and nucleic acid-protein interactions.

Cell Structure and Function: High voltage electron microscopy, cell division in green algae, cytoskeleton, biophysical cytology, flagellar assembly, carbonhydrate biochemistry of plant cell walls, and host pathogen interaction in plants.

Developmental Biology: Mechanisms and regulation of morphogenesis and cell growth, cellular aging, genetic control of development, developmental genetics of *Drosophila*, and genetic control of invertebrate embryogenesis.

Membrane Biology and Neurobiology: Mitochondrial biogenesis, spatial arrangement of cytomembranes, sensory and developmental neurobiology.

Entrance Requirements and Prerequisites. The graduate programs of the Department of Molecular, Cellular, and Developmental Biology are sufficiently flexible to accommodate students with a wide range of training. Students with bachelor's degrees in any of the biological, biochemical, or physical sciences are encouraged to apply. Background necessary for the program includes the equivalent of undergraduate courses in cell biology, developmental biology, genetics, organic chemistry, chemical thermodynamics, differential and integral calculus, and general physics. These requirements are intentionally stated in terms of areas of knowledge rather than as credits in specific courses. Students accepted with deficiencies may demonstrate mastery of the required areas by taking appropriate undergraduate courses, by passing advanced-standing examinations, or by successfully completing graduate-level courses that require the undergraduate courses as prerequisites.

Areas of Study. All students will be expected to develop competence in five areas: (1) *biochemistry*, including biochemical phenomena associated with cellular and molecular biology; (2) *genetics*, including molecular mechanisms of gene function, regulation of gene activity, and genetic control of development; (3) *cell structure and function*, including interaction of organelles, molecular organization, ultrastructure, biosynthesis, growth and reproduction; (4) *developmental systems and mechanisms*, including types of developmental phenomena and the morphological and molecular mechanisms involved; and (5) *current research techniques* of experimental biology.

Doctoral Program

Course of Study. The faculty of the department offers a variety of courses to help graduate students acquire knowledge in the various areas of study. Further, students are encouraged to work in several different laboratories to broaden their education and to help them identify the field of greatest interest for their thesis work.

Examination Sequence. At the time of entrance a counseling committee examines each student's background and interests and recommends courses for the first year in residence. A member of the faculty is then appointed as advisor for each new student to serve until the student is ready to select a sponsor for his or her thesis research.

A preliminary examination is held at the end of the student's second semester in residence to determine eligibility for continued graduate study and to identify areas of weakness, if any.

The comprehensive examination, which is normally scheduled during the student's fourth regular semester in residence, consists of two parts: a written research proposal and an oral examination designed to test the student's mastery of the broad field of knowledge related to his or her overall degree program.

Language. Before admission to candidacy for the Ph.D. degree, students must satisfy the language requirement established by the Graduate School.

Thesis. The principal elements in graduate training are defining a thesis problem, investigating this problem with a coherent piece of research that constitutes a substantial contribution to knowledge, and writing a report on this work in the form of a thesis submitted to a departmental committee for approval. After completion of the thesis, each candidate for the Ph.D. degree is required to present a public seminar and to take a final oral examination on the thesis and related topics.

Teaching. Two semesters of apprentice teaching are required of each candidate for the Ph.D. degree. Normally this obligation is met during the student's second or third year of graduate study.

Course Requirements. A minimum of 30 semester hours of courses numbered 500 and above is required. Specific courses depend on the student's background and field of specialization.

In view of the strong research orientation of the fields involved, the department does not accept applications from students seeking the M.A. as a terminal degree. The Master of Arts degree, either with a thesis (Plan I) or without (Plan II) is awarded under special circumstances. Candidates must pass the preliminary examination and a comprehensive final examination. There is no foreign language requirement. For Plan I a thesis based on original research must be submitted. Final determination of whether a student will follow Plan I or Plan II is made by the department.

BLACK STUDIES PROGRAM

Office in Woodbury Building, Room 302
Campus Box 294

The Black Studies Program (an affiliate of the Center for Interdisciplinary Studies, Ketchum 128) is multidisciplinary and offers courses in the humanities and social sciences. Some of these courses will satisfy the area requirements in the College of Arts and Sciences. Although its primary purpose is to explore, analyze, and experience various aspects of Afro-American life and culture, the program is enhanced by courses, seminars, and colloquia which focus on the African and Caribbean experience as well. The program offers a major which leads to the B.A. in black studies.

BACHELOR'S DEGREE REQUIREMENTS

1. Satisfactory completion of the regular College of Arts and Sciences requirements for the B.A. degree.
2. Satisfactory completion of Bl.St. 200, Introduction to Black Studies; Bl.St. 450, Research Methods in Black Studies: and Bl.St. 495, Senior Seminar in Black Studies.
3. Satisfactory completion of the core program in black studies as defined below. At least 3 credit hours are required from each of the categories below.

History

Bl.St. 215-216. Afro-American History I and II

Literature

Bl.St. 232-233. Survey of Afro-American Literature I and II
Bl.St. 260. Introduction to African Literature

Music, Art, Dance

Bl.St. 240. Afro-American Dance I

Social Sciences

Bl.St. 203-204. Behavioral Analysis I and II
Bl.St. 220. Black Social Movements

4. Satisfactory completion of black studies courses in an area of concentration. This includes 15 hours of additional course work in a subject area chosen by the student and approved by the Black Studies Program faculty for a total of 36 hours of credit in black studies. Of this total, at least 16 hours must be in upper division courses.

CENTER FOR INTERDISCIPLINARY STUDIES

Office in Ketchum Building, Room 128
Campus Box 331
Associate Professor David M. Armstrong, Director

The Center for Interdisciplinary Studies creates and offers interdisciplinary courses and programs in the major areas of learning: humanities, natural sciences, and social sciences. It also sponsors interdisciplinary programs and courses, taught by faculty of other departments in the college. For descriptions of individual programs and offerings, see entries for those programs: American Studies, Asian Studies, Black Studies, Comparative Literature, Conflict and Peace Studies, Women Studies, Humanities, Natural Science, Social Science, Honors, Experimental Studies, and Mountain View Center for Environmental Education.

CENTRAL AND EAST EUROPEAN STUDIES

Office in Ketchum Building, Room 215
Campus Box 333
Professor Edward J. Rozek, Chairman

All schedules for students majoring in Central and East European Studies must be approved by the advisor of the program.

BACHELOR'S DEGREE REQUIREMENTS

1. Satisfaction of the regular college requirements for the Bachelor of Arts degree.
2. A demonstrated proficiency in German, Russian, Polish, Serbo-Croatian, or any other Central European language.
3. At least 48 semester hours selected from courses numbered 200 or above, dealing with problems of Central or Eastern Europe or the Soviet Union, which are offered by any department in the College of Arts and Sciences; e.g., economics, geography, history, political science, Slavic languages, and sociology.
4. The specific courses that may be counted to meet these requirements are to be determined by the advising committee for the Bachelor of Arts in Central and East European Studies and the dean of the College of Arts and Sciences.

CHEMISTRY

Office in Chemistry Building, Room 109
Campus Box 215
Professor Tad H. Koch, Chairman
Professor Bert Tolbert, Associate Chairman

BACHELOR'S DEGREE REQUIREMENTS

A student can earn a bachelor's degree in chemistry in one of three ways: (1) as a regular major in chemistry, (2) as a major in chemistry with the biochemistry option, or (3) as a major in distributed studies with chemistry as the primary area. A student will be helped in choosing among these possibilities by a department advisor.

For graduation with a *regular chemistry major*, students must present credits in the following courses or their equivalent: Chem. 103, 106 (or 107, 108), 335, 336, 337, 338, 418, 451, 452 or 453, 455; Phys. 111, 112, 114; and Math. 130, 230, 240. Honors Chem. 107 and 108 are recommended for the student with exceptional training in mathematics and/or physics. A minimum of 33 semester hours in chemistry is required for a degree. Chemistry majors concentrating in physical chemistry should take the entire physical chemistry sequence: Chem. 451, 452, 453, and 455. All students, but especially students intending to enter graduate school in chemistry, should take additional advanced courses. Recommended courses include Independent Study, Chem. 943; a third semester of physical chemistry;

Inorganic Chemistry, Chem. 401 or 501; Biochemistry, Chem. 481 and 482; an advanced analytical chemistry course (Chem. 516, 517, or 518); and Advanced Organic Chemistry, Chem. 531.

Students majoring in chemistry with the *biochemistry option* must present credits in the following courses or their equivalents: Chem. 103 and 106 (or 107, 108); 331 and 332, 333, and 334; 450 or 451, 452 or 453; 481, 482, and 486; Phys. 111, 112, and 114; Math. 130, 230, and 240; MCDB 105, 106 or EPOB 121, 122, 123, 124; and MCDB 384. All biochemistry option students, and especially students intending to enter graduate school in the biological sciences, should take additional advanced courses. Especially recommended are Independent Study, Chem. 943; Analytical Chemistry, Chem. 418; Advanced Organic Chemistry, Chem. 531; Advanced Biochemistry, Chem. 587, 588; and courses in the biology departments such as EPOB 320, 385, MCDB 312, 412, 465, 472, and 489.

Distributed Studies (Chemistry Primary Area). The following courses or their equivalents are required for a distributed studies (chemistry) major. (Register at the Innovative Education Office, Ketchum 226.)

1. General Chemistry: Chem. 103 and 106, 10 credit hours. Chem. 100, 101, and 104 may *not* be substituted for these requirements nor included in the 30-hour requirement of item 4 below.
2. Organic Chemistry: Chem. 331, 332, 333, and 334.
3. Physical Chemistry: Chem. 450 or 451.
4. Additional chemistry credit hours to make a total of 30 hours.

ACS Certification. The American Chemical Society maintains a certification program in which a student graduating with a specified minimum program is certified to the society upon graduation. To be certified, a graduate must satisfy requirements in addition to the minimum for graduation. A list of these requirements may be obtained from the department office.

Chemistry Honors Program. Opportunity is provided for qualified chemistry majors, including those with the biochemistry option, to participate in the Chemistry Honors Program and graduate with honors (*cum laude, magna cum laude,* or *summa cum laude*) in chemistry. Students interested in the Honors Program should contact the departmental honors advisor during their junior year.

Transfer students who plan to take a regular or biochemistry option major must complete at the Boulder campus a minimum of 9 credit hours of upper division work covering at least two of the subdisciplines: organic, physical, analytical, inorganic, and biochemistry.

A more detailed listing of the bachelor's degree requirements, together with advising information and alternate course options, is available at the Chemistry Department Office.

GRADUATE DEGREE PROGRAMS

Students wishing to pursue graduate work in chemistry leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section. For information on the doctoral program in chemical physics offered jointly with the Department of Physics, see Chemical Physics under Interdepartmental Programs in the Graduate School section of this catalog. Following are some of the special departmental requirements. Copies of more detailed rules are distributed to graduate students.

Prerequisites. An undergraduate major in chemistry is desirable since entering graduate students are required to pass examinations covering the major fields of chemistry. GRE scores are required for fellowship competition; they are strongly recommended but not required for admission to the department.

Master's Degree

Language. A student must demonstrate proficiency in a foreign language at a level comparable to a third-semester undergraduate course. This requirement may be satisfied either by having received a satisfactory grade in a third-semester course or by an equivalent grade in the GSFLT. Organic chemistry majors must satisfy this requirement in German; students in other fields may fulfill the requirement in French, German, Japanese, or Russian.

Examinations. Preliminary examinations are given during registration week of the fall semester. These examinations are offered in five fields: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. They cover undergraduate-level material, and their purpose is to determine qualifications for advanced study. A student must take examinations in physical chemistry and at least two other subjects. The grades earned in any three of these examinations will be used to determine what courses the student must take.

Candidates also must pass master's final oral examinations at the time of completion of their work.

Course Requirements. There are two methods of obtaining a master's degree from the Department of Chemistry. Plan I requires 24 credit hours including 15 to 20 credit hours of formal course work, 4 to 9 credit hours in research courses, the completion of research investigation, and the presentation of a thesis. Plan II requires 30 credit hours including 24 credit hours of formal course work plus 6 credit hours of research, but no thesis; Plan II is available only with departmental approval.

The student should consult with the graduate advisor in the department to ascertain that the proposed plan satisfies the major and minor field requirements.

Doctor's Degree

Language. The language requirement is similar to that for the master's degree except that the level of proficiency required is that of a fourth-semester undergraduate course.

Examinations. The preliminary examinations are the same as those described for a master's degree. The comprehensive examination consists of written and oral parts. These examine candidates for advanced knowledge in their field of specialization. The written part consists of a series of monthly cumulative examinations, of which the candidate must pass six over a two-

year period. Students entering with bachelor's degrees must start taking these in their third semester of graduate school; those entering with master's degrees must start in their second semester. The oral comprehensive must be taken during the fourth semester or the second semester depending upon whether the student enters with a bachelor's or a master's degree. Candidates must also pass a final Ph.D. oral examination at the time of completion of their thesis.

CHICANO STUDIES

Office in Denison Building, Room 101
Campus Box 217
Assistant Professor Cordelia Candelaria, Director

The Chicano Studies Program at the University of Colorado provides all students a conceptual means by which bilingualism and biculturalism, in a context of racial/ethnic pluralism, can be fully developed. The undergraduate program provides students majoring in related disciplines an extensive knowledge and insight into the largest single language minority in the country. It also provides an academic context for the study of the Chicano experience in both a historic and demographic/structural framework. No major is offered at this time.

This department encourages students to include in their studies the study abroad programs offered in Mexico in order to gain deeper understanding of the culture and attitudes of Mexico and their carry-over into the United States, especially the Southwest. Students interested in study abroad will find further information under the section on Special Educational Opportunities or they may consult the Office of International Education.

CLASSICS

Office in Education Building, Room 320F
Campus Box 248
Associate Professor Joy K. King, Chair

BACHELOR'S DEGREE REQUIREMENTS

The major in classics is, upon consultation with the undergraduate advisor, tailored to the student's interests in the field. Major programs can be arranged with a concentration on either Latin or Greek or a combination of the two, or a broadly based program in classical antiquities (mythology, literature, philosophy and religion, art, archaeology, and history). The candidate for the degree must present a minimum of 36 credit hours plus the equivalent of two college years of either Greek or Latin. Prospective majors should consult the undergraduate advisor and the departmental major list.

General classics courses do not require a knowledge of Greek or Latin and may also be used as a secondary field in the distributed studies major or in an individually structured program.

Students who have completed a Level III high school Latin course have automatically satisfied the college graduation requirement in foreign language. This requirement may also be satisfied by completion of Lat. 211 or by demonstration of equivalent proficiency by placement test. Students who have studied Latin in high school and wish to continue with the language will be placed according to the results of their placement examinations taken during student orientation. Students may not receive credit for a course at a lower level than that into which they are placed. Questions concerning language placement should be directed to the classics department office.

GRADUATE DEGREE PROGRAMS

Master's Degree

The candidate may choose to emphasize Greek, Latin, classical antiquities, classical humanities, or the teaching of Latin.

The student choosing to emphasize Greek or Latin as a major will be required to take a qualifying examination to demonstrate proficiency in translating Greek or Latin.

The student choosing to emphasize classical antiquities or classical humanities will be required to take a qualifying examination to determine a breadth of knowledge in the general area of classical Greek and Roman culture. It is expected that the student opting for the teaching of Latin either has achieved accreditation at the secondary level or is planning to do so through the regular School of Education program. The M.A. degree alone does not satisfy the state requirements for certification.

Language Requirement. The department requires a reading knowledge of one modern language for those students emphasizing the study of Greek or Latin. A student concentrating on one of the classical languages must demonstrate competence in the other classical language appropriate for a student with two years of college Latin or Greek.

Degree Requirements. Candidates for the M.A. degree in Latin (Greek) will be required to take written comprehensive examinations in the following fields:

1. The language (translation test), literature, and history of Rome (Greece). This examination will be both comprehensive and detailed.
2. The literature and history of Greece (Rome). This examination will test the candidate's general survey knowledge of these fields.

Candidates for the M.A. Plan I (24 hours including thesis) will take an oral examination in defense of the thesis. Candidates for the M.A. Plan II (30 hours without thesis) must have departmental approval.

Candidates for the M.A. degree with emphasis upon either classical antiquities or classical humanities will be required to complete at least one graduate-level course in either Greek or Latin with a grade of *B*, will be required to take written comprehensive examinations, and must take Plan II (30 hours without thesis).

Candidates for the M.A. degree with emphasis on the teaching of Latin will take an oral comprehensive examination based on the courses taken and a reading list. Thirty hours of course work, including two Latin workshops and a Special Project, will be required.

Doctor's Degree

The candidate may choose to emphasize Greek and Latin languages and literatures or classical archaeology and history. For those selecting the languages and literatures emphasis, the following are required:

1. Excellent command of Greek and Latin languages and a knowledge of Greek and Roman history and literature.
2. A reading knowledge of two modern foreign languages; one must be German and the other is to be approved by the department.
3. Successful completion of at least four graduate seminars.
4. Comprehensive examinations. The candidate will be tested in Greek and Latin languages (translation tests) and will write examinations on a major classical author and one of the following special fields: art and archaeology, history, linguistics, mythology and religion, palaeography, or philosophy. There will be an oral examination in which the student is expected to demonstrate overall factual knowledge of the field of classics.
5. The candidate must write a Ph.D. dissertation, which is a contribution to knowledge, and complete an oral examination on the dissertation.

For those selecting the archaeology and history emphasis, the following are required:

1. Excellent command of the Latin (Greek) language and literature and satisfactory course work in the Greek (Latin) language and literature.
2. A reading knowledge of two modern foreign languages; one must be German and the other is to be approved by the department.
3. Successful completion of at least four graduate seminars.
4. Comprehensive examinations. The candidate will be tested in the Greek (Latin) language (translation tests) and will write examinations in classical archaeology, history, and on a major classical author. There will be an oral examination in which the student is expected to demonstrate his or her overall factual knowledge of the field of classics.

COMMUNICATION

Office in Hale Science Room 112
Campus Box 270

BACHELOR'S DEGREE REQUIREMENTS

The program in communication has both humanistic and social scientific concerns. Major areas of undergraduate emphasis are interpersonal and organizational communication. Students should indicate as soon as possible their desire or intent to major in communication and seek departmental advising. Freshmen and sophomores desiring to major in communication will first be classified as precommunication students. They may apply for admission to the communication major after completion of 45 hours applicable to the bachelor's degree and satisfaction of certain other requirements (available from the department.) For graduation, majors must present a minimum of 30 semester hours, including specific requirements. Only courses in which the student earns a grade of *C* or better are applicable to the major requirements. Current lists of required and suggested courses may be obtained from the departmental office. (Freshmen are not eligible for 400-level courses.)

GRADUATE DEGREE PROGRAMS

At present, admission to the graduate program in communication is suspended.

COMMUNICATION DISORDERS AND SPEECH SCIENCE (CDSS)

Communication Disorders Building
Campus Box 409
Professor Richard H. Sweetman, Chairman

BACHELOR'S DEGREE REQUIREMENTS

The Bachelor of Arts degree with a major in communication disorders and speech science provides a broad general education, develops concepts basic to human communication and normal language processes, and provides an understanding of disorders of speech, hearing, and language. This material serves as necessary background for entrance into professional training at the graduate level.

Majors must present a minimum of 35 semester hours of course work listed in the schedule below. Prior to entering the third year of study, students should have completed at least 6 semester hours of psychology and biology.

Enrollment is limited, and prospective majors must apply for assignment to an academic advisor as soon as they enter the program.

(All courses offered in Sequences A, B, and C are required for graduation with a major in communication disorders and speech science.)

SEQUENCE A (FRESHMAN OR SOPHOMORE YEAR)

Fall

EPOB 342. Introduction to Human Anatomy (Prer., EPOB 121-124) 5
CDSS 304. General Phonetics[1] 3

Spring

CDSS 305. Anatomy and Physiology of the Speech and Hearing Mechanisms[1] 4

SEQUENCE B (SOPHOMORE OR JUNIOR YEAR)

Fall

CDSS 200. Voice and Diction 3

Spring

CDSS 308. Introduction to Speech and Hearing Sciences[1] 3
CDSS 301. Speech and Language Development in Children[1] 3

SEQUENCE C (JUNIOR OR SENIOR YEAR)

Fall

CDSS 450. Speech Disorders I[1] 4
CDSS 470. Audiology I[1] 3

[1]These nine courses, plus CDSS 411, Computer Applications in Communication Sciences for 3 hours credit, plus 30 hours of credit in computer science are required for the major in CDSS and computer applications.

CDSS 469. Observation and Cotherapy[1] 1

Spring

CDSS 451. Speech Disorders II[1] 4
CDSS 471. Audiology II[1] 3
CDSS 469. Observation and Cotherapy[1,2] 1

SEQUENCE D (SENIOR YEAR)

(Courses in Sequence D are available to students who have completed Sequences A, B, and C. Sequence D is not required for a B.A. degree in communication disorders and speech science and need not be taken in its entirety.)

Fall

CDSS 370. Manual Communication I 2
Graduate-level course 2-4

Spring

CDSS 371. Manual Communication II 2
Graduate-level course 2-4

GRADUATE DEGREE PROGRAMS

The graduate curriculum in communication disorders and speech science leads to either a master's or a doctoral degree. All courses of study are planned by the student and an advisor and formalized in a degree plan. The programs in speech-language pathology and audiology are accredited by the American Speech-Language-Hearing Association (ASHA).

Prospective students should read Requirements for Advanced Degrees in the Graduate School section and request additional information from this department.

Master's Degree

The master's program in communication disorders emphasizes clinical training and experiences. The program leads to certification by ASHA and the Colorado State Department of Education in speech-language pathology and/or audiology. Students having an undergraduate degree in speech-language pathology and audiology can expect to spend two calendar years to complete the program. Those without such background are required to make up undergraduate deficiencies which normally require at least an additional year. Students not seeking clinical certification may place major emphasis on speech-hearing science.

Doctor's Degree

The doctoral program demands demonstrated expertise beyond the academic knowledge and clinical skills required for clinical certification. Supervisory, administrative, instructional, and research activities are provided to acquaint the student with problems and concepts at a higher level of activity and responsibility.

Wide latitude prevails in planning individual programs. It is expected that students will have some professional experience before entering the program, and that they will have specific academic or professional goals in mind. Student degree plans are individually prepared through the joint efforts of the student and an advisory committee.

Ph.D. candidates must take a four-course sequence in statistics and computer science in addition to the Graduate School foreign language requirement, which can be satisfied with American Sign Language.

COMMUNICATION DISORDERS CLINIC

The Communication Disorders Clinic has a two-fold purpose: it provides facilities for the training of undergraduate and graduate students, and it provides speech, language, learning and hearing evaluation and intervention services for persons of all ages in the metropolitan area. Any student of the University or any member of the community is eligible for the services offered. Fees are commensurate with other university programs in Colorado. Services include evaluations of speech and language skills, training for the improvement of communication skills, evaluation for hearing aid use, and auditory training for the hearing impaired. The Communication Disorders Clinic, as well as the office and classrooms for the Department of Communication Disorders and Speech Science, are located west of the Events/Conference Center. Address inquiries to Chairperson, Communication Disorders and Speech Science, Campus Box 409, University of Colorado, Boulder, 80309.

COMPARATIVE LITERATURE

Office in Ketchum 226
Campus Box 331
Associate Professor Edward P. Nolan, Chairperson

Although comparative literature is a graduate program, undergraduates should be aware that comparative literature may form either a primary or secondary field in a distributed studies major (see Distributed Studies Program) as well as function as a related field in individually structured majors. Any student selecting comparative literature as a field in such a major program should confer with the chairperson as early as possible.

Students wishing to pursue graduate work in comparative literature should consult the Graduate School section of this catalog.

Prerequisites. On the 400 level students may read all texts in translation; however, reading knowledge in at least one foreign language is highly recommended. On the 500 level students must be able to read in two foreign languages or obtain the consent of the instructor. Comparative literature seminars (numbered 600) are open only to those who have the necessary linguistic qualifications and literary background.

For Latin/Greek for graduate students, see Classics.

For foreign literatures in translation, see the individual foreign language departments.

GRADUATE DEGREE PROGRAMS

Students wishing to pursue graduate work in comparative literature leading to candidacy for advanced degrees should read the information provided in the Graduate School section of this catalog and the special

[1]These nine courses, plus CDSS 411, Computer Applications in Communication Sciences for 3 hours credit, plus 30 hours of credit in computer science are required for the major in CDSS and computer applications.
[2]Only one semester of CDSS 469 is required.

memoranda for the M.A. and Ph.D. degrees in this field. These memoranda are available in Ketchum 226, Box 331.

Master's Degree

Prerequisites. For those seeking the M.A. degree, the following are required:

1. Upon entrance to the program a student must have a reading, speaking, writing, and auditory ability in one foreign language and knowledge of its literature and civilization.
2. By the completion of M.A. work, a student must have acquired reading competence in a second foreign language and knowledge of its literature.

Requirements. In consultation with the graduate advisor, students will plan as the basis of their M.A. programs a set of interrelated courses, with emphasis on the two literatures for which their B.A. degrees have equipped them. Students will take a minimum of 12 hours in comparative literature (including C.L. 510 and at least one proseminar in literary theory and research methods). Reading competence in an ancient language is recommended.

Examinations and Thesis. Students should consult the memorandum available in Ketchum 226.

Doctor's Degree

Prerequisites. An M.A. degree in comparative literature, in a single literature (which may be English), with a proven capability in a second literature, or in a cognate discipline (philosophy, history, etc.). Reading competence in two foreign languages.

Requirements. Candidates for the Ph.D. degree in comparative literature must fulfill the general requirements of the Graduate School. They must take at least 30 semester hours of work at the 500 level or above in comparative literature or related courses approved by their advisory committee. Students will be responsible for one language and literature as a chronological whole (including its philology), and will take at least 18 hours of graduate work in that department. In addition students, who must have mastered two foreign languages to enter the doctoral program, must master a third to complete it. They will also be required to master the literature of those languages in their areas of specialization.

Students are, in addition, required to take one year of an ancient language. If study of an ancient language is a substantial element in a student's work and is pursued beyond one year's work, it will count as one of the student's three languages (see above).

C.L. 560 (The Art of Translation) is required for all doctoral candidates.

Comparative Literature is an administrative unit of the Center for Interdisciplinary Studies.

CONFLICT AND PEACE STUDIES

Office in Ketchum 223
Campus Box 331

The Conflict and Peace Studies Program is affiliated with the Center for Interdisciplinary Studies (Ketchum 128). The program is a multidisciplinary concentration of courses, seminars, field work, and independent study possibilities centering on the peace development process. Analysis of peace and war systems, dispute settlement techniques, social movements, future world systems, conflict analysis and regulation, and mediation and arbitration are among the areas of faculty expertise represented in the concentration. While no C.P.S. major is offered, it is possible for a student to design an Individually Structured Major with a faculty advisory committee.

Because of the intrinsically international nature of conflict and peace studies, students are encouraged to consider a program of study abroad to gain an understanding of intercultural relations. For information on study abroad, consult the Office of International Education.

The Conflict and Peace Studies Committee, composed of faculty and students from various humanities and social science disciplines, meets regularly and welcomes those interested in this area of study.

DISTRIBUTED STUDIES PROGRAM

Students working toward the B.A. degree may elect a two- or three-area major in the distributed studies program. The areas which may be used in the program are limited to those in which a departmental major for the B.A. is offered. Astrophysical, planetary and atmospheric sciences, and comparative literature are also acceptable as either primary or secondary areas.

Those students wishing to pursue a two-area major must complete 30 hours of course work in each department; 15 hours in each department must be upper division course work. Students must have a 2.0 grade point average and 30 hours of *C* grade or better, including the 15 hours of upper division course work in each department.

In a two-area major, each department must approve the student's program, and therefore either department may deny the student's proposal.

Students pursuing a three-area major must designate one area as primary and the other areas as secondary. In the primary area, 30 hours of work including 15 hours of upper division work must be completed. A grade point average of 2.0 in the primary area and 30 hours of *C* grade or better, including the 15 hours of upper division work, are required.

In the secondary areas the student must complete 15 hours in each of the departments, including 8 hours of upper division work in each department. A grade point average of 2.0 is required in each of the secondary areas, as well as 15 hours of *C* grade or better, including the 8 hours of upper division work in each department.

No first-year course in a foreign language (101-102) or English language (composition) may be used in satisfaction of the requirements of the distributed studies major.

For guidelines and application forms, consult the College of Arts and Sciences Dean's Office.

COMPUTER APPLICATIONS

A computer applications major has been set up as a part of the Distributed Studies major program. This major requires a minimum of 60 semester hours, 30 hours in computer science, and 30 hours in a participating department. Fifteen hours in each department must be upper division course work. Students must have a 2.0 grade point average and 30 hours of *C* grade or better, including the 15 hours of upper division work, in each department. A senior project is a recommended option for this major.

No first-year course in foreign language or English language (composition) may be used in satisfaction of the major requirements.

For additional information on the program, as well as a list of departments participating in the major, consult the College of Arts and Sciences Dean's Office.

ECONOMICS

Office in Economics Building, Room 212
Campus Box 256
Professor Wesley J. Yordon, Chairman

BACHELOR'S DEGREE REQUIREMENTS

Students majoring in economics must take a minimum of 38 semester hours, of which 22 semester hours must be in upper division courses and 30 must be with grades of *C* or better. The following courses are required of all economics majors: Math 107, Math 108, and Acct. 200 *or* Math 107 and Math 130; Econ. 201, 202; Econ. 381, 407, 408, 480 (with grades of *C* or better). The required mathematics courses should be taken as soon as possible because they are prerequisites for Econ. 381, 407, 408, and 480. Students who plan a career in economics should take Math 130. Required courses may not be taken on a pass/fail basis. Six semester hours of accounting may count toward the economics major.

Students may take a year of course work in one of several Study Abroad Programs (e.g., University of Reading, University of Regensburg, University of Lancaster, or University of Costa Rica). Qualified senior economics majors may enroll in the department's Honors Program in the fall of their senior year.

For all courses numbered 300 and above, the prerequisite, unless otherwise indicated, is Econ. 201 and 202 or permission of the instructor.

GRADUATE DEGREE PROGRAMS

Master's Degree

1. *Admission Requirements:* An applicant for admission as a regular degree student must:
   a. Hold a baccalaureate degree from a college or university of recognized standing, or have done work equivalent to that required for such a degree and equivalent to the degree given at this University. The undergraduate grade point average must be at least 2.75 (2.0 = *C*).
   b. Have at least 16 semester credit hours in economics.
   c. Submit Graduate Record Examination scores for Aptitude and Economics if the applicant resides in the United States. (Applicants who do not reside in the United States are urged to take the Graduate Record Examination if practicable, especially if they are applying for fellowships or scholarships, and foreign applicants for teaching assistantships are urged to take the Test of Spoken English.)
   d. Arrange for the submission of four letters of recommendation.

Students who do not meet the requirements for admission as regular degree students may be recommended for provisional degree status. Application deadlines for foreign students are April 1 for summer and fall terms and November 1 for spring term. There is no deadline for U.S. applicants; however, anyone who wishes to be considered for an assistantship should apply by February 1.

2. *Required Courses* (grade of *B* or better required in each course):
   a. Theory: Econ. 507, Applied Economic Theory, or Econ. 601 and 602.
   b. Quantitative Methods: Econ. 581, Introduction to Econometrics, or Econ. 681, General Economic Statistics.

The graduate advisor may permit substitutions of courses taken outside the department for the required courses if, in his judgement, at least the same body of material was covered at an equivalent level; except that when such substitution is for Econ. 507 and/or 581, the student must take and pass the 507 and/or 581 final examination(s) with grade of *B* or better to effect the substitution. A course syllabus will be prepared for each of the required courses to provide a basis for materials to be covered wherever and whenever these courses are offered and for making up the final examinations in these courses.

M.A. candidates are required to attempt the courses or examinations in theory and quantitative methods within two academic years and be passed within two and one-half academic years from the date that they enrolled in the graduate program. Passing the Ph.D. preliminary examinations in theory, quantitative methods, and history of thought also satisfies this M.A. requirement.

For any student entering the Ph.D. program from the master's program, the preliminary examinations for the Ph.D. must be attempted within three academic years and passed within three and one-half years from the date the student enrolled in the graduate program. The Graduate Review Committee is empowered to make exceptions for regular and provisional students in M.A. and Ph.D. programs.

3. *Credit Hours:*
   Plan I
   a. Minimum of 24 semester hours of graduate work, including a thesis to count for 4 semester hours;
   b. Minimum of 12 semester hours, exclusive of thesis, in courses at the 600 level or above;
   c. A *B* or better average in all work presented for the degree.

Plan II

a. Minimum of 30 semester hours of graduate work;
b. Minimum of 15 semester hours in courses at the 600 level or above.
c. A *B* or better average in all work presented for the degree.
d. No thesis requirement.

4. *Examinations:*

a. Comprehensive-Final Examination: Each candidate for a master's degree is required to take a comprehensive-final examination after the other requirements for the degree have been completed. This examination may be given near the end of the candidate's last semester of residence while he is still taking courses, provided that he is making satisfactory progress.

(1) Plan I candidates must take an oral examination covering the thesis and other work presented for the degree. (See Rules of the Graduate School for details concerning coverage of work not done in formal courses and seminars in economics.)

(2) Plan II candidates will be examined in two fields. (Ph.D. comprehensive examinations are acceptable substitutes.) In each of the fields the candidate must have had a minimum of 6 semester hours of course credit, of which at least 3 semester hours must be at the 600 level or above. One of the fields may be individually structured to meet a particular need provided the candidate's plan is approved by the student's advisor and the campus departmental graduate advisor. An individually structured field may be based wholly or partly upon the candidate's work in an Economics Internship (Econ. 698). If a field is based wholly on an economics internship the examination for that field may be oral, written, or both, at the option of the examining committee. Otherwise, the examination in each field consists of a three-hour written examination. Candidates ordinarily present two fields based on regular course work in economics at the University of Colorado; deviations from this are limited to *one* of the following options:

(i) One of the fields may be outside the discipline of economics *or*
(ii) Course credits for one field may be transferred from another university *or*
(iii) One of the fields may be based wholly or partly upon an economics internship.

4. *Other Requirements:* M.A. requirements regarding (1) transfer of credits, (2) residence, (3) time limitations, (4) thesis, and (5) admission to candidacy, are stated in the Graduate School section of this catalog.

5. *Special Program in International Economic Development:* Students participating in the special program in International Economic Development must meet the general requirements for the Master of Arts degree specified above. In addition, the following course and examination requirements must be satisfied for a master's degree with a double field of specialization in development:

a. Completion of at least 6 hours in general economic development (Econ. 577, 578 and 677).
b. Completion of at least 9 hours from at least two of the following allied fields:

Agricultural and rural economics
Resources and environment
International trade and finance
Comparative economics
Other field studies approved by the Development Program Committee

c. In place of the two separate field examinations, successful completion of a two-part comprehensive examination covering material from sections (a) and (b) above. The examining committee will consist of one faculty member representing the field of general economic development and two from the allied fields.

Students electing to combine a single field of specialization in development with a second separate field of specialization will complete a minimum of 9 hours of course work from sections a and b, including Econ. 577 or 677 to meet the course requirements for a single field in development. The comprehensive examination in development will be administered by at least one faculty member from general development and at least one from the allied fields.

Doctor's Degree

1. *Admissions:* An applicant for admission as a regular degree student must:

a. Hold a baccalaureate degree from a college or university of recognized standing, or have done work equivalent to that required for such a degree and equivalent to the degree given at this University. For those applicants who do not have a master's degree in economics, the undergraduate grade point average must be at least 2.75 (2.0 = *C*).
b. Have completed intermediate micro and macro economic theory courses, introductory calculus, and introductory statistics.
c. Submit Graduate Record Examination scores for Aptitude and Economics if the applicant resides in the United States. (Applicants who do not reside in the United States are urged to take the Graduate Record Examination if practicable, especially if they are applying for fellowships or scholarships, and foreign applicants for teaching assistantships are urged to take the Test of Spoken English.)
d. Arrange for the submission of four letters of recommendation.

It is not necessary to have an M.A. degree to be admitted to the Ph.D. program; qualified applicants may be admitted directly to the Ph.D. program and may obtain the M.A. degree while working toward the Ph.D. Application deadlines for foreign students are April 1 for summer and fall terms and November 1 for spring term. There is no deadline for U.S. applicants; however,

anyone who wishes to be considered for an assistantship should apply by February 1.

2. *Course Requirements:*
   a. Core courses in microeconomic theory (601, 603), macroeconomic theory (602, 604), history of economic thought (600), and economic statistics (681) must be completed with a grade of *B* or better. Transferred courses must be approved, except for courses from UC-Denver, which are automatically approved. At least one-half of the core requirements must be filled on the Boulder Campus.
   b. After entry into the Ph.D. program, all remaining core requirements must be taken on the Boulder Campus.
   c. Not more than 12 hours of credit (exclusive of dissertation credit) from a single faculty member may be counted toward Ph.D. requirements.
   d. Students must apply to the curriculum committee in order to take independent study in the Ph.D. program. Not more than 3 hours of independent study taken from a single faculty member may be counted toward a degree. Not more than 3 hours of independent study may be counted toward field course requirements. Independent study to count toward a field course requirement must be approved by the curriculum committee in advance. Not more than 6 hours of independent study may be counted toward the Ph.D. requirements.
   e. Prior to admission to candidacy, a minimum of 12 hours of course work must be completed per 12 months by all full-time students in the Ph.D. program. Students who plan to register for fewer than 12 hours must obtain permission for part-time status from the graduate advisor.
3. *Preliminary Examinations:*
   a. The student must pass written preliminary examinations covering microeconomic theory, macroeconomic theory, history of economic thought, and statistics. Microeconomic theory and macroeconomic theory preliminary examinations must be taken in one examination period.
   b. Preliminary examinations are given regularly in August and January.
   c. Normally students will be expected to attempt at least part of the preliminary examinations by the beginning of the second year.
   d. An examination attempted and failed must be taken again and passed in the next examination period.
   e. Students must pass all preliminary examinations within two and one half years of beginning the Ph.D. program.
   f. The graduate advisor is empowered to make scheduling exceptions for part-time students in the Ph.D. program.
4. *Comprehensive Examinations:*
   a. The student must pass a written and oral comprehensive examination in each of two or three fields of specialization (see g.).
   b. These examinations must be attempted within four years of entry into the Ph.D. program.
   c. These examinations cannot be attempted before satisfying field course requirements with a grade of *B* or better and the foreign language requirements (See i.). Field course work may be taken at any University of Colorado campus. Comprehensive examinations (written and oral) may be taken and completed before satisfying the University foreign language requirement following a successful petition to the associate dean of the Graduate School for an exception. Admission to candidacy will not be granted, however, until after the language requirement has been satisfied.
   d. Comprehensive examinations are given regularly in August and January. In case of failure, in one or more fields, the unsatisfactory examination may be attempted once more during a regularly scheduled comprehensive examination.
   e. A minimum of 6 semester hours of course work at the 600 level or above is required in each field of specialization.
   f. In lieu of one of the standard fields the student may offer a combination field when the material in certain courses spans two or more areas or when courses from different areas are complementary in meeting the specialization objectives of the student. Courses may be included from outside the Economics Department on approval of the Curriculum Committee. The student offering a special field is responsible for obtaining the written agreement of at least two faculty members who will be involved in evaluating the student's competence in the field.
   g. Students who present two fields for comprehensive examinations must complete (in lieu of a third field) four elective courses with a grade of *B* or better; these courses must include courses from at least two fields other than the two presented for comprehensive examinations and must include at least two formal economics courses at the 600 level at any campus of the University of Colorado. (The term "formal course" as used here includes seminars but excludes independent study.)
   h. Doctoral students electing a field of specialization in economic development are required to complete a minimum of 9 credit hours of course work at the 600 level or above, selected from the areas of general economic development and the following allied fields:

      Agricultural and rural economics
      Resources and environment
      International trade and finance
      Comparative economics
      Other field studies approved by the Development Committee.
      Econ. 677 must be taken as part of the required 9 hours. The examining committee in development shall consist of one faculty member from the general development field and two from the allied fields.

   i. The students must satisfy the Graduate School's foreign language requirement. Students whose

native language is English must demonstrate at least second-year college proficiency in a foreign language of their choice; students whose native language is not English will demonstrate sufficient ability in English to meet the requirement if they pass their courses and complete their graduate work.

5. Students are not formally admitted to candidacy for the Ph.D. degree until they have completed the above requirements and have earned four semesters of residency. After admission to candidacy they must register each fall and spring semester for dissertation (Econ. 800) until attaining the degree; the accumulated credit for thesis must total at *least 30 semester hours* to attain the degree. The minimum residence requirement for the Ph.D. degree is six semesters of scholarly work beyond the bachelor's degree.

6. After the dissertation has been accepted, the student must pass a final examination of the dissertation and related topics. If a student fails to complete all requirements for the degree within four years of the date on which the comprehensive examination was passed, a second comprehensive examination similar to the first will be required before the candidate may take the final examination.

ENGINEERING

The following courses offered in the College of Engineering and Applied Science are accepted for College of Arts and Sciences credit (see College of Engineering in Course Description section).

Engr. 109-3. Creative Uses of Technology I
Engr. 110-3. Creative Uses of Technology II

ENGLISH

Office in Hellems Building, Room 101
Campus Box 226
Professor Lesley W. Brill, Chairman

BACHELOR'S DEGREE REQUIREMENTS

Expository Writing Program

Expository writing courses are now offered by the Arts and Sciences College Expository Writing Program (CEWP). See listings under Arts and Sciences.

Students Who Contemplate Teaching

Sheets listing curriculum required for a teaching certificate for secondary schools may be obtained in room 247, Education Building. Students should consult Mrs. Cline, Mr. Olson, or Mr. Di Stefano, who supervise the English education program. Since requirements for education and English make a very tight schedule, students should seek early advising to complete their college requirements.

Departmental Honors

Students interested in pursuing a special program leading to graduation with departmental honors should confer with the director of undergraduate studies as soon as possible, but definitely no later than the beginning of spring term in their junior year.

Students Majoring in English

Expository writing courses (freshman composition) do not apply toward the major. English courses taken *P/F* will not fulfill major requirements. Transfer students must take a minimum of 18 hours in English at the University of Colorado and must have English courses taken at other colleges evaluated by the English Department. Courses taken in other departments will not count in the English major.

Program I. A minimum of 36 credit hours, divided as follows, is required for a major in the Department of English:

Lower Division (100- and 200- Level Courses)
Engl. 200. Writing about Literature—3 credit hours
Upper Division (300- and 400-Level Courses)

1. One 3-credit-hour course in each of the following:
   a. Major Author (Chaucer, Shakespeare, Milton)
   b. English Literature Before 1800 (Engl. 350, 450, 451, 452, 453, 454, 455)
   c. English Literature after 1800 (Engl. 351, 422, 434, 446, 456, 457, 460, 461)
   d. American Literature (Engl. 365, 366, 465, 466)
   e. New Directions (Engl. 385-387)
   f. Senior Seminar (Engl. 490-498)
2. Nine credit hours in concentration courses: courses in one area, period, topic, or author. The director of Undergraduate Studies in English has on file faculty recommendations for course combinations to fulfill this requirement and will approve appropriate combinations proposed by students. Some of the credits for the Concentration Courses will coincide with the specific category requirements listed in *a*.

Note: In order for upper division courses in English to count as a year of the Arts and Sciences Humanities requirement, a lower division sequence in English is required. See College List for particulars. Engl. 260-261 is strongly recommended.

Program II: The Creative Writing Program. The Creative Writing Program requires a minimum of 36 hours in English: 18 hours of creative writing courses, 9 of which must be upper division writing workshops; and 18 hours of English and American literature, 9 of which must be upper division courses (300-level or above). Admission to the program is not automatic, although all courses are open to all students whether or not they are majors. Students who have reached second-semester sophomore standing and have taken at least 6 hours of writing courses can be considered for admission. Students must have an advocate-advisor (a Creative Writing faculty member with whom they have studied) and must submit a manuscript of 10-12 pages for faculty approval. Transfer students must take at least 3 hours of writing with the program before being considered for admission, no matter how many courses they have taken previously. A student must be accepted formally into the major before the last semester of the senior year. The student should apply by the second semester of the junior year at the latest or be prepared to complete the English major in Program I.

Undergraduate English Awards and Prizes

The Katherine Lamont Scholarship. The Lamont scholarship is a $300 annual award to a continuing English major in recognition of sustained excellence and exceptional scholarly performance in the major. Applications are made through the University's Office of Financial Aid by March 1.

The Harold D. Kelling Essay Prize. The Kelling Prize is a $100 cash award for the best essay on literature submitted by an undergraduate currently enrolled in the University. The essay must have been written for an English class and should be submitted to the English Department before April 15.

GRADUATE DEGREE PROGRAMS

Comprehensive examinations for both the M.A. and the Ph.D. will be given each semester. Graduate students planning to take any departmental examination must state their intention to the secretary of the director of the graduate studies no later than the end of the third week of any given semester.

Admission Requirements

Master's Degree in English Literature. Satisfactory scores on verbal and advanced literature parts of the GRE, plus at least 24 semester hours in English (exclusive of composition, creative writing, and speech). These hours should include the equivalent of a survey of English literature. Sixteen of the 24 hours must be in upper division courses.

Master's Degree in English With Emphasis in Creative Writing. Candidates seeking this degree must meet all of the above-listed minimum admission requirements. In addition, each student must submit a manuscript of at least 10 pages of poetry or a minimum of 25 pages of fiction for evaluation. The candidate must meet the additional requirements specified in the brochure, *Master of Arts Degree in English With Emphasis in Creative Writing,* issued by the department.

Doctor's Degree. Satisfactory scores on verbal and advanced literature parts of the GRE; either an M.A. degree in English or at least 30 hours of postgraduate English course work beyond the B.A. degree. Entering graduate students with no degree beyond the B.A. will normally be admitted to the M.A. program. They may later petition for admission to the Ph.D. program.

Degree Requirements

Students wishing to pursue graduate work in English should note Requirements for Advanced Degrees in the Graduate School section of this catalog and should write the department for a fuller description of the graduate programs in English.

ENVIRONMENTAL CONSERVATION

Office in Guggenheim Building, Room 110
Campus Box 260

The environmental conservation (EC) major is a program administered by the Department of Geography, which receives program advice from representatives of the Departments of Economics and EPO Biology.

Environmental conservation, although similar to majors in environmental studies elsewhere, stresses conservation, i.e., a reasoned use of the natural environment so that utilization does not impair the environment's capacity for self-renewal. The major combines the study of technique and philosophy, natural and social science, with course options from 10 areas: biology, computer science, economics, English, geography, geology, physics, political science, quantitative methods, and sociology.

To complement the curriculum, the Geography Department offers environmental conservation majors internship opportunities, in which students earn academic credit in Geog. 499, Internship, while working in selected positions with private and public agencies and firms.

Students should consult with the secretary in Guggenheim 110 for further information.

BACHELOR'S DEGREE REQUIREMENTS

1. Satisfaction of the regular degree requirements for the College of Arts and Sciences.
2. A total of 46 to 50 hours distributed as follows: 31 to 33 hours of required courses, 6 to 7 hours selected from the skills courses, and 9 hours from the elective courses group.
3. Each course applied to the major requires a minimum grade of *C*.
4. Courses taken on a pass/fail basis may not be applied toward the major.
5. A double major of environmental conservation and geography is not permissible.
6. All transfer credit toward the environmental conservation major must be evaluated. As of fall 1982, transfer credit will only be accepted for one of the two required courses in the Geog. 339, 341, 342 sequence.

	Semester Hours
Required Courses (31-33 hours from the following)	
Econ. 201. Principles of Macro economics	4
Econ. 202. Principles of Micro economics	4
EPOB 121/123. General Biology I (with laboratory)	4
EPOB 122/124. General Biology II (with laboratory)	4
EPOB 302. Principles of Ecology	3
Geog. 100. Environmental Systems-Climate and Vegetation	4
Geog. 101. Environmental Systems-Landforms and Soils	4
Geog. 339. Conservation of Natural Resources	3
Geog. 341. Conservation Practice and Resource Management	3
Geog. 342. Conservation Thought	3
(Select two of three: Geog. 339, 341, 342)	
Skills Courses (6-7 hours)	
(*Required:* one computer science course and one other course from the following:)	
Econ. 480. Introduction to Mathematical Economics	3
Engl. 315. Report Writing	3
EPOB 352. Flowering Plants Systems	4
EPOB 409. Biometry	4
Geog. 305. Cartography I	3
Geog. 306. Maps and Mapping	3
Geog. 401. Introduction to Quantitative Methods in Human Geography	3

Geog. 402/Geol. 477. Statistics for Earth Sciences	3
Geog. 406. Geographic Interpretation of Aerial Photos	3
Geog. 409. Remote Sensing of the Environment	3
Geog. 417. Research Seminar	3
Q.M. Any introductory statistics course	3

Elective Courses (9 hours; select any courses from this group)

Econ. 353. Natural Resource Economics (for nonmajors)	3
Econ. 354. Environmental Economics (for nonmajors)	3
Econ. 453. Natural Resource Economics	3
Econ. 454. Environmental Economics	3
EPOB 317. Arctic and Alpine Ecology	3
EPOB 361. Insect Biology (with laboratory)	4
EPOB 403. Limnology	3
EPOB 410-414. Advanced Ecology	3
EPOB 475. Ornithology	3
EPOB 476. Mammalogy (with laboratory)	4
Geog. 325. Mountain Geography	3
Geog. 332. Geoecology of Alpine and Arctic Regions	3
Geog. 435. Biogeography	3
Geog. 437. Forest Geography: Principles and Dynamics	4
Geog. 438. Forest Geography Laboratory	4
Geog. 443. Seminar: Conservation Trends	3
Geog. 450. Water Resources and Water Management of Western United States	3
Geog. 451. Surface Hydrology	3
Geog. 473. Population Geography	3
Geog. 474. Environments and Peoples	3
Geog. 499. Internship	3
Phys. 207. Energy in a Technical Society	3
Phys. 208. The Physics of Contemporary Social Problems	3
P.Sc. 435. The Environment and Public Policy	3
Soc. 220. Introduction to Demography and Human Ecology: The Sociology of Survival	3

EXPERIMENTAL STUDIES (CENTER FOR INTERDISCIPLINARY STUDIES)

Office in Ketchum 226
Campus Box 331

The mission of experimental studies is to foster innovation. Experimental studies courses allow faculty and other experts to present students with novel subject matter, new combinations of ideas, or new approaches to old combinations of subject matter. Experimental studies courses are taught for elective credit and are meant to add diversity to a student's general education. They may not be counted toward the fulfillment of area requirements or towards a major, with the exception of some individually structured majors. Experimental studies courses are not taught more than twice consecutively; hence, there is an ever-changing list of innovative subject matter available through this program.

For lists of courses and for information and guidelines about proposing an experimental studies course, contact the Experimental Studies Office.

FILM STUDIES

Office in Hunter Building, Room 102
Campus Box 316

Photography and cinematography are attracting increasing interest as media of communication and artistic expression. Various departments of the college offer courses dealing wholly or to a significant degree with film as an art form, film history, film in contemporary society, and the art of still photography. Frequent showings of important films are presented on campus for educational purposes by the International Film Series and the Avant-Garde Cinema program.

Students who are interested in the study of film should consult the Film Studies listing in the current *Schedule of Courses* and its supplement issue each semester.

Information on the Study Abroad Program, Inter-University Center for Critical and Film Studies in Paris, may be obtained at the Office of International Education (303) 492-7741.

The Arts and Sciences Committee on Film Study hopes to offer a bachelor's degree program in the near future. Interested students are advised to check with the Film Studies office, extension 1531, for information on the possibilities of a degree in film studies.

FINE ARTS

Office in Sibell-Wolle Fine Arts Building, Room N196A
Campus Box 318
Professor Jerry W. Kunkel, Chairman
Associate Professor Anne C. Currier, Associate Chairperson

Majors are available for the B.A. and B.F.A. degrees in art education, art history, and studio arts. Students are encouraged to consult with an undergraduate advisor in the appropriate area in order to obtain advice and current information.

BACHELOR OF ARTS DEGREE REQUIREMENTS

General Requirements

1. Candidates for either the B.A. and/or B.F.A. degrees must satisfy the general college requirements.
2. Fine Arts majors may not count any fine arts courses taken above the 200 level on a *pass/fail* basis toward fulfillment of the *minimum* requirements of the major.
3. Not more than 8 hours of independent study may be credited toward the *minimum* requirements of the major.
4. Transfer students who are B.A./B.F.A. candidates must complete a minimum of 9-15 hours of fine arts course work while attending the University. (Transfers must have an evaluation completed of all fine arts credit by a fine arts transfer advisor as soon as possible).
5. Students must arrange for a graduation packet (S.M.S.) during the penultimate semester.

Major Requirements

ART EDUCATION: 41-45 SEMESTER HOURS IN THE MAJOR

Required Courses	*Semester Hours*
Any two of the lower division art history 280 series	6
Any two of the upper division art history 400 series	6
F.A. 100 or 101. Basic Drawing	2 or 3
F.A. 120 or 121. Basic Painting	2 or 3
F.A. 150 or 151. Basic Sculpture	2 or 3
F.A. 216. Beginning Photo I	3
F.A. 287 or 289 First Year Handbuilding or Wheelthrowing	3
F.A. 377. Jewelry Design	3
F.A. 364. Art in the Elementary Schools	2

F.A. 366. Art Materials Workshop 2
F.A. 367. Art Materials Workshop: Weaving 2
F.A. 368. Art in the Secondary Schools 2
F.A. 369. Practicum in Art Teaching 1-2
Studio concentration (consult department for combinations) 6-9
Teacher Education Program (see School of Education for specific requirements) 28

ART HISTORY: 34-45 SEMESTER HOURS IN THE MAJOR

Required Courses	*Semester Hours*
Any two of the following: F.A. 100 or 101, F.A. 120 or 121, F.A. 150 or 151	4-6
Any four lower division art history (280 series)	12
Any six upper division art history	18

STUDIO ARTS: 33-45 SEMESTER HOURS IN THE MAJOR

Required Courses	*Semester Hours*
F.A. 100 or 101. Basic Drawing	2 or 3
F.A. 120 or 121. Basic Painting	2 or 3
F.A. 150 or 151. Basic Sculpture	2 or 3
Any three lower division art history (280 series)	9
Any two upper division art history	6
Upper division F.A./F.A.H. elective (minimum)	12

BACHELOR OF FINE ARTS DEGREE REQUIREMENTS

Note: The B.F.A. is considered to be a professional degree.

1. Students in art history must complete the minimum B.A. requirements for the area plus additional F.A./F.A.H. electives to total 50-67 hours in the major.

2. Students majoring in art education or studio arts must complete the minimum B.A. requirements, including the completion of 3-hour basics (F.A. 101, 121, and 151) rather than 2-hour basics (F.A. 100, 120, and 150). If 2-hour courses have been completed prior to fall 1982, students will be required to complete one additional 200-level course.

In addition to the above, studio majors must complete F.A. 104 (Basic Art Lecture) plus two lower division art history surveys (F.A.H. 280s) rather than three lower division art history surveys.

3. B.F.A. candidates must complete the minimum 50 semester hours required prior to the beginning of their senior year.

4. Students are required to complete three studio courses outside their major area of studio concentration.

5. Students are required to take a senior seminar, which could be one of the courses required in number 4. The emphasis in this course would be the development of a professional portfolio and work for an exhibition. It is recommended that this course be taken in the student's first semester of the senior year.

6. Students will be required to exhibit at least one work in a B.F.A. group exhibition during their senior year.

Honors

Students may graduate with departmental or general honors. Those interested in pursuing this program should contact the Honors Department or Dr. Ronald M. Bernier, Fine Arts Department Honors Representative, as early as possible.

Special Programs

Art History Program in Italy. Art history faculty annually conduct this program which offers 6 semester hours of credit during a six-week term. Course offerings, which vary each year, include Ancient Etruscan and Roman Art; Late Medieval and Early Renaissance Art; the Later Quattrocento and the High Renaissance; and the Later Renaissance and Mannerism. Centered in Florence, the course includes numerous visits to other Italian towns and cities.

Inquiries may be directed to the Office of International Education or to the Department.

Other programs, such as Art History in India, are arranged by the department in conjunction with the Office of International Education.

Exhibitions Program. The department organizes exhibitions from its own collections and from those of artists, museums, collectors, and galleries throughout the country. The exhibitions are shown in the Eve Drewelowe Gallery and the other two University of Colorado Art Galleries, which are all located in the Sibell-Wolle Fine Arts Building.

Visiting Artist Program. Artists of national and international reputation interact with graduate and advanced graduate students and discuss their studio work at seminar meetings. Artists present a public lecture during their visit, providing continuous input of significant developments and a comprehensive view of contemporary issues in the arts.

Slide Collection. An extensive collection of slides representing art from prehistoric to modern times is maintained by the Department of Fine Arts. This collection is especially strong in the areas of African, Asian, European, Islamic, Medieval, North American, Oceanic, and Pre-Columbian art.

Permanent Collection. The department has an extensive collection of old master, modern, and contemporary prints; drawings; paintings; sculpture; and photographs. Art history graduate students use this collection for research; faculty use it for instructional purposes.

Thesis Collection. A collection of work donated by M.F.A. candidates from the thesis exhibition is also owned by the department.

Special Note: Students must be aware that work left in studios and/or exhibited in the Sibell-Wolle Fine Arts Building is at their own risk so far as loss or damage is concerned.

GRADUATE DEGREE PROGRAMS

Master of Arts Degree (Art Education)

Prerequisites. The following are required for admission to regular graduate status:

1. The baccalaureate degree in art or art education from an approved college or school of art and valid certification for teaching art (see 3 below).

2. At least 30 semester hours of acceptable work in art, including some background in the history of art.

3. It is preferred that teaching experience precede the beginning of graduate study, but experience may be obtained during the period in which one is studying for

the master's degree. A teacher certification program may also be pursued concurrently with the master's program with the approval of the art education faculty.

4. Submission of slide portfolio (minimum of ten examples) representing creative work.

5. Review of undergraduate scholastic achievement.

Plan I (With Thesis) Course Requirements

Minimum of two semesters of acceptable graduate work (24 hrs.) beyond the bachelor's degree, consisting of:

1. *Minimum* of 3 hours in F.A. 564 (Seminar in Art Education) and 3 hours in F.A. 568 (Current Issues in Art Education), or equivalent in approved Independent Study. *Note:* Students are expected to enroll in F.A. 564 *each time* it is offered unless the advisor approves a change.

2. Specified course work (14 hours) in fine arts, of which 6 hours may be devoted to a minor in an academic area outside the Fine Arts Department, as approved by the art education faculty.

3. Master's thesis (F.A. 700) totaling 4 hours.

4. The final examination will be oral and must be scheduled during the semester in which the student expects to graduate; this oral examination will deal primarily with the thesis.

Plan II (Without Thesis) Course Requirements

Students must receive written approval for this program and will complete a minimum of 6 hours of course work beyond the requirements for Plan I in lieu of the thesis enrollment. A nonthesis project will only be approved if the student can satisfactorily show the research project cannot be appropriately reported in regular thesis form.

A written comprehensive final examination of approximately three hours in the field of art education and general theory of art must be taken not more than one semester in advance of the graduation date.

Master of Arts Degree (Art History)

Prerequisites. The following are required for graduate work:

1. A baccalaureate degree from an approved college with a minimum cumulative grade point average of at least 3.0.

2. A satisfactory score in the Graduate Record Examination.

3. A broad general background in history, literature, and philosophy.

4. Two semesters (minimum) of art history surveys or equivalent.

Examinations. The *qualifying examination,* covering western art history at the elementary level in the student's intended area of specialization, will be given within two months of acceptance into the program. If necessary, additional course requirements beyond the minimum may be required based on the results. If the examination is clearly inadequate, a second examination will be required at a later date. If the results of the second examination are unsatisfactory, the student will be dropped from the program.

The *final examination,* approximately six hours in length, will be given to all candidates.

Plan I (With Thesis) Course Requirements

1. Three semesters of acceptable graduate work (minimum of 30 credits) spent in residence. Summer residence alone is unacceptable.
   a. F.A.H. 649, *Tools of Research,* 4 hours, must be completed during the first semester.
   b. Minimum of 15 hours (500-level) in the field of art history, of which 6 hours must be in seminar course work.
   c. Minimum of 6 hours in a minor field or fields to be determined by the needs of the student for thesis preparation.
   d. F.A.H. 700, *Master's Thesis,* 4 hours.

2. Thesis: see thesis requirements under Master of Arts and Master of Science in the Graduate School section of this catalog.

3. After acceptance of the final draft of the thesis, an oral examination will take place dealing with the subject matter of the thesis and any areas of weakness which may have been found in the written comprehensive.

Plan II (Without Thesis) Course Requirements

Students must complete a minimum of 3 hours of course work beyond the requirements for Plan I in lieu of thesis enrollment.

A nonthesis project (3 hours) must also be completed. This major study project (F.A.H. 950) must be approved by the entire art history faculty.

Master of Fine Arts Degree (Creative Arts)

Prerequisites. The following are required for admission to graduate study:

1. Bachelor's degree from an approved college or school of art.

2. Minimum of 34 semester hours of acceptable work in art, of which 12 credits must be in fine arts history.

3. Submission of slide portfolio (must include 20 examples) representing creative work.

4. Change in area of concentration: students who, after admission, wish to change, must reapply to the department.

5. *Exception:* students who have not fulfilled the aforementioned entrance requirements may, on recommendation of the department, be granted provisional status.

Course Requirements

1. Minimum of four semesters (54 hours, of which 38 must be taken in residence on the Boulder Campus) of acceptable graduate work beyond a bachelor's degree consisting of:
   a. Fourteen hours in nonstudio areas, of which 6 hours must be in art history, or a combination of F.A. 503 (Art of the Last Decade) plus one art history course. The remaining 8 hours may be taken in art history, criticism, art seminars, and/or art education. Nonstudio hours com-

pleted *outside* the department may be taken at the 400 level.

b. Thirty-four hours in studio art, of which a minimum of 12 must be completed in the area (painting, drawing, sculpture, etc.) in which the student was accepted.

c. F.A. 750 (M.F.A. Creative Thesis), 6 hours.

2. F.A./F.A.H. course work must be completed at the 500 level.

3. *Photography* students must enroll in F.A. 519 (Graduate Photography) each semester, with the exception of the thesis semester.

4. *Printmaking* students are required to complete a 60-hour program. Course requirements must be completed during the first two years; the final year is devoted exclusively to the creative thesis.

5. *Integrated Media Arts* students should submit portfolios of creative work to include slides, video and/or audio tapes, film, etc, as appropriate (especially for documentation of performance and/or installations) for screening by the Integrated Media Arts Committee for presentation to the full graduate faculty. Students should not send original work.

Course requirements are those established by the Graduate Committee and graduate faculty at large. The requirement that 12 hours of graduate work in studio be taken in the area of admission shall be met as approved by the advisor assigned by the Graduate Committee. Suggested courses that presently exist in the Fine Arts Department graduate program include:

a. F.A. 591. Special Topics
b. F.A. 592. Special Topics
c. F.A. 590. Video
d. F.A. 518. New Directions in Photography (subject matter varies each semester)
e. F.A. 550. Graduate Sculpture
f. Any graduate-level studio course currently listed may be used to meet the 12-hour requirement upon the approval of the advisor. It is anticipated that other courses will be added to the suggested list as this track develops. Courses outside the Department of Fine Arts in the College of Arts and Sciences may be petitioned to meet the 12-hour requirement as approved by the advisor and the Graduate Committee.

The nature of this program suggests that a student seek broad and varied course work throughout the University. Any regular, special, or independent study course in any department, institute, center, or other special unit can be presented to the advisor, with supporting rationale, as good and reasonable for study for this program (presented to the I.M.A. Committee for corrections, additions, deletions, etc.).

Year-End Review. After completing 18 semester hours of work, students must make application for a year-end review. The review is mandatory when 24 semester hours will have been completed by the end of the semester in which the review takes place. Hours in excess of 24 accumulated before the end of the semester in which the review occurs will not be counted towards the degree. No student will be allowed to continue in the program who has accumulated more than 40 hours without a year-end review. The year-end review must take place at least one year prior to the thesis show.

On the basis of this review the committee will determine whether the student may continue in the program, and will identify specific requirements for further work in both studio and nonstudio course work.

Printmaking students will be reviewed when they have completed 30 semester hours. At that time the student may petition to be allowed to complete the program in two years.

Transfer of Credit. Procedures for transferring credit from other graduate programs are governed by the regulations of the Graduate School. Credit, not to exceed 16 semester hours, must first be approved by faculty in the student's major area.

Graduation. Prior to registration for Thesis 750 (M.F.A.) or Thesis 700 (M.A.), the student must meet with the thesis committee and obtain written permission to register.

1. M.F.A. thesis work must take the form of original creative work of acceptable professional standards.

2. In conjunction with the thesis exhibition will be an oral comprehensive examination and the candidate will provide a critical written statement concerning the work.

3. Upon the successful completion of the oral examination, the candidate's written statement plus 10-15 slides (representing work in the exhibition) is to be filed with the Fine Arts Department. The written statement must conform to departmental requirements. The slides become part of the slide collection which is housed in the Department of Fine Arts.

4. The committee may request a contribution of original work.

FRENCH AND ITALIAN

Office in Hellems Building, Room 290
Campus Box 238
Professor Jacques Barchilon, Chairman
Professor Louis Tenenbaum, Director, Italian Section

French

Students who have completed a Level III high school French course have automatically satisfied the college graduation requirement in foreign language. This requirement may also be satisfied by completion of Fr. 201 or 211 or by demonstration of equivalent proficiency by placement test. Students who have studied French in high school and who wish to continue with the language will be placed according to their high school record and verbal SAT and/or ACT scores. Students normally may not receive credit for a course at a lower level than that into which they are placed. Exceptions are determined through consultation with the department.

BACHELOR'S DEGREE REQUIREMENTS

Students majoring in French must complete 35 hours beyond the first year with a 2.0 average or better. Students presenting four years of high school French for admission must complete 30 hours beyond the second year. Required courses are Fr. 202 or 212, if applicable, 301-302, 305 and 306 or upon consultation, 311-312, 401-402, plus 9 hours of literature/civilization or linguistics courses at the 400 level. A major in business

French is also available (see departmental guidelines). Courses at the 400 level are closed to freshmen.

Students majoring in French may not take any of their major requirements *pass/fail.*

For students interested in study abroad, the University of Colorado offers a year-long study abroad program at the University of Bordeaux, a semester or year-long program in Rennes, France, and a semester program in Chambéry for near-beginners. Further information is available from the Office of International Education. The Ayer Romance Language Scholarship is available for majors through the department for application toward study abroad programs. The Lamont Scholarship is awarded to a major in alternate years.

GRADUATE DEGREE PROGRAMS

Students wishing to pursue graduate work in French leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section of this catalog. A graduate teaching exchange is available to students who have earned a master's degree. The Lamont Scholarship is awarded to a graduate student in alternate years.

Master's Degree

Prerequisites. The following are prerequisite to graduate study in French:

1. A reading, speaking, writing, and auditory comprehension ability in French (all candidates must have a reading knowledge of one foreign language in addition to the major language).
2. A general knowledge of French literature and civilization.

Prerequisites for a Minor in a Foreign Language. Two years of college work or the equivalent, a course in conversation, and some knowledge of the literature and civilization of the country or countries concerned.

Required Courses. The department allows students to specialize in literature, in linguistics, or in teaching. Each of these tracks differs somewhat from the others in its requirements. See the department's guidelines for M.A. candidates.

Examinations. Graduate Record Examination required for admission; final examination (conducted partly in French) on the areas covered in the student's program (see M.A. and M.A.T. guidelines and reading lists).

Doctor's Degree

Prerequisites. Excellence in reading, speaking, writing, and auditory comprehension in French; a general knowledge of French literature and civilization. Reading knowledge of two other foreign languages.

Required Courses. The department allows students to specialize in literature or in linguistics. Each track differs from the other in its requirements. See the department's guidelines for Ph.D. candidates.

Language Requirement. A reading knowledge of a modern foreign language other than that used for the Graduate School communication requirement, except if the same language is studied through 400-level courses offered by the appropriate department. This language may be one of the following: German, Spanish, Italian, Russian; other languages will be considered depending upon the student's area of research.

Italian

Students who have completed a Level III high school Italian course have automatically satisfied the college graduation requirement in foreign language. This requirement may also be satisfied by completion of Ital. 211, or by demonstration of equivalent proficiency. Students who have studied Italian in high school and who wish to continue with the language will be placed according to their high school record and verbal SAT and/or ACT scores and interview. Students may not receive credit for a course at a lower level than that into which they are placed.

Students interested in study abroad will find further information under the section on Special Educational Opportunities. The Ayer Romance Language Scholarship is available for majors through the department for application toward study-abroad programs and the Lamont Scholarship is awarded to a major in alternate years. A junior year abroad program in Bologna and a summer program for near beginners in Perugia are available. For further information inquire at the Office of International Education.

For comparative literature and linguistics courses with Italian emphasis, see those sections.

BACHELOR'S DEGREE REQUIREMENTS

The primary goals of the undergraduate Italian major program are to provide a mastery of the language skills (listening, speaking, reading, writing) and to promote an understanding of the Italian literary and cultural tradition within Western civilization. At the same time, the major provides the necessary background for advanced professional study and specialization.

Students wishing to major in Italian are required to have a thorough advising session with the Italian program undergraduate advisor. In this session the student's program of study will be outlined in detail. Students are required to see the undergraduate advisor in the event that any of their major courses are canceled so that substitutions and revisions in their programs can be made. The department will not approve a major in Italian unless the student has been advised by the undergraduate advisor.

Students will be offered the option of a senior seminar for 1 credit hour in which direction and advising will be given in order to fill in gaps in their studies.

Students majoring in Italian may not take any of their major requirement courses *pass/fail.*

A student is required to complete 30 credit hours of course work *beyond* the first year of Italian with a 2.0 average or better. A student may not take more than 45 credit hours in Italian (including the first year).

GEOGRAPHY

Office in Guggenheim Building, Room 110
Campus Box 260
Professor Nel Caine, Chairman

The Geography Department offers theoretical and practical work in (a) physical geography, including climatology, geomorphology, and biogeography; (b) conservation of natural resources, including environmental education and conflict analysis; (c) human geography, including urban, social, economic, political, historical, cultural, and population geography; (d) regional analysis, including mountains, natural hazards, and specific regional courses. To complement its curriculum, the department offers geography and environmental conservation majors internship opportunities, in which students earn academic credit in Geog. 499, Internship, while working in selected positions with private and public agencies and firms.

The Geography Department offers B.A., M.A., and Ph.D. degree programs in geography, and an interdisciplinary B.A. in Environmental Conservation (see separate listing).

BACHELOR'S DEGREE REQUIREMENTS

In addition to the college requirements, students majoring in geography shall successfully complete the following regularly scheduled courses or their equivalents: Environmental Systems—Climate and Vegetation (Geog. 100), Environmental Systems—Landforms and Soils (Geog. 101), and two of the following: World Regional Geography (Geog. 198), Introduction to Human Geography (Geog. 199), World Geographic Problems (Geog. 200). Students shall complete two additional courses: one from a list of options in statistical methods and one from a list of options in geographic skills. These lists are available in the department office. In addition, majors are expected to have or to achieve competence in written, oral, symbolic, and graphic skills.

Distributed majors selecting geography as a primary or secondary subject should consult with the departmental undergraduate advisors. Distributed majors selecting geography as a primary subject shall complete those geography courses identified as departmental requirements plus any other departmental offering relevant to their total program consisting of a minimum of 30 credit hours in geography; 15 of the 30 hours in geography must be upper division.

Distributed majors with geography as a secondary subject shall complete a minimum of 15 total hours of geography courses, with at least 6 credit hours from lower division geography courses and at least 8 credit hours from upper division geography courses.

Students should consult the departmental office for further information and referral to departmental advisors.

GRADUATE DEGREE PROGRAMS

Students wishing to pursue graduate work in geography leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section. Graduate-level course work at the Boulder Campus may be combined with graduate courses offered at the Denver and Colorado Springs campuses. Additional information should be obtained from the Department of Geography. The following are departmental requirements.

Master's Degree

Prerequisites. For admission without deficiency, the requirements are approximately 20 semesters hours of geography, including introductory courses in both human and physical geography, but an undergraduate major in geography is not required. It is desirable that the student have course work in at least two areas outside geography in cognate fields in the social sciences and natural sciences. Graduate students are encouraged to have some background in college mathematics, statistics, and computer skills. Without the kind of background described above, it is likely that admission will be on a "provisional" status.

General Requirements. The minimum requirements for an M.A. in geography may be fulfilled by one of two options.

1. Plan I: By completing 24 semester hours of graduate work, including a master's thesis, which carries 6 credit hours, i.e., 18 hours of course work and 6 hours of thesis work.
2. Plan II: By completing 30 semester hours of graduate work, including a 2-to-4-credit-hour research report, usually taken as Independent Study. This research will involve the preparation of a paper of publishable quality, or writing a critical review of published works, or preparing an original map, or development of curriculum materials, or similar scholarly work.

All grades offered for a degree must average at least 3.0 (a *B* average).

Doctor's Degree

Prerequisites. The minimum requirements for admission to the Ph.D. program are normally a master's degree or significant published research or equivalent standing.

General Requirements. The Ph.D. degree is not conferred merely upon the satisfactory completion of a course of study. The candidate must also demonstrate proficiency in some broad subject of learning, and be able to critically evaluate work in the field, show the ability to work independently in the chosen field, and make an original contribution of significance to the advancement of knowledge.

Thirty semester hours of course work numbered 500 or above is the minimum requirement; ordinarily the number of hours will be greater than this. Thesis credit hours may not be used to fulfill the 30-hour requirement. At least 20 of these hours must be taken at the University of Colorado; up to 10 semester hours from another institution may be transferred upon approval.

A *B* average or higher must be maintained in all course work.

Six semesters of residence are required beyond the bachelor's degree, of which four must be at the Univer-

sity of Colorado; this may include two semesters for the master's degree. Students with a University of Colorado master's degree in geography, with departmental approval, may apply all credit hours from 500 or above courses (except thesis credits) to the Ph.D. requirements.

GEOLOGICAL SCIENCES

Office in Geology Building, Room 205A
Campus Box 250
Professor Hartmut A. Spetzler, Chairman

BACHELOR'S DEGREE REQUIREMENTS

Students who wish to major in the geological sciences (Major Code 129) or who wish to pursue a major in Distributed Studies (Major Code 109) with geology as one of the principal subjects, must apply to the department for admittance. Application is normally made at the conclusion of the freshman year, after the student has completed the following courses with a grade point average of 2.5 or better:

1. Geol. 101-102/153, plus:
2. Any two of the following courses:
   a. Chem 103 (or 107)
   b. Chem. 106 (or 108)
   c. Math. 130 (or AM 135)
   d. Math. 230 (or AM 136)
   e. Phys. 111
   f. Phys. 112

Because the number of majors is limited, even successful completion of these requirements will not guarantee acceptance into the program; top applicants will be admitted until the limit is reached. Once in the program, students must maintain minimum academic standards (a 2.0 average in all geology courses and a 2.0 average in the additional courses in mathematics and allied sciences that are required for the major) or risk being dropped from the program.

Students who are interested in the geological sciences but have not been admitted to the major program should register for the pre-geology program (Major Code 164).

Transfer students who are accepted directly into the major program must satisfactorily complete a minimum of 12 semester hours of advanced work (300 level or above) in the Department of Geological Sciences in Boulder, if they wish to obtain a degree in geology from the University of Colorado at Boulder. Before registering for the first time, or within the first week of the semester, such students must see a member of the departmental Academic Progress Committee so as to have previous course work in geology, mathematics, and allied sciences evaluated.

The major program contains curriculum options in both geology and geophysics, each leading to a B.A. degree in the geological sciences. A student should select the option appropriate to the student's interests and objectives. Information on required courses and other departmental requirements may be obtained from the departmental office.

New freshman applicants, and transfer applicants with fewer than 60 semester hours in progress or completed, must apply as pre-geology students. Admission to the geology major is determined by work completed in the freshman and sophomore years. The code for other transfer applicants and former geology majors is AS129.

GRADUATE DEGREE PROGRAMS

Students interested in graduate work in the geological sciences should read carefully the detailed information regarding admission, registration, and degree requirements that is available from the departmental office. A brief summary follows.

All students applying for admission must take the Graduate Record Examination. Results of this examination will be used both for determining admittance and for initial academic counseling.

Entering students will normally have completed at least 24 semester hours of basic courses in geological science and two semesters each of chemistry, physics, and calculus. In some cases, exceptional undergraduate preparation in other fields of science, mathematics, or engineering will substitute for part of the 24 hours in geological science.

Initial counseling will be provided on an individual basis by the departmental Committee on Academic Progress. Thereafter each student will acquire an advisory committee which will provide guidance throughout the degree program.

Master's Degree

Candidates for the master's degree in geological sciences must complete at least 24 semester hours of course work numbered 500 or above, including a thesis (Plan I), or 30 semester hours in courses numbered 500 or above without a thesis (Plan II). The Plan II program requires at least 3 hours of Geol. 970 under the supervision of the advisory committee, or 5 hours of Geol. 562 (Field Vertebrate Paleontology). Upon the recommendation of the advisory committee, a student may substitute up to 12 hours of course work taken in related outside departments, including courses numbered below 500.

Doctor's Degree

Candidates for the doctoral degree must complete at least 30 semester hours in course work numbered 500 or above, of which at least 20 must be taken at UCB. In addition to course work, candidates must take a total of at least 30 hours of 800 doctoral dissertation hours, with not more than 10 of these in any one semester and not more than 10 before the comprehensive examination is passed.

Doctoral candidates are required to demonstrate second-year college proficiency in a foreign language of their choice.

GERMANIC LANGUAGES AND LITERATURES

Office in McKenna Building, Room 130
Campus Box 276
Professor Hugo Schmidt, Chairman

Students who have studied German in high school and wish to continue with the language will be placed in

accordance with a placement test administered by the university. The general rule is that one level in high school is the equivalent of one semester in college.

The department sponsors programs in Germany for undergraduate students. Students with at least four semesters may apply for a Junior Year Program in Regensburg, Stuttgart, or Tübingen, Federal Republic of Germany. There is also a summer program in Kassel. Further information on these programs may be obtained from the Office of International Education.

BACHELOR'S DEGREE REQUIREMENTS

The primary goals of the undergraduate German major program are to provide a mastery of the language skills (understanding, speaking, reading, writing) and to promote an understanding of the German literary and cultural tradition within its place in Western civilization. The German major is thus a liberal arts major. At the same time the major provides the necessary background for advanced professional study and specialization.

The German major will normally present a minimum of 35 semester hours from the courses listed in the Course Description section of this catalog; however, the minimum number of hours will be 30 if all the hours are at the 300 level or above. Courses at the 100 level will not be counted toward the 35 hours. Also German literature and culture courses in English translation normally do not count toward the 35 hours.

For additional information, prospective majors should obtain a copy of *Requirements for a Major in German* from the departmental office.

GRADUATE DEGREE PROGRAMS

Students wishing to pursue graduate work in Germanic languages and literatures leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section, and the departmental memorandum for the M.A. degree.

Master of Arts

Prerequisites. For students seeking admission to the M.A. program in German the following are required:

1. The ability to speak, read, and write German and to comprehend spoken German.
2. Knowledge of the main currents and masterpieces of German literature and civilization.
3. A reading knowledge of one foreign language other than German. Students lacking such knowledge when entering the program must demonstrate that they have made up this deficiency by passing an examination or by completing appropriate course work in a foreign language before they can be admitted to candidacy for the M.A. degree.

Examinations. For information concerning qualifying and comprehensive examinations and the master's thesis, consult the departmental Memorandum for M.A. Candidates.

HISTORY DEPARTMENT

Office in Hellems Building, Room 204
Campus Box 234
Professor Boyd H. Hill, Jr., Chairman

BACHELOR'S DEGREE REQUIREMENTS

Students majoring in history must complete a minimum of 30 semester hours of history courses with a grade of *C* or better. Not more than 45 semester hours in history will apply to the 124-semester hour requirement for the Bachelor of Arts degree. A student must have a grade point average of at least 2.0 in the major in order to graduate.

All history majors must complete Hist. 151-152 or Hist. 161-162 (6 semester hours) *and one* of the following course *sequences:* Hist. 101-102, 103-104, 105-106, 111-112, 141-142, or 181-182 (6 semester hours each). Any one of these course sequences will satisfy the first-year social science requirement of the College of Arts and Sciences.

All majors must also complete one course at the 300 level entitled Selected Readings or Research Seminar. Senior history majors may, with instructor's permission, substitute a 600-level course entitled Readings.

A history major must also complete a minimum of 18 semester hours of upper division (300-400 level) course work in history.

Completion of course work for the major in history will not automatically satisfy the second-year social science requirement of the College of Arts and Sciences.

Transfer students majoring in history must complete at least 12 semester hours of upper division history courses at the University of Colorado at Boulder.

Students may receive credit for Hist. 101-102 and/or 151-152 by advanced placement.

GRADUATE DEGREE PROGRAMS

Students wishing to pursue graduate work in history leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section. Following are special departmental requirements. Additional information should be obtained from the Department of History.

Admission requirements. For purposes of admission to the graduate program, the verbal portion of the Graduate Record Examination is required and a score in the 80th percentile or above shall normally be required for admission. The department also requires Ph.D. applicants to take the advanced history test of the GRE.

Master's Degree

Prerequisites. As general preparation for graduate work in history, it is desirable that a student have had a broad liberal arts education as well as a major in history. Candidates for graduate degrees may be required to pursue such fundamental courses in history as the department deems necessary to provide a suitable historical background.

Residence. While it is possible to obtain the M.A. degree in two full semesters of residence, it is frequently

advisable and at times necessary that more time be spent in graduate work.

Degree Requirements. A total of 24 semester hours of course work plus 4 to 6 hours in M.A. Thesis, or 30 semester hours of course work without a thesis is required for the degree. The required qualifying examination is met by a satisfactory score on the Graduate Record Examination. A comprehensive examination must be passed in the major field of concentration before the degree is granted. Candidates should request from the Department of History the set of instructions for M.A. candidates.

Doctor's Degree

Prerequisites. Students who wish to work toward the Ph.D. degree in history must indicate familiarity with certain fields of history, acquaintance with the fundamental tools of historical scholarship, and the ability to do original work. The Departmental Preliminary Evaluation for the Ph.D. program shall be the successful completion of the M.A. degree in history (or its equivalent) and the positive recommendation of the Graduate Admissions Committee that the student be admitted to the program.

Residence. At least three years of graduate study, two of which must be spent in residence, are required for the Ph.D. degree.

Degree Requirements. A total of 30 credit hours, 20 of which must be taken at this University, and dissertation is required for the degree. One language is required; however, students must be able to use those languages essential to research and advanced study in their respective fields.

A comprehensive written and oral examination, a dissertation which is an original contribution to knowledge, and an oral examination on the dissertation must be successfully completed. Candidates should request from the Department of History the set of instructions for doctoral candidates.

HISTORY AND PHILOSOPHY OF SCIENCE

Campus Box 390
Allan Franklin and Howard Smokler, Co-Chairmen

The College of Arts and Sciences offers courses in the history and philosophy of science. These courses are Nat. Sci. 321-322-323-324, offered in the Center for Interdisciplinary Studies, and Phil. 341-342-343-344, offered in the Department of Philosophy. The four semesters cover the time periods: ancient to Copernicus, Copernicus to Newton, Newton to Einstein, and twentieth century. Of related interest is Hist. 415, History of Science From the Ancients to Sir Isaac Newton.

The History and Philosophy of Science Committee sponsors a series of lectures by visiting scholars as well as a biweekly seminar by both visiting and local scholars. Each spring there is a regional conference on the History and Philosophy of Science. Cassette tape recordings of the lectures and seminars are available for loan from the committee office.

No formal major is offered in the history and philosophy of science, but interested students may design their own majors in this area through the individually structured major, with the aid of a faculty advisory committee and the approval of the dean of the College of Arts and Sciences. Information may be obtained from the Office of Innovative Education and the Committee on the History and Philosophy of Science.

Students are also encouraged to consider a distributed major in the appropriate departments: a major in either history or philosophy with courses on the history and philosophy of science, or a major in one of the scientific disciplines with courses in the history and philosophy of science as electives. In addition, physics majors pursuing Plan 2 may take history and philosophy of science to satisfy the interdisciplinary requirement.

An M.A. program in the history and philosophy of science is available in the Philosophy Department.

HONORS PROGRAM (CENTER FOR INTERDISCIPLINARY STUDIES)

Office in Norlin Library
Professors J. McKim Malville and Ronald G. Billingsley, and Associate Professor Elizabeth W. Moen, Directors

The Honors Program at the University of Colorado is designed to provide special educational opportunities for particularly able and highly motivated students. It is open to well-prepared freshmen as well as to students who enter the program at a later stage. The Honors Program offers a guide to a carefully constructed curriculum in the liberal arts, thoughtful advising, close contact with faculty and with other honors students, and an opportunity to write an honors thesis.

Students will become conversant with the humanities, the social sciences, and the natural sciences. Faculty teaching honors seminars are carefully selected for special interests and enthusiasm, for teaching ability in small discussion classes, and for insistence on high standards. The emphasis is on working. These are seminars designed for the student who welcomes challenge, who knows that the mind expands only with effort, and who willingly accepts the opportunity. Honors courses will strive to be integrative. They will encourage students to combine and synthesize concepts and methodologies from other courses and disciplines. Many honors courses will be consciously interdisciplinary, but all will stimulate students to structure their total academic experience into a meaningful framework.

The Honors Program is also responsible for determining which students merit the award of the bachelor's degree with honors: *cum laude, magna cum laude,* and *summa cum laude.* These awards are made on the basis of special honors work and not simply on the basis of grades earned in courses.

The student may participate in either departmental honors or general honors, or both. Departmental honors may require a junior or senior honors seminar, an independent research project, and/or directed readings. Each department has information pertaining to its own particular program. General honors is designed to help students explore areas outside their major fields and to

broaden the basis of their liberal education. Each year over 30 honors courses in a wide variety of areas are offered; each course is limited to an enrollment of 15 students. Candidates are required to take the Senior Seminar.

Detailed information concerning the Honors Program may be obtained in the Honors Office in Norlin Library. Application for admission to the Honors Program can also be made in the Honors Office in Norlin Library, either in person or by mail. Freshmen are accepted for honors work on the basis of achievement in high school; students currently enrolled are accepted on the basis of academic achievement at the University of Colorado. While honors students are expected to have a grade point average of at least 3.3, it should be emphasized that no student who shows ability and promise is excluded from consideration. This is a program of excellence and commitment in which the best teaching faculty is committed to serve the most highly motivated students for the benefit of those students and the larger society.

HUMANITIES

Office in Ketchum Building, Room 128
Campus Box 331
Associate Professor Nancy Hill, Program Chairwoman

The humanities major is structured on an interdisciplinary approach to the arts. In addition to taking courses which combine the study of literature, music, and the visual arts, all students must do work in depth in the literature of a single language. Beyond these requirements students may select a secondary field of concentration as listed below. Since the program is tailored as much as possible to the individual student's interests, majors should see their departmental advisor each semester. Departmental advisors for the major are Professors Palmer, Hill, and Holloway. Early completion of the foundation course, Hum. 101-102, is essential.

BACHELOR'S DEGREE REQUIREMENTS

1. Satisfaction of the regular college requirements for the Bachelor of Arts degree.
2. A total of 63 semester hours distributed as follows:
   a. Twelve hours: Introduction to Humanities (Hum. 101-102).
   b. Fifteen hours: upper division humanities courses.
   c. Twenty-four hours: language/literature courses. These must be within a single language—English or a foreign language, either ancient or modern. First-year courses in a foreign language cannot be counted. Literature courses where material is studied in translation cannot be counted as meeting requirements, though they may be recommended as electives.
   d. Twelve hours: courses chosen from any one of the following with approval of the humanities major advisor:[1]
      (1) A second language/literature (*not* courses with material studied in translation)[2]
      (2) Fine arts
      (3) Music
      (4) Dance
      (5) Theatre
      (6) Film[3]
      (7) Philosophy

All students must have their schedules approved each semester by a departmental advisor.

INDIVIDUALLY STRUCTURED MAJOR

The individually structured major is designed by the student during the sophomore year in consultation with a three-member faculty advisory committee. It must be approved by the dean of the College of Arts and Sciences, and once approved, it may be amended only with approval of the student's committee and the dean. The proposal must include a Senior Thesis (A.S. 940) for a maximum of 6 semester hours of credit. Guidelines and proposal applications, as well as advising, are available in the College of Arts and Sciences Dean's Office.

INTERNATIONAL AFFAIRS

Office in Ketchum Building, Room 103
Campus Box 333
Professor George Codding, Program Chairman

With the increasing involvement of the United States in world problems, opportunities in government, business and international organization have expanded enormously. Today there is an urgent need for college graduates with strong backgrounds in international affairs. To meet this need the University of Colorado offers a comprehensive and flexible interdisciplinary program in international affairs leading to the degree Bachelor of Arts.

BACHELOR'S DEGREE REQUIREMENTS

In addition to the general college requirements for the Bachelor of Arts degree, the major in international affairs requires the following:

1. Requirements:
   a. *General*—41 hours (34 hours with Grade *C* or better), distributed as follows (*none* may be taken pass/fail):

Lower Division (17 Hours)	*Semester Hours*
Econ. 201. Principles of Macroeconomics	4
Econ. 202. Principles of Microeconomics	4
P.Sc. 110. American Political System	3
P.Sc. 201. Introduction to Comparative Politics: Developed Political Systems	3
or	
P.Sc. 202. Introduction to Comparative Politics: Developing Political Systems	3
P.Sc. 222. Introduction to International Relations	3
Upper Division (24 Hours)	
Anth. 451. Applied Cultural Anthropology	3
or	
Anth. 458. Power: Anthropology of Politics	3
or	

[1]These 12 hours may not include more than 6 of studio or practice courses.
[2]In the case of the second language, not more than 6 hours of a beginning course may be counted.
[3]Not more than 9 hours of upper division humanities courses may be in film. If film is the minor area, film courses may not count for upper divison credit in humanities.

Anth. 450. Cross-Cultural Aspects of Socioeconomic Development	3
Econ. 440. International Economics and Policy	3
Econ. 471. Comparative Economic Systems	3
or	
Econ. 477. Economic Development: Theory and Problems	3
or	
Econ. 478. Policies of Economic Development	3
Geog. 471. Political Geography	3
Hist. 432. Twentieth-Century Europe	3
or	
Three additional hours of history in student's area of concentration[1]	
P.Sc. 421. International Relations	3
or	
P.SC. 428. International Behavior	3
P.Sc. 423. American Foreign Policy	3
or	
P.Sc. 468. Diplomatic History of the U.S. Since 1914	3
P.Sc. 425. International Organization	3
or	
P.Sc. 426. International Law	3

b. *Area*—12 hours of upper division courses concentrating on the whole or part of a region outside the U.S. (principally, but not exclusively, Africa and the Middle East, Asia, East Europe and the Soviet Union, Latin America, and Western Europe). *None* may be taken pass/fail.

c. *Language*—A third-year proficiency in a foreign language appropriate to the area of concentration. This requirement may be met (1) by completion of two third-year, university-level grammar courses in the language[2] or (2) by certification by the appropriate department of such competence.

2. Recommendations:

a. All international affairs majors should have a *good* command of the English language.

b. Students should choose electives with a view to their relevance to this program.

c. During the semester prior to graduation, each student must complete a Statement of Major Status to be obtained from the office of the College of Arts and Sciences.

d. Students in the International Affairs Program are encouraged to consider the possibility of participating in one of the study abroad programs directly or indirectly affiliated with the University of Colorado. Students wishing to participate in such a program should contact their advisor and the chairman of the Committee on International Affairs to work out an appropriate program. Some variation in the general requirements will be permitted in these cases.

The specific courses that may be counted to meet the requirements in this program are determined by the Committee on International Affairs and the dean of the College of Arts and Sciences.

LATIN AMERICAN STUDIES

Office in McKenna 132A
Campus Box 278
Assistant Professor Salvador Rodriguez Del Pino, Chairman

Colorado's proximity to Mexico and the long-standing mutual influences of the United States and Latin America make Latin American studies a timely and interesting field. The Latin American studies program offers a broad and flexible interdisciplinary approach designed to provide a comprehensive rather than a narrow, single-discipline understanding of Latin America. The curriculum leads to the Bachelor of Arts degree with a major in Latin American studies.

BACHELOR'S DEGREE REQUIREMENTS

1. Satisfaction of the regular college requirements for the Bachelor of Arts degree.

2. A demonstrated proficiency in Spanish or Portuguese (successful completion of at least one upper division Spanish or Portuguese course).

3. At least 48 hours in courses pertaining to Latin America, to be distributed among as many of the following fields as possible: anthropology, art history, economics, geography, Hispanic literature, history, and political science. Not more than 24 hours in one department may count toward the major. Majors are encouraged to include a study-abroad semester or summer (Mexico; San José, Costa Rica; or Lima, Peru) in their academic programs.

4. The senior seminar in L. Am. 498, normally given during the fall semester.

5. All schedules for students majoring in Latin American studies must be approved by the advisor of the program. Prospective majors in Latin American studies should consult with the advisor at the first opportunity.

6. The specific courses that may be counted to meet the requirements in this program are determined by the Committee on Latin American Studies and the dean of the College of Arts and Sciences. In addition to the courses listed below, special offerings in the honors program, experimental studies, comparative literature, etc., may also be applied with the advisor's consent.

Other related courses may be counted toward the major in Latin American studies with the approval of the advisor.

	Semester Hours
Anth. 227. New World Archaeology	3
Anth. 311. Ethnography of Mexico and Central America	3
Anth. 312. Peoples of Latin America	3
Anth. 421. Southwestern Archaeology	3
Anth. 422. Archaeology of Mexico and Central America	3
Ch.St. 101. Introduction to Chicano Studies	3
Ch.St. 104. Introduction to Chicano Literature	3
Ch.St. 313. Study of Chicanas	3
Ch.St. 435. The Mexican Revolution	3
Econ. 487. Economic Development of Latin America I	3
F.A. Hist. 471. Pre-Columbian Art	3
F.A. Hist. 472. North American Indian Art	3
Geog. 381. Latin America	3
Hist. 181. History of Latin America: The Colonial Experience	3
Hist. 182. History of Latin America: The National Experience	3
L.Am. 495. Interdisciplinary Seminar in Latin American Studies (offered periodically)	3
L.Am. 498. Senior Seminar in Latin American Studies (required of majors)	3

[1]These three hours must be in addition to the 12 hours of area courses.
[2]With certain exceptions, these courses may not be taken pass/fail.

L.Am. 940. Independent Study ..... 1 to 3
P.Sc. 513. Seminar: Latin American Politics 3
Port. 211, 212. Second-Year Reading and Conversation 6
Port. 403, 404. Topics: Luso-Brazilian Civilization 6
Port. 411, 412. Survey of Brazilian Literature I and II 6
Port. 415, 416. Survey of Portuguese Literature I and II 6
Port. 451, 452. Contemporary Brazilian Prose Fiction I and II 6
Port. 940. Independent Study ..... 1 to 3
Soc. 481. Family Planning and Population Control 3
Span. 211, 212. Second-Year Spanish 6
Span. 334. Twentieth-Century Spanish-American Literature 3
Span. 335. Spanish-American Literature to the 20th Century 3
Span. 411. Women in Hispanic Literature 3
Span. 416. Masterpieces of Spanish Literature: 1700 to Present 3
Span. 420. Spanish Culture 3
Span. 422. Special Topics in Spanish and Spanish American Literature 3
Span. 612. Spanish-American Literature 3

CERTIFICATE IN LATIN AMERICAN STUDIES

A certificate is awarded to students who have demonstrated strong preparation in Latin American studies accompanying a major in another area. Students who satisfy the following requirements are eligible for the certificate in Latin American studies:

1. A demonstrated proficiency in Spanish or Portuguese (successful completion of at least one upper division Spanish or Portuguese course).
2. At least 24 hours in courses pertaining to Latin America with not more than 9 hours applicable from any one department. Substitutions must be approved by the advisor of Latin American Studies.
3. L.Am. 495, 498, or a substitution approved by the advisor of the program.

LINGUISTICS

Office in Woodbury Building, Room 403
Campus Box 295
Associate Professor Alan Bell, Chairman

BACHELOR'S DEGREE REQUIREMENTS

Majors in linguistics must complete a total of 45 hours of study in general linguistics, a natural language, and appropriate language-related electives. Language study, and some or all elective hours, may be taken in other departments. The three-way division of the major is intentional. The hours in general linguistics are intended to give the student the basic theory which underlies the scientific study of language. The study of a natural language is intended to give the student a self-conscious awareness of the phenomena which linguistic science describes and seeks to explain. The language-related electives are intended to acquaint the student with other theoretical or disciplinary perspectives on the phenomena which linguistics studies.

1. *College Requirements.* Students must satisfy all of the regular college requirements for the Bachelor of Arts degree.
2. *Course work.* Students must complete the following courses in general linguistics with a grade of *C* or better.

	Semester Hours
Ling. 100. Language	3
Ling. 200. Introduction to Linguistics	3
Ling. 330. Linguistic Analysis	3
Ling. 401. The Nature of Grammars	3
One course from each of the following pairs:	
Ling. 343. Semantics	3
or	
Ling. 350. Language and the Public Interest	3
Ling. 493. Linguistic Phonetics	3
or	
Ling. 460. English Phonology for Teachers of English to Speakers of Other Languages	3
Ling. 497. Introduction to Diachronic Linguistics	3
or	
A course in the history of a particular language	3
Ling. 440. Introduction to Transformational-Generative Grammar	3
or	
Ling. 461. English Structure for Teachers of English to Speakers of Other Languages	3
	24

3. *Foreign Language.* Students must complete with a grade of *C* or better a minimum of 15 hours of study of a natural language. All hours offered in satisfaction of this requirement must be in a single language and at the 200 level or above. Students selecting English must include the following courses: Engl. 485, Ling. 460, 461. All courses not specifically listed here must be approved in advance by the undergraduate advisor.

4. *Electives.* A minimum of 6 elective hours must be completed with a grade of *C* or better. A large number of courses appropriate to this area of the major are taught in various university schools, departments, and programs, such as anthropology, communication, communication disorders and speech science, computer science, education, linguistics, modern languages, philosophy, sociology, and psychology. A list of suggested courses, periodically updated, is available from the undergraduate advisor. In any case, courses submitted in satisfaction of this requirement must have the prior approval of the undergraduate advisor. Students must of course complete any prerequisites which may be required for courses they choose as electives.

For students choosing English to satisfy the natural language requirement, Ling. 460 and 461 also satisfy 6 hours of the general linguistics requirement. Such students must take a total of 12 hours of approved electives to fulfill the total of 45 hours for the major.

Depending on the choice of courses, a student can finish the B.A. in linguistics with either a theoretical or an applied emphasis. Since there is a great deal of latitude for individual choice, students majoring in linguistics should consult the undergraduate advisor at the beginning of each registration period.

Language study and some other sources in the major may be completed in Unversity or University-affiliated study abroad programs, and such study is recommended. Students interested in doing part of their major work in a study abroad program should discuss the matter with the undergraduate advisor prior to going abroad. For information on study abroad programs, consult the Office of International Education.

GRADUATE DEGREE PROGRAMS

Students wishing to pursue graduate work in linguistics should read carefully Requirements for Advanced Degrees in the Graduate School section of this catalog and the departmental directives for the M.A. and Ph.D. degrees listed below.

Prerequisites. B.A. degree in linguistics *or* a B.A. or B.S. in other fields provided that the following prerequisites are satisfied:

1. Applicants must have had Ling. 200 (Introduction to Linguistics) or the equivalent.
2. Applicants should have considerable knowledge (e.g., college junior level proficiency) of and about one or more languages other than their native language. This knowledge may have been gained by formal study of the language(s), by residence in a country where the language(s) is (are) spoken, or by some other means. The department may require formal study of foreign languages by graduate students whenever their knowledge in this area is found to be deficient.
3. Applicants should have had course work in other disciplines, some of whose concerns are close to the concerns of linguistics; for example, in anthropology, sociology, psychology, phonetic sciences, communication disorders, mathematics, computer science, or philosophy.
4. Applicants must have a 3.0 undergraduate grade point average. Graduate Record Examination scores *are required* except under very special circumstances.

Master's Degree

Completion of an M.A. degree will normally call for a *minimum* of three semesters of study.

The requirements for the M.A. degree are as follows:

Plan I

1. *Language Reading Ability.* The student must demonstrate a reading knowledge of one language other than English. The other language must be French, German, or another language accepted by the graduate advisor. French is strongly recommended. Foreign students whose native language is not English may offer English as a foreign language for purposes of this requirement.
2. *Course work.* The following courses or equivalents must be completed:

	Semester Hours
Ling. 633. Phonological Analysis and Theory	3
Ling. 634. Methods of Grammatical Analysis	3

A student who has already taken any of these courses (or equivalents) as an undergraduate must earn an equal number of credits in other linguistics courses.

The student must complete additional work amounting to a minimum of 18 hours which will include (a) 4 to 6 thesis hours, (b) at least 6 hours of courses designated Ling. in this catalog, and (c) up to 6 hours of electives approved in advance by the graduate advisor.

3. *Comprehensive Examination.* The student must pass a comprehensive examination in general linguistics. A section on a specialized area may be included if the student so desires.
4. *Thesis.* Students must complete an acceptable thesis, which must be submitted to the committee members two weeks before the comprehensive examination.

Plan II

Plan II includes all items listed in Plan I except item 4. If the student is allowed by the department to choose Plan II, the course requirements are 30 hours of graduate work, distributed as follows: (a) a minimum of 24 hours of course work to be chosen from courses labeled Ling. (Ling. 633 and 634 are included in these 24 hours); and (b) up to 6 hours of additional course work approved in advance by the graduate advisor.

Doctor's Degree

A student admitted only to an M.A. program must apply for admission to the Ph.D. degree program whether the student receives the M.A. degree or not. Students proceeding directly to the doctoral degree may apply for the M.A. degree upon passing the doctoral preliminary examination, providing that all M.A. requirements except the comprehensive examination have already been met.

A committee of three faculty members will be appointed at the beginning of the second year of full-time work. This committee will guide students as to their course work and foreign language requirements, and will determine other details of their programs as the need arises.

Preliminary Examination. Every student planning to pursue a Ph.D. program must take a preliminary examination. An M.A. degree will *not* substitute for the preliminary examination, which will be offered only once per year and will consist of language data problems. Students are normally expected to present themselves for the preliminary examination during their second year in the Ph.D. program, but the department reserves the right to require a student whose course work and experience warrant it to attempt the examination earlier. Under special circumstances, the department will consider a petition to defer the examination. If failed, the preliminary examination may be repeated only once, and the second try must be at the next administration of the examination. Upon failing the preliminary examination a second time, a student will be dropped from the Ph.D. program.

Requirements for the Ph.D. (subject to possible reevaluation and readjustment by the student's committee) follow. All of the requirements, and the Graduate School language requirement, must be satisfied before the student will be admitted to the comprehensive examination.

1. *Language Reading Ability.* All students must demonstrate ability to read linguistic literature in two of the following: French, German, Russian. All language examinations will be administered by the department.
2. *Knowledge of a Related Area.* All students must demonstrate more than superficial acquaintance with

some field related to linguistics. The field may be anthropology, computer science, mathematics, sociology, psychology, phonetic sciences, or another field approved by the graduate advisor or the student's advisory committee. The requisite knowledge may be gained by taking at least 8 hours of nonintroductory courses in that field, or it may be the result of work completed before entering the program. Under no circumstances will experience or independent reading alone substitute for formal course work as preparation for satisfying this requirement. Demonstration of this knowledge may be in any one of these ways:

a. The student will pass a four-hour (half-day) examination in which solutions to problems of linguistics are approached through the materials and methodology of the related field.
b. The student may present a research paper on a problem approved by the advisory committee. This paper may not be merely a survey of those areas or problems which the related field has in common with linguistics.
c. The student may present a master's degree in anthropology, psychology, sociology, mathematics, or computer science.
d. The student may present for approval to the graduate advisor or committee some other evidence that this requirement has been satisfied. This option is appropriate for a student with a master's degree in a field not listed in "c," or with unusually advanced accomplishments.

3. *Knowledge of Non-Native Language.* All students must demonstrate a thorough acquaintance with a non-native language, a language family, or a language area, equivalent to at least 8 hours of nonintroductory courses. This knowledge may be demonstrated in one of the following ways:

a. Students will pass a four-hour (half-day) examination in the structure and history of the language, family, or area they have chosen.
b. Students may prepare a research paper demonstrating understanding of the structure or history of the language, family, or area of their choice.
c. Students may present a master's degree in the language or literature of their choice.

4. *Course work.* The following courses, or equivalents, are required of all students: Ling. 633, 634, 641, 642, 643, 697.

In addition, all students must complete three courses selected from the following list; any of these may be repeated for credit and offered as two separate courses for purposes of this requirement, unless otherwise specified by the student's advisor: Ling. 717, 724, 738, 741, 743, 750, 797.

Additional credits in linguistics or electives offered by the department or by other departments may be recommended by the student's committee. Some credit hours earned at linguistic institutes may be accepted on the recommendation of the committee.

5. *Comprehensive Examination.* The comprehensive examination, usually conducted in English and at the conclusion of course work, is in (a) general linguistics and (b) a specialization of the student's choice, e.g., a language area, applied linguistics, history of linguistics, phonetics, psycholinguistics, semantics, and syntax. Comprehensive examinations may be repeated once. They may also be passed conditionally, i.e., subject to specifically stated conditions.

6. *Dissertation and Dissertation Defense.* A final examination and a dissertation suitable for publication are required. Normally the dissertation will be directed by a member of the Linguistics Department. If the student wishes to write under the direction of someone outside the department, the topic and director must be approved by the department chairman. The dissertation committee, which is selected by the student, consists of the director and four additional members. At least one member of the committee, but not more than two, must be chosen from outside the Department of Linguistics. This committee will meet formally with the candidate to consider a dissertation prospectus no later than one year after the student's formal advancement to candidacy. The prospectus will normally consist of a review of the literature relevant to the topic and a description of the research plan and expected results. The final form of the prospectus must be approved formally (with amendments as necessary) by the entire dissertation committee. The same committee will usually serve as the examining committee for the dissertation defense.

Students who are working on their dissertations must be registered for thesis in the term or terms in which they are doing research and/or writing. For these hours a grade of *IP* is automatically awarded. After the submission of the dissertation and a successful final examination (defense of thesis), the grade of *IP* is changed to either *A* or *B*, as determined by the committee.

MATHEMATICS

Office in Engineering Classroom Building, Room 2-38
Campus Box 426
Professor John H. Hodges, Chairman

UNDERGRADUATE PROGRAMS

The Department of Mathematics offers degree programs leading to the B.A. degree in mathematics in the College of Arts and Sciences and the B.S. degree in applied mathematics in the College of Engineering and Applied Science.

The B.A. degree requires the completion of at least 30 hours of mathematics, all with a grade of *C* or better, and a 2.0 grade point average or better in all courses in mathematics, including three semesters of calculus and 18 hours of mathematics courses numbered above 300. The 18 hours must include Math. 313 and 6 hours of mathematics courses numbered above 400 (Math. 587 may not be counted in these 6 hours). Math. 435, 436 do not count toward minimum hours for B.A. degree.

Mathematics majors may *not* use mathematics courses to satisfy either the humanities or the natural sciences requirement of the college.

Students seeking the B.A. degree may choose a program with emphasis on preparation for graduate work, one with a background in computer science, one with

emphasis on preparation for secondary teaching, or one emphasizing applied mathematics.

Students seeking information regarding the B.S. degree should refer to the Applied Mathematics section in the College of Engineering and Applied Science portion of this catalog.

Students should obtain a major requirement sheet from the Mathematics Department office.

Undergraduate students planning to do graduate work in mathematics should take Math. 314 and Math. 431-432, and should fulfill the College of Arts and Sciences language requirement with German, French, or Russian.

A student who is a candidate for a B.A. degree in mathematics or in distributed studies with mathematics as one area from the College of Arts and Sciences must complete with a grade of *C* or better at least 9 hours of upper division mathematics courses in the college, *Boulder Campus.*

No student may obtain more than 12 hours credit in mathematics courses numbered below 130.

GRADUATE DEGREE PROGRAMS

The Department of Mathematics offers degree programs leading to the M.A., M.S., and Ph.D. degrees in mathematics and applied mathematics. The Ph.D. in mathematical physics is also offered in cooperation with the Department of Physics. (See Mathematical Physics listed under Interdepartmental Programs in the Graduate School section of this catalog.)

The prerequisite for graduate work in mathematics is at least 30 semester hours in mathematics, including two semesters of advanced calculus, a semester of linear algebra, and a semester of either higher algebra or differential equations. The prerequisite for a graduate level minor in mathematics is three semesters of calculus.

Students desiring the Ph.D. must demonstrate a reading knowledge of two of the following languages: French, German, and Russian. Only 500- and 600-level courses will receive graduate credit. The details of the degree requirements are available in the department office.

MEDIEVAL STUDIES

Office in Ketchum Building, Room 226
Campus Box 331
Professor Edward P. Nolan, Program Chairman

The Committee on Medieval Studies is founded on the conviction that the European Middle Ages represents a cultural unity in which the Roman church, the medieval Latin language, the concept of the Holy Roman Empire, and the polarity of East and West created institutions transcending the normal boundaries of nation, language, and scholarly discipline. Medieval Studies is therefore necessarily interdisciplinary; and the committee's function is to make possible and encourage such interdepartmental cooperation.

The following courses in various departments are available to those students whose area of specialization within a given department is the medieval period and who wish to broaden their knowledge of medieval culture. With the approval of the major department, a coherent group of these courses may be accepted as a related field of study and as part of the requirements for an advanced degree. For additional details concerning these courses, see departmental listings.

Medieval Culture

M.St. 401/501-3. Medieval Culture I
M.St. 402/502-3. Medieval Culture II
C.L. 542-3. Medieval Literature
Engl. 951-variable credit. Tutorials in Medieval Literature
Engl. 961-variable credit. Advanced Medieval Studies
F.A. Hist. 506-3. Art of Islam
Fr. 525-3. Medieval and Renaissance Readings
Hist. 412-3. Intellectual History of Medieval Europe
Hist. 413-3. Constitutional and Legal History of England to 1485
Hist. 415-3. History of Science From the Ancients to Sir Isaac Newton
Hist. 488-3. The Medieval Middle East
Hist. 621-3. Readings in Medieval History
Ital. 511-3. Dante: *Inferno* and *Purgatorio*
Ital. 513-3. Medieval Lyric Literature
Ital. 570-3. Dante: *Paradiso, la Vita Nuova,* and Minor Works
Mus. 582-3. Medieval Music
Phil. 591-3. St. Thomas Aquinas
Span. 614-3. Seminar: Spanish Literature of the Middle Ages

Medieval Languages

Engl. 570, 571-3. Anglo-Saxon
Engl. 682-3. Middle English
Fr. 603-3. History of the French Language to 1300
Fr. 604-2. History of the French Language From 1300 to the Present
Fr. 605-2. Old Provencal
Ger. 521-3. Introduction to Middle High German
Slavic 503-3. Old Church Slavonic

MUSEUM

Office in Henderson Building, Room 207
Campus Box 218
Professor William W. Hay, Director

Although no undergraduate major is offered in museum studies, courses listed in the Course Description section may be taken with the approval of the student's major department.

In addition to the above courses, graduate training in anthropology, botany, zoology, and paleontology is provided under the direction of museum faculty in cooperation with the anthropology, biology, and geological sciences departments. Areas of study include archeological theory and interpretation, southwestern archeology and ethnology, textile history and analysis, and early man in North America (Wheat, Huse); plant taxonomy and phytogeography with specialties in lichenology and bryology (Weber); vertebrate paleontology and Cenozoic stratigraphy (Robinson); lower vertebrate paleontology, African Tertiary faunas and paleoenvironments (Harris); biology of mollusks, taxonomy of annelids and crustacea (Wu); taxonomy of insects of Rocky Mountain region (Lanham); and marine micropaleontology (Hay).

Museum assistantships, research support from the Walker Van Riper Fund, and other financial assistance are available to selected students. Students interested in working toward advanced degrees in the above areas under the direction of museum faculty should write the appropriate professor, University of Colorado Museum, Campus Box 218, Boulder, Colorado 80309.

Applicants accepted for graduate work by museum faculty must be admitted to the Graduate School and to the graduate program of the cognate department.

Courses offered by museum faculty through cooperating departments are listed below.

Anth. 940-variable credit. Independent Study
Anth. 950-variable credit. Guided Study
Anth. 960-variable credit. Independent Research
Anth. 700-4 to 6. Master's Thesis
Anth. 800-0 to 8 (16 to 24 maximum). Doctor's Dissertation
EPOB 467/567-4. Advanced Invertebrate Biology
EPOB 940-1 to 3. Independent Study in Biology
EPOB 700-4 to 6. Master's Thesis
EPOB 800-0 to 8 (16 to 24 maximum). Doctor's Thesis
Geol. 447/547-4. Paleontology of the Lower Vertebrates
Geol. 448/548-4. Paleontology of the Higher Vertebrates
Geol. 561-2. Mammalian Micropaleontology
Geol. 562-5. Field Problems of Vertebrate Paleontology
Geol. 579-3. Seminar: Oceanography/Paleoceanography
Geol. 940-variable credit. Independent Study in Geology
Geol. 950-variable credit. Independent Study
Geol. 960-variable credit. Research
Geol. 700-4 to 6. Master's Thesis
Geol. 800-0 to 8 (16 to 24 maximum). Doctor's Thesis

MUSIC

The following courses offered in the College of Music are accepted for College of Arts and Sciences credit (see College of Music in Course Description section).

Mus. 183-3. Appreciation of Music
Mus. 275-3. History of Folk and Popular Music: USA
Mus. 276-3. Music and Drama
Mus. 277-3. World Music
Mus. 308-3. American Popular Music
Mus. 364-3. History of Jazz
Mus. 382-3. Music Literature I
Mus. 383-3. Music Literature II
Mus. 489-3. Latin American Music

NATURAL SCIENCE

Office in Ketchum Building, Room 128
Campus Box 331

The Natural Science Program in the Center for Interdisciplinary Studies offers courses that go beyond the limits of single University departments. Some natural science courses are designed to provide broad introductory courses for nonscience majors. Others seek to bring the perspectives of several scientific disciplines to bear on common problems or concepts. Courses in the history of science allow insight into the development of science in the broader context of the development of human thought. Overall, the Natural Science Program strives to make the sciences an integral part of the undergraduate, liberal arts curriculum.

ORIENTAL LANGUAGES AND LITERATURES

Office in McKenna Building, Room 16
Campus Box 279
Associate Professor Paul W. Kroll, Chairman

Students who have studied Chinese or Japanese in high school or at another university and who wish to continue with the same language must consult the department for placement. Successful completion of course 211 in either language satisfies the college graduation requirement in foreign language.

BACHELOR'S DEGREE REQUIREMENTS

Chinese

Students majoring in Chinese must complete 41 semester hours of course work in Chinese. Required courses for the major are Chin. 101-102, 211-212, 311-312, 321-322, 481, 482, 483. This program intends to provide a thorough grounding in the modern language, sufficient to prepare the student for graduate studies, to read and translate fluently, and to communicate orally with confidence. The student will also acquire a solid introduction to the classical language and literature, as well as an appreciable familiarity with Chinese literary and cultural history. Advanced work in classical Chinese, with special emphasis on medieval literature, is also offered. For further information the student should request the Chinese major sheet from the department.

All students planning a major in Chinese are encouraged to consider study abroad in order to improve their language ability. The University of Colorado is affiliated with a study abroad program based at National Taiwan University, Taipei, Taiwan. There are also numerous other programs, in which interested students may enroll, both in Taiwan and the People's Republic of China. For further information, contact the Office of International Education. Note, however, that not more than 20 semester hours of transfer credit, from universities in this country or abroad, may be counted toward the major in Chinese.

Japanese

Students majoring in Japanese must complete 41 semester hours of course work in Japanese. Required courses for the major are JPN 101-102, 211-212, 221, 311-312, 411-412, 483, 484. This program intends to provide a thorough grounding in the modern language, sufficient to prepare the student for graduate studies; an introduction to the classical language and literature; and a basic familiarity with Japanese literary and cultural history. For further information the student should request the Japanese major sheet from the department.

All students planning a major in Japanese are encouraged to consider study abroad in order to improve their language ability. The University of Colorado is affiliated with a study abroad program based at Konan University, Kobe, Japan. There are also numerous other programs in Japan, in which interested students may enroll. For further information, contact the Office of International Education. Note, however, that not more than 20 semester hours of transfer credit, from universities in this country or abroad, may be counted toward the major in Japanese.

COURSES IN TRANSLATION

The department offers several courses in translation. These courses require no previous study of the language, history, or culture of the area involved and are

open to all interested students, whether majors in this department or not. They provide excellent introductions to Chinese or Japanese literary and cultural history. Chin. 481, 482, 483 focus on Chinese poetry, fiction, and drama, respectively, with primary emphasis on works from ancient and medieval times. JPN 483 and 484 focus, respectively, on classical and modern Japanese literature, while JPN 221 provides an overview of Japanese culture.

PHILOSOPHY

Office in Hellems Building, Room 169
Campus Box 232
Professor Wesley Morriston, Chairman

Students are cautioned to consult the current *Schedule of Courses* for the most accurate information on prerequisites since these sometimes vary with instructors.

Courses at the 100 level are open to all; courses at the 200 level are open to all who meet the prerequisites; courses at the 300 and 400 levels are recommended only for juniors and seniors; courses at the 500 and 600 level are recommended primarily for graduate students.

Courses may be taken in any order providing prerequisites, if any, are met.

BACHELOR'S DEGREE REQUIREMENTS

A program for a departmental major must include History of Philosophy (Phil. 300, 301), Metaphysics and Epistemology (Phil. 335), Ethical Theory (Phil. 302), a logic course (Phil. 244 or 444), Twentieth-Century Philosophy (Phil. 404), and one course concerned with a single philosopher (or a substitute as approved by the student's advisor).

The department offers a number of topically oriented majors, which are interdisciplinary in nature. These currently include Law and Society, Dimensions of the Self, Philosophy and the Arts, and Values and Social Policy. Each of these majors requires two semesters in the history of philosophy, as well as a series of core courses which vary according to the topical emphasis. *A student intending to complete a topical major in philosophy should see either the appropriate advisor in the area or the department undergraduate advisor as soon as possible.*

GRADUATE DEGREE PROGRAMS

Applicants for admission to the Graduate School for work toward a master's or doctor's degree with a major in philosophy are expected to have had 18 or more semester hours in undergraduate courses in the subject.

Students wishing to pursue graduate work in philosophy should note Requirements for Advanced Degrees in the Graduate School section of this catalog and should obtain from the department a copy of the *Graduate Program in Philosophy.*

The department offers special M.A. programs in the History and Philosophy of Science and in Major Philosophies: Traditional and Modern. In connection with the Center for the Study of Values and Social Policy, the department also offers an M.A. and Ph.D. in values and social policy. These programs include an internship and the possibility of nonacademic placement.

Beyond the required course work and examinations for the Ph.D., a diversified faculty provides opportunity for a wide range of specializations in the dissertation project. The department makes available a limited number of teaching assistantships and assists with job placement. Descriptions of all degree programs are available from the Philosophy Department.

PHYSICAL EDUCATION

Office in Clare Small Gym, Room 113
Campus Box 354
Professor Dale P. Mood, Chairman

BACHELOR'S DEGREE REQUIREMENTS (B.S.P.E.)

Semester hours and grade point requirements for the degree Bachelor of Science in physical education are the same as those for the B.A. degree, listed under the College of Arts and Sciences Area Requirements, General and Major Requirements, and Scholastic Dismissal. (There is no foreign language requirement.)

A minimum of 32 and a maximum of 50 semester hours of credit in physical education may be counted toward the B.S.P.E. degree. The specific courses that may be counted to meet the above requirements are determined by the Department of Physical Education and Recreation and the dean of the College of Arts and Sciences. Information regarding the specific requirements of the various curricula options may be obtained from the departmental office.

Kinesiology Program

The primary aim of the kinesiology program is to provide students with a scholarly understanding of the multidimensional aspects of the study of human movement. These program plans do not include teacher preparation. Generally students wishing to prepare for graduate work or careers utilizing a strong background in physical education should choose a specialization in either exercise science or motor behavior. Students in this program are strongly urged to include the College of Arts and Sciences foreign language requirement.

Teacher Certification

The teacher certification program emphasizes skill, and experience necessary for teaching physical education. Courses can be added for coaching, athletic training, health, and special physical education. Specializations are available for different levels of teaching (elementary, secondary, or both). (There is no foreign language requirement.) A 2.5 grade point average is required for admission to all methods courses.

Education Courses Required

Physical education majors who have been accepted into the teacher education program must take certain required courses in teacher education for certification. Close planning with an advisor is essential.

Students should plan their programs so they can complete all general college and most physical education requirements prior to their final year. During the junior year students should check with their major advisor and the School of Education concerning the Teacher Education Program. A 2.5 grade point average is required for admission to student teaching.

In addition, students are required to pass the California Achievement Test in mathematics and English before working in the schools or taking T.Ed. 412.

Basic Degree Plan

The basic major program in physical education requires a minimum of 32 semester hours, including core course requirements. Students should consult with a physical education advisor about specific program and course requirements.

GRADUATE DEGREE PROGRAM

To obtain materials for application and for any additional information, address inquiries to the graduate coordinator of the Department of Physical Education and Recreation.

Departmental Requirements

Students may follow Plan I or Plan II for the degree program. The minimum requirement for Plan I may be fulfilled by presenting 30 semester hours of approved graduate work including 4-6 semester hours of thesis. The minimum requirement for Plan II may be fulfilled by presenting 33 semester hours of approved graduate course work including 1-3 semester hours of research project. Candidates for the master's degree may select Plan II only on the recommendation of the department.

Master of Science Degree (Physical Education)

Prerequisites. Entering graduate students must have an undergraduate preparation equivalent to the basic core course requirements in physical education and recreation at the University of Colorado or make up undergraduate deficiencies. Satisfactory scores on the Graduate Record Examination tests are also required for admission to the department's graduate program for regular or provisional degree status. These scores should be submitted at the time of application for admission to pursue a graduate degree.

Deficiencies. If the undergraduate preparation does not include required basic core courses, the student may be allowed to pursue graduate study with the understanding that certain deficiencies must be made up. The nature and extent of these deficiencies will be determined by the graduate coordinator and faculty members in the student's chosen program option.

Deficiencies in any area of the undergraduate major may be met by completing approved course work in the subject or by satisfactory examination. Courses taken to meet deficiencies may not be counted toward the master's degree. Graduate courses taken before removing deficiencies may be accepted for graduate degree credit only if prior approval of the graduate coordinator has been granted.

Program Option Requirements. Students may elect to specialize in one of the four following program options: exercise science, motor behavior, sports humanities, or recreation. Courses in the stated program option are to be selected in consultation with the student's graduate advisor. Students who wish to pursue a general rather than specialized degree program may select, in consultation with a graduate advisor, courses to form a program of study to fit the student's needs and interests.

Basic Requirements. In addition to the specific program options, the following are required of all students for the Master of Science degree: P.E. 592 (Application of Statistics to Physical Education and Recreation), P.E. 690 (Methods of Research); a minimum cumulative grade point average of 3.0 in all graduate work undertaken; satisfactory performance on the comprehensive examination; and requirements for advanced degrees as stipulated by the Graduate School. For students enrolled in Plan I, P.E. 700 (Thesis) is required; for students enrolled in Plan II, additional course work and P.E. 699 (Research Project) are required.

Comprehensive Examination. All candidates are required to take an oral comprehensive examination covering the thesis or research project as well as a written comprehensive examination covering course work leading to the degree.

Recreation

BACHELOR'S DEGREE REQUIREMENTS

Students who major in recreation examine numerous facets of leisure experience. Included in this study are the historical development and philosophical foundations, leadership functions, programmatic approaches, administrative structures, and relationship to other social institutions in our culture. In order to apply this knowledge to actual working environments, students supplement course work with supervised field experiences and internships within their areas of specialized interest. Students may select from two curricular options: Leisure Behavior and Commercial Recreation.

The Leisure Behavior option focuses on the social-psychological aspects of the leisure experience. Individual leisure values, motivations, attitudes, and interests are studied in a variety of leisure settings. In addition, the role of the leisure services manager in providing leisure services is addressed. Through academic and practical experiences, students study the impact that proper use of leisure has on the individual and society.

The Commercial Recreation option combines many of the specialties of business such as marketing, finance, economics, accounting, business law, and management, with the specific orientation of recreation. The extensive development of tourism and related commercial recreational enterprises is studied and the emergence of tourism as a major industry in the United States and the world is examined.

Major Requirements

In addition to the general college requirements, students majoring in recreation must complete a minimum of 30 semester hours in the recreation area, of which at least 18 semester hours must be in upper division courses. Courses fulfilling the nonrecreation requirements in the option selected by the student are to be chosen in consultation with a department advisor. Description of courses may be found under Physical Education.

PHYSICS

Office in Duane E-032
Campus Box 390
Professor Neil Ashby, Chairman

BACHELOR'S DEGREE REQUIREMENTS

Three curricula are available for students wishing to major in physics. *Plan 1* (45 hours of physics courses) is intended primarily for those students who plan to pursue graduate studies in physics. *Plan 2* (minimum of 36 hours of physics courses) is intended for students who desire an undergraduate concentration in astrophysics, atmospheric physics, or geophysics, or who want to combine a physics major with work in other areas such as applied mathematics, biophysics, chemical physics, environmental sciences, philosophy and history of science, premedicine, etc. *Plan 3* (minimum of 26 hours of physics courses plus 20 hours of education courses) is a program designed specifically for students intending to become secondary school teachers. Professional opportunities in physics are available for students graduating at the bachelor's level in any of these plans. Students in plans 2 or 3 who may wish to go on into advanced studies in physics can prepare themselves to start graduate work by taking more than the minimum number of courses listed for these plans. Moreover, it is possible at any stage of their college careers for students to transfer among plans, athough junior or senior students transferring into Plan 1 may require an additional semester or two of studies beyond the normal four years.

These three curricula do not constitute all of the options open to the student; they have been the most popular ones in the past. In addition, the content of courses and certain details of the requirements for the degree are changed from time to time. As far as possible, the department encourages students to pursue their own interests in setting up their curricula. The final responsibility for fulfilling the requirements for the degree rests with the student.

For these reasons, students who plan to major in physics should consult with their (departmental) advisors at least once per semester. Even if first-year students are only considering physics as a major, they are strongly encouraged to visit a departmental advisor and discuss the situation. Because most of the advanced physics courses have various prerequisites, failure to settle on an appropriate plan of study early in the college career can result in delay and complications later.

Eight hours of General Physics, Phys. 111 and 112,[1] are required of students in all three plans, preferably in the freshman year for majors in Plan 1. It is possible, with the approval of the advisor, for a student who starts with Phys. 301 and then decides upon a physics major to go directly into Phys. 112[1]. Similarly, it is not essential for students who have completed Phys. 302 to take Phys. 112 and 114 before continuing with the requirements listed below.

Phys. 212, a sequel to Phys. 111 intended primarily for majors in electrical engineering, may be substituted for Phys. 112 by other students in some cases. See the description of courses.

Students who have acquired the knowledge and skills equivalent to those taught in Phys. 111 and 112 may apply, following standard University procedure, for permission to take an advanced standing examination.

For graduation, Plan 1 physics majors must present credits in the following additional courses: 114, 213,[1] 214,[1] 215, 317, 318, 321, 322, 331, 332, 341, 491, 492, 495, 496; one year of general chemistry; Math. 130, 230, 240, and A.Math. 236 or Math. 313 and 443. Recommended upper division mathematics courses for Plan 1 majors include linear algebra, advanced calculus, complex variables, and partial differential equations. It is also recommended that Plan 1 majors take one or more semesters of a biological science. Students who intend to go on to do graduate work at the University of Colorado are advised to complete the fourth semester of a foreign language, inasmuch as this will fulfill the language requirement of the Graduate School.

For graduation, Plan 2 physics majors must present credits in the following additional courses: 114, 213,[1] 214,[1] 215, 317, 321, 322, 331, 332, 341; one year of general chemistry; Math. 130, 230, 240, and A. Math. 236 or Math. 313 and 443. In addition, a minimum of 3 hours of electives must be taken from the following courses: Phys. 318, 446, 451, 461, 462, 491, 495, 501, 503, 504, and 585.

A student in plan 2 is ordinarily required to satisfy an interdisciplinary requirement. The courses should be selected with the concurrence of the student's advisor, usually *prior* to the junior year. These interdisciplinary courses must be approved by the Arts and Sciences Advising Committee; *it is therefore imperative that students in Plan 2 be in close contact with their advisors.* Astrophysical, planetary, and atmospheric science courses numbered 300 or above are acceptable to meet the Plan 2 interdisciplinary requirement.

Plan 3 for physics majors is offered only with the 20-hours-in-education plan, and is intended for students going into secondary school teaching. In addition to the 8 hours of general physics listed above, students electing this major must also present credits in the following additional courses: Phys. 115, 213, 214, 216, 317, 321, and 331; one year of general chemistry; and Math. 130, 230, 240, and A.Math. 236 or Math. 313 and 443. Recommended elective mathematics courses for students in this plan include Introduction to Abstract Mathematics, Math. 272; Theory of Numbers, Math. 311; and Higher Geometry, Math. 321.

[1]The 116-217 honors sequence can replace Phys. 112, 213 and 214.

Combinations of courses which are recommended for meeting the College of Arts and Sciences area requirements are Phys. 101 and 102, Phys. 111 and 112, Phys. 301 and 302, APAS 111 and 112, and APAS 113 and 114; a more extensive list of possibilities is published in the *Schedule of Courses.*

GRADUATE DEGREE PROGRAMS

Graduate study and opportunities for basic research are offered in the areas of nuclear physics, theoretical physics, condensed matter physics, elementary particle physics, plasma physics, atomic and molecular physics, laser physics, and fundamental measurements.

Doctoral programs in chemical physics, geophysics, and mathematical physics are offered jointly with the Departments of Chemistry, Geology, and Mathematics, respectively. For information on these programs, see Interdepartmental Programs in the Graduate School section of this catalog.

In addition, a program leading to a Ph.D. in physics with a specialization in medical physics is offered jointly with the Department of Radiology at the Health Sciences Center.

Departmental Requirements

Students wishing to pursue graduate work in physics leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section of this catalog. Following are special departmental requirements.

Master's Degree (M.S.)

Prerequisites. Entering graduate students must have a thorough undergraduate preparation in physics, equivalent to an undergraduate physics major at the University of Colorado. This preparation includes courses in general physics, analytical mechanics, electricity and magnetism, thermodynamics, quantum mechanics, and atomic and nuclear physics, as well as two semesters of general chemistry, and mathematics through differential equations and complex variables.

Language. The department has no foreign language requirement.

Course Requirements. There are two separate plans for obtaining the master's degree. Plan I includes a thesis (4 hours), Phys. 621 (Theoretical Mechanics), 625 (Introduction to Quantum Mechanics), 631 (Electromagnetic Theory), and 632 (Electromagnetic Theory) along with electives (5 hours) and mathematics (3 hours). Plan II (without thesis) includes Phys. 621, 625, 631, 632, and 626 (Introduction to Quantum Mechanics) or 656 (Atomic and Molecular Spectra) along with mathematics (6 hours) and electives (9 hours). All courses must be graduate courses numbered 500 or above.

Qualifying Examination. The Graduate Record Examination aptitude tests and advanced test in physics are normally used in place of a qualifying examination, and this examination is normally taken before the time of entry into Graduate School.

Preliminary Examination. Each candidate for the master's degree, whether by Plan I or Plan II, must pass the preliminary examination. This examination is given each fall and spring semester. For details, see discussion under Doctor's Degree.

Comprehensive-Final Examination. After the other requirements for the master's degree are completed, each master's degree candidate must take a comprehensive-final examination. If the student is following Plan I, in which a thesis is included, the final examination will cover the thesis. The comprehensive-final examination will be oral.

Doctor's Degree (Ph.D.)

Prerequisites. Same as for master's degree, above.

Languages. The Department of Physics strongly recommends that the Graduate School communication requirement be met by fourth-semester courses in a living language taken while the student is an undergraduate. The department has no tool requirement in foreign languages.

Qualifying Examination. Same as for master's degree, above.

Preliminary Examination. The preliminary examination consists of two three-hour parts. It will be given on one or two days of the registration period at the beginning of the fall semester. This examination will be a written examination on the material covered in the undergraduate courses leading to a B.A. or B.S. in physics at the University of Colorado, or comparable courses at other institutions. All incoming regular or provisional degree students in the department are required to take this examination in their first semester.

The preliminary examination is also given at the end of the spring semester and it must be taken and passed at this time by all students who failed it in the fall and wish to continue in a graduate degree program in the Department of Physics.

Comprehensive Examination. On the weekend preceding the start of spring semester and the first weekend of the semester, the written part of the comprehensive examination will be given. The examination will cover the material in the courses normally taken by all Ph.D. candidates in the first and second years of graduate study. The oral part will be given shortly after the written part. The performance on both written and oral examinations will be the basis for decision on passing or failing of this general part of the comprehensive examination. A student who fails the general part of the comprehensive examination on his first attempt may take the examination once more a year later.

The final (research) part of the comprehensive examination is taken during the September following the passing of the general section. It consists of a presentation of a thesis prospectus to the student's thesis committee.

Course Requirements. A set of specific course requirements for the Ph.D. has been eliminated in order to increase the flexibility of the Ph.D. program. The total number of hours required for the Ph.D. in physics, however, is 39 (passed with a grade of *A* or *B*) of which

at least 27 must be from 500- or 600-level physics courses and the remainder must also be from that group or be substitutes approved by the Graduate Committee. Elimination of specific course requirements allows students who have a particularly strong background in one or more of the traditional core areas of physics to skip the appropriate courses in favor of additional physics electives. It is expected however that the student with typical undergraduate preparation will take Quantum Mechanics (625-626), Electricity and Magnetism (631-632), Statistical Mechanics (644), and Theoretical Mechanics (621). Most students will also find it necessary to take one or more Mathematical Physics courses. In addition, Advanced Quantum Mechanics (627) is considered essential material for Ph.D. level physicists.

For a Ph.D. in physics with a specialization in medical physics, the following physics and mathematics courses (24 semester hours) are required: Phys. 621, 631, 632, 625, 626, 644, and 6 semester hours of 500- or 600- level mathematics courses. In addition, 18 semester hours of courses in Medical Physics are required as follows:

Clinical Experience (Rad. 600-4)
Clinical Radiology (Rad. 610-2)
Basic Radiological Physics (Rad. 613-4)
Physics of Radiation Therapy (Rad. 615-2)
Physics of Medical Imaging I and II (Rad. 616-2 and 617-2)
Radiopharmacy, Anatomy, and Physiology (Rad. 623-2)

Final Examination. The final examination is oral and covers the thesis.

POLITICAL SCIENCE

Office in Ketchum Building, Room 106
Campus Box 333
Professor James R. Scarritt, Chairman

The Department of Political Science offers instruction and research on the art and science of politics. Work within the department is organized around seven basic fields: (a) American government and politics, (b) comparative politics, (c) public administration, (d) law and politics, (e) political philosophy, (f) empirical theory and methodology, and (g) international relations. Three major, current research interests cut across these areas and concentrate teaching and research efforts on the areas of American government, comparative politics, and international relations. The department houses two centers of research activities, the Center for International Relations and the Center for Public Policy Analysis, as well as an undergraduate program in International Affairs. A public service option is also available for undergraduates wishing to prepare for and participate in policy-oriented organizations outside of the University. Additionally, a five-year B.A./M.A. program is available for undergraduates interested in studying public policy. The department also participates in the distributed studies program, offering courses leading to a major combining computer science and data analysis skills with knowledge of the political system. Programs leading to the M.A., and Ph.D. degree are offered.

BACHELOR'S DEGREE REQUIREMENTS

Students majoring in political science must complete a minimum of 36 semester hours in this department (30 hours for the public service option and 30 hours for computer applications in political science), of which 30 hours must be with a grade of *C* or better. A minimum of 21 hours must be in upper division courses. Not more than 45 hours in political science courses will count toward the 124 hours the College of Arts and Sciences requires for graduation. All undergraduate transfer students majoring in political science must accumulate a minimum of 45 grade points in upper division political science courses at the University of Colorado in order to qualify for the B.A. degree.

Specific Requirements—Political Science Major

1. At least 9 hours must be completed with a grade of *C* or better in the following lower division courses: P.Sc. 110, 201 (or 211 *and* 212, or 202), 222, 240. Political science majors are not permitted the pass/fail option in any of the above courses. Students cannot receive credit for P.Sc. 201 if they have received credit for P.Sc. 211 and/or 212 (and vice versa).

2. At least 6 hours of upper division courses must be completed with a grade of *C* or better in each of the three primary fields: American, international/comparative, and theory. Political science majors are not permitted the pass/fail option in any of these courses. No course may be used in satisfaction of more than one field requirement.

3. P. Sc. 439, History of Political Philosophy, is required with a grade of *C* or better. Political science majors are not permitted the pass/fail option for this course. This course will count as one of the required upper division theory courses.

4. The following specific courses are required in related fields: Econ. 201 and 202, Principles of Economics. These two courses are in addition to the 36 hours required in political science and must be passed with a grade of *C* or better. Political science majors are not permitted the pass/fail option for these two courses.

Specific Requirements—Public Service Option

For students interested in a career in public service (government or private public-policy-oriented organizations), the Department of Political Science offers a special program designed to prepare students for such careers. This program is oriented toward the American political system; however, with special counseling students may organize their studies to emphasize another country or international organizations.

Public service option majors may also apply for early admission to the M.A. program in Public Policy Analysis. With proper planning, students may complete the two-year M.A. program in one year by substituting graduate level courses for public service option requirements during their senior year.

1. Each student must complete at least 30 hours and not over 45 hours in political science with grades of *C* or better, including 21 upper division hours in political science. None of these hours may be taken pass/fail.

2. The following specific courses are required: P.Sc. 110, 210, 432, 494, and Econ. 201 and 202.

3. At least one upper division course is required in each of the following two fields: international/comparative; political theory.

4. At least five courses are required from the following list, including at least one course in state/urban government, and at least one in federal government.

State/Urban Government

P.Sc. 402. Legislatures and Legislation
P.Sc. 406. State Government and Administration
P.Sc. 407. Urban Politics
P.Sc. 408. Municipal Government and Administration
P.Sc. 409. Comparative Metropolitan Systems
P.Sc. 452. Urban Policy Analysis

Federal Government

P.Sc. 400. Government Regulation of Business
P.Sc. 401. The American Presidency
P.Sc. 403. Political Parties and Pressure Groups
P.Sc. 404. Advanced American Government: The Congress
P.Sc. 405. Public Opinion/Public Behavior
P.Sc. 434. National Security Organization and Policymaking
P.Sc. 435. Environment and Public Policy
P.Sc. 437. Public Priorities: Revenues and Program Expenditures
P.Sc. 456. Bureaucratic Power in American Politics

Law

P.Sc. 248. Introduction to the American Legal Process
P.Sc. 446. Administrative Law
P.Sc. 447. Constitutional Law I
P.Sc. 448. Constitutional Law II
P.Sc. 449. The Judicial System
P.Sc. 492. Women and the Law

Other Departments

Econ. 421. Public Finance
Econ. 425. Urban Economics

5. To enhance their quantitative skills public service option majors are required to take P.Sc. 494, Quantitative Research Methods (see paragraph 2) and 15 hours of courses from the following lists:

a. Computer Science: C.S. 120, 121, 324
b. Math/Statistics: Math. 107, Math. 108, and Econ. 381
c. Accounting: Acct. 200, 202, 322, 332, 480

A student may request in writing that specific alternate courses be approved by the department in place of one or more from the above list.

6. A public service option student may wish to consider a semester internship during the junior or senior years (P.Sc. 480). The normal internship requires about 15 hours of work per week for three credits. A full-time internship may result in 6 credit hours. An internship is *not required,* however.

Specific Requirements — Computer Applications in Political Science

Computers are becoming increasingly important in political science research. The Political Science Department offers a computer applications in political science option for students interested in combining a political science major with course work in computer science. This option will be especially appropriate for students considering careers in public policy analysis, public administration, or research and teaching in political science.

In addition to certain required computer science courses designated by the College of Arts and Sciences, the following specific requirements are required in political science:

1. Each student must complete a minimum of 30 hours in political science with grades of *C* or better and a minimum of 21 upper division hours in political science. None of these hours may be taken pass/fail.

2. At least 6 hours must be completed in the following lower division courses: P.Sc. 110, 201 (or 211 *and* 212, or 202), 222, 240. Students cannot receive credit for P.Sc. 201 if they have received credit for P.Sc. 211 and/or 212 (and vice versa).

3. At least 6 hours of upper division courses are required in each of the following two primary fields: American; international/comparative.

4. P.Sc. 439, History of Political Philosophy, and P.Sc. 494, Quantitative Research Methods, are both required.

5. Either P.Sc. 405 *or* 421 is required. The course selected may be used as one of the courses in the appropriate field mentioned in item 3.

GRADUATE DEGREE PROGRAMS

The faculty encourages applications for the M.A. and Ph.D. degrees from qualifed and motivated students wishing to probe deeply into the analysis of political life. Professional courses in the graduate curriculum range from the analysis of Colorado water policy to the study of the political economy of the global system. The curriculum is structured to lead the Ph.D. degree as well as offer several programs culminating in the M.A. degree. In addition to the M.A. degree in political science special focus is placed on two professionally oriented M.A. degrees, one that is oriented toward entry into the public sector as a policy analyst and one concentrating on preparing students for positions in international organizations.

Students wishing to pursue graduate work toward one of these degrees should read carefully the Graduate School requirements for admission and degrees in this catalog. In addition they should write to the departmental office for additional information on graduate programs.

The department does not offer the Plan II option for the Master of Arts degree.

Departmental Admission Requirements

Applicants to the graduate program in political science should normally present evidence of at least 18 semester hours of course work in political science, 9 of which should be at the upper division level. In addition the department requires applicants to the program to present quantitative and verbal GRE scores, that total at least 1000, and that show at least a score of 400 on the verbal. Four letters of recommendation, an undergraduate grade point average of at least 2.75, official transcripts, and a short essay detailing interests and plans are also required to complete the application

packet. Those applying directly to the Ph.D. program must possess a M.A. degree. Applications should be filed with the department by February 28, although late applications are considered until May 15. Decisions regarding admission and financial aid are typically completed during the first half of March each year.

Doctor of Philosophy

An applicant must have a master's degree in political science or in a related field from this University or from another accredited institution before entering the Ph.D. program.

The Department of Political Science requires at least 42 hours of course work (with a grade of *A* or *B* beyond the bachelor's degree for the Ph.D. Except for 3 semester hours which may be taken at the senior undergraduate level in a cognate field at this University, all 42 hours must be at the 500 level or above. Not to be included in the 42 hours are dissertation and research hours, master's thesis hours, or those hours used to fulfill the language and statistics requirements. The 42 minimum hours must include at least two seminars in each of the three fields which the candidate presents for the written comprehensive examination. Furthermore, each student's program shall include at least one seminar in each of the following three categories: (1) American (American government, public administration, law and politics); (2) International Relations/Comparative Politics (comparative politics, international relations); (3) Theory (political philosophy, empirical theory, and methology).

Twenty-seven hours must be taken in political science. Of this 27, 24 must be in regularly scheduled seminars, not more than 6 hours of which may be transferred from another accredited institution. Not more than 6 hours of P.Sc. 599 and 699 (Graduate Research Topics) combined will be allowed toward the degree. The maximum amount of work which may be transferred to this University for the Ph.D. is 10 semester hours, but the Department of Political Science will accept an additional 5 hours as in-house credit toward the degree.

The First-Year Requirements. Each beginning graduate student for the Ph.D. program is required to take a core seminar in the fields of American politics, comparative politics, and international relations during their first year in residence. In addition, each incoming student will take a course focusing on a broad-ranging introduction to the methods of research and inquiry in political science. Further, during the first year of residence each student will take an additional core seminar which will be chosen by the student from the fields of political philosophy, law and politics, public adminstration, and empirical theory and methods.

Students will be required to formulate an area of interest in collaboration with their major advisor which will lead to the formulation, execution, and written presentation of a piece of original research. This research paper will demonstrate original research of potentially publishable quality and will be due the first day of finals in the second semester of residence. This work will be evaluated by five readers. Following this, an oral examination focused on the content of the core seminars will be conducted by the student's major advisor and two other members of the department.

Advisory Committee. The role of the Advisory Committee is crucial. Its function is to guide students in their progress through their degree programs. Students shall select a chairman for their Advisory Committee before the end of the semester during which the requirements for the Ph.D. preliminary examination are fulfilled. Normally this will be by the end of the second semester in residence. Exceptions will occur if a part or all of the preliminary examination must be retaken. If a student does not select a chairman during the time specified, the departmental chairman shall designate such a chairman for the purpose of administration and advising.

The Advisory Committee shall consist of three regular faculty members in residence who are members of the political science graduate faculty and who each represent one of the student's fields of concentration. The second and third members of the Advisory Committee shall be selected by the student with the approval of the chairman of the committee within two weeks after the selection of the advisory chairman. The Advisory Committee shall meet with the student at least once during each academic year to review the student's progress and to assist in planning the student's future course of study.

Changes in the composition of the Advisory Committee may be made by the Graduate Curriculum Committee, upon petition from the student or one or more members of the student's Advisory Committee.

Language Requirement. The department requires fulfillment of the Graduate School Communication Requirement 1.

Statistics Requirement. Each student shall be required to take at least two courses from among those designated by the Graduate Curriculum Committee. The Graduate Curriculum Committee will distribute a list of these courses on an annual basis.

Comprehensive Examinations. Comprehensive examinations shall consist of a written and an oral part. The written examination shall cover the three fields of concentration selected by the student; the oral examination will be a rigorous comprehensive test of the student's knowledge of the major field of emphasis, including the location of the field in a broad comparative, philosophical, and methodological context.

For the purpose of the comprehensive examination, the discipline of political science is divided into the seven fields listed above. In the preparation of the student's comprehensive examination, each member of the Advisory Committee, in conjunction with not less than two other members of the department who are rostered in the same field of concentration, shall design a written examination which shall seek to measure the candidate's range of knowledge over the field involved, as well as the capacity to engage in sophisticated analysis of specific problems identified with that field. The student shall demonstrate close familiarity with the literature of the three fields chosen for the written examination and shall consult frequently in this regard with the members of the department who are rostered

in those fields. Students must receive a *pass* or *high pass* from at least two members of the three-member committee in each field to pass that examination.

A student who fails to pass the written comprehensive examination in any field shall be allowed to take that written comprehensive examination again during the following semester. If the student fails this second examination, he or shall shall automatically be dismissed from the department's graduate program.

No student may be permitted to take the oral part of the comprehensive examinations until he or she has passed the written part.

The oral part of the comprehensive examination shall be scheduled within two weeks after the student has passed the written examination. Normally, this examination shall be administered by the three persons who prepared the student's written examination in the major field of emphasis, plus two additional members selected by the Graduate Curriculum Committee from the faculty roster for this field of emphasis. To insure comprehensiveness where appropriate, one member of the oral examining committee, representing the student's major field of concentration, may be drawn from outside of the department. If a student fails the written examinations, the oral examination will be canceled in accordance with departmental rules. At least four of the five members of the examining committee must concur for a student to pass this examination. A student may retake the oral part of the comprehensive examination once, after a lapse of not less than eight months. To the extent possible, this reexamination will be conducted by the same examiner(s). If the student fails this second examination, he or she shall automatically be dismissed from the department's graduate program.

Dissertation Requirements and Final Examination. A dissertation based on original investigation and showing mature scholarship and critical judgment, as well as familiarity with tools and methods of research, is required. A candidate for the Ph.D. shall select a dissertation topic in consultation with a dissertation advisor who is rostered in the student's primary field of emphasis, a second reader who has general competence in the dissertation topic, and at least one additional faculty member rostered in the student's primary field of interest. The dissertation advisor shall submit the topic, along with the names of the second reader and other faculty consulted in its selection, to the departmental chairman for approval. These steps must be completed at least eight months prior to the dissertation defense.

Once the dissertation has been accepted tentatively by the first two readers, a final oral examination will be conducted by the dissertation committee. Approved by the dean of the Graduate School, the committee shall consist of not fewer than five representatives from those departments in which a student has worked, including at least one professor outside the Political Science Department but who is a member of the University of Colorado graduate faculty.

The examination is open to the public. More than one dissenting vote from the committee will disqualify the candidate in the final examination.

Graduate Minor in Political Science

Graduate students who choose to minor in political science should consult the College of Arts and Sciences section for the descriptions of 400-level courses, since minors but not majors are eligible to receive credit for 400-level courses.

Master of Arts in Political Science

Students desiring a graduate major in political science should present 18 semester hours of undergraduate work in the subject, 9 hours of which must be in upper division courses. Any deficiencies must be made up before the student will be admitted as a regular degree student and the work involved will be in addition to the minimum hourly requirements for the degree.

Political science is divided into seven fields: (1) American Government and Politics, (2) Comparative Politics, (3) International Relations, (4) Public Administration, (5) Law and Politics, (6) Political Philosophy, and (7) Empirical Theory and Research Methods. Students shall concentrate in any one of the fields and offer 3 semester hours of work in regularly scheduled political science seminars in each of three areas defined as follows: American, including (1), (4), and (5) above; International, including (2) and (3) above; and Theory, including (6) and (7) above.

Students are responsible for familiarizing themselves with all degree requirements, some of which are outlined in the Graduate School section of this catalog. In brief, the degree requirements include a minimum of 25 semester hours of graduate credit, encompassing (a) at least 21 semester hours at the 500 level or above, to include at least 12 semester hours of work in regularly scheduled political science seminars; and (b) 4 semester hours for the M.A. thesis. Students may offer up to 6 hours in (1) P.Sc. 599 and/or P.Sc. 699, and (2) up to 6 hours in a cognate discipline (graduate seminar, senior undergraduate course, or independent study), but not more than a total of 9 hours may be in (1) and (2) combined. The 9 semester hours may not be substituted for required seminars. The student must take work from at least four members of the graduate faculty.

Students shall select a faculty advisor from among the regular members of this department's graduate faculty at the earliest possible date, but no later than the end of the second week of the second semester of residence. The faculty advisor must have general competence in the student's primary field of emphasis and will serve as the first reader of the M.A. thesis. The second reader, who shall likewise have general competence in the topic of the M.A. thesis, must be associated intimately with the thesis from its inception and in no case after the student begins writing. The completed draft of the thesis must be in the hands of the second and third readers at least four weeks prior to the comprehensive-final examination.

The purpose of the thesis is to build on mastery of the substantive materials for the chosen topic in order to apply one or more conceptual/analytical devices to those materials and to end with a sophisticated, systematic conclusion.

Each candidate for a master's degree is required to take a comprehensive-final examination *after* the other requirements for the degree have been completed. This examination may be given near the end of the last semester of residence while the candidate is still taking required courses for the degree, provided satisfactory progress is being made in those courses. The examination will be oral and last approximately two hours. It will concentrate on the student's field of emphasis as well as the M.A. thesis. The Comprehensive-Final Examination Committee will have three members, including the faculty advisor (in the chair) and the second reader of the thesis. At least two committee members must be chosen from among regular members of the graduate faculty of this department, in consultation with the faculty advisor; the third committee member may be a Graduate faculty representative from a cognate discipline. Satisfaction of the examination requires the affirmative vote of each of three committee members.

M.A. comprehensive-final exminations shall normally not be given during the summer months. In exceptional circumstances, a student may petition the Graduate Curriculum Committee of the department, showing cause why this rule should be waived. Such a petition shall be received no later than April 15.

Master of Arts in Political Science (International Affairs)

The increased participation of the United States in world politics has opened a variety of new careers in international affairs. The master's program in international relations of the Department of Political Science is designed to provide a well-rounded education in international affairs for students who are seeking careers of international service with the national government, with international organizations, with private business, with nongovernmental organizations, or in the fields of teaching and research. This M.A. program is also a logical step toward obtaining a Ph.D. in political science at the University of Colorado or elsewhere.

Students desiring an M.A. in political science (international relations) shall normally offer 12 hours of work in the international area, 9 of which must be in the field of international relations, and 3 hours in two other areas: American and theory. It is advisable for the student to include the international relations proseminar in the 9 hours in the field of international relations. If a student's plan of studies so indicates, and permission is granted by the student's faculty advisor and the department chairman, the student may substitute up to 6 hours of credit from another department for the 3 hours in each of the other two areas of study.

Each student in this program must pass a GSFLT proficiency test in a foreign language approved by the student's advisors and/or present evidence of an advanced proficiency in social statistics or computer science. The latter proficiency may be achieved by obtaining a *B* or better in a sequence of courses to be identified by the student's committee. A list of the course sequences that have been approved to meet this requirement will be available in the departmental office. In exceptional cases, the committee may accept other evidence that the student has acquired a good working knowledge of a foreign language or the advanced proficiency in social statistics or computer science.

The degree requirements include a minimum of 25 semester hours of graduate credit, encompassing (a) at least 21 semester hours at the 500 level or above, to include at least 12 semester hours of work in regularly scheduled political science seminars; and (b) 4 semester hours for the M.A. thesis. A maximum of 9 semester hours may be offered in a combination of (1) P.Sc. 599 and/or P.Sc. 699, and (2) a cognate discipline; not more than 6 hours will be accepted in either (1) or (2). These 9 semester hours may not be substituted for required seminars. The student must take work from at least four members of the graduate faculty. Transfer of credit may not be applied for until the student has been in residence for one semester and completed, with a *B* or better average, a full-time course load.

Early in the first semester of residence, each student must arrange for a qualifying interview with a graduate faculty member in the student's special areas of interest (this may be a temporary advisor). Degree plan forms can be picked up in the departmental office at Boulder.

Students shall select a faculty advisor from among the regular members of this department's international relations graduate faculty at the earliest possible date, but *no later than the end of the second week of the second semester in residence.* The faculty advisor will serve as the first reader of the M.A. thesis. The second reader *must be associated intimately with the thesis from its inception, and in no case after the student begins writing.* The completed draft of the thesis *must* be in the hands of the second reader, and of other readers if appropriate, at least four weeks prior to the comprehensive-final examination. At no time will the oral examination be scheduled until the thesis is found substantially acceptable to the first two readers. Students should choose a thesis topic and begin research as soon as feasible during their program of study. Students need not register for all 4 hours of thesis at one time and *must not* register for more than a total of 4 thesis hours.

The purpose of the thesis is to build a mastery of the substantive materials for the chosen topic in order to apply one or more conceptual/analytic devices to those materials and to end with a sophisticated, systematic conclusion which includes a synthesis of the insights embedded in the elements of the analysis and a critical review and assessment, in light of the materials and topic covered, of the conceptual/analytic devices used.

Each candidate for a master's degree is required to take a comprehensive-final examination *after* the other requirements for the degree have been completed. This examination may be given near the end of the last semester of residence while the candidate is still taking required courses for the degree, provided satisfactory progress is being made in those courses. *Not later than ten weeks before the date on which the students expect to schedule their comprehensive-final examination, they must file an application for candidacy. Forms are available in the departmental office.* Students must be registered for the term during which they take the final examination for an advanced degree. If students have

completed all course hours and have previously registered for the total 4 hours allowed for the thesis, they will register "Candidate for Degree" to take the final examination. This examination will be oral and last approximately two hours. It will concentrate on the student's field of emphasis as well as the M.A. thesis. The Comprehensive Examination Committee will have three members, including the faculty advisor (in the chair) and the second reader of the thesis. At least two committee members must be chosen from among regular members of the graduate faculty of this department, in consultation with the faculty advisor; the third committee member may be a graduate faculty representative from a cognate discipline. Satisfaction of the examination requires the affirmative vote of each of the three committee members.

M.A. comprehensive examinations shall normally not be given during the summer months. In exceptional circumstances, a student may petition the Graduate Curriculum Committee, showing cause why this rule should be waived. Such a petition shall be received no later than April 15.

Master of Arts in Political Science (Public Policy Analysis)

The goal of this program is to produce professionally oriented policy analysts for the public and private sector.

This is two-year (and two summers) Master of Arts program with thesis, requiring 42 hours of credit, including 36 hours of course work divided among a core curriculum (including a quantitative methods requirement), geographical context courses, and one topical area of specialization. The remaining 6 hours include 2 hours of internship credit and 4 hours of thesis credit. The student must take work from at least four members of the graduate faculty and must take work in his or her specialization from at least two members of the graduate faculty.

The core curriculum consists of 21 required seminar hours including the quantitative methods requirement.

Seminar hours include Public Policy Analysis, Problems of Public Policy Analysis Workshop, Research Methods, Political Theory and Public Policy, and Legal Foundations of Public Policy Analysis (3 hours each). Foreign students may substitute an additional context course for the legal foundation course.

Quantitative methods (6 hours) is fulfilled by taking one course in intermediate statistics and one course in advanced analytic methods, selected from lists of appropriate courses approved by the department. If these courses require prerequisites which the student does not have, these prerequisites must be added to the minimum of 42 hours required to complete the program. Specific courses within each list must be selected in consultation with a specialization advisor, and any departure from the lists must have the approval of the program administrator.

The geographical context component consists of 3 required seminar hours selected from the following list: (1) P.Sc. 501 (American Politics); (2) P.S. 502 (Colorado Politics) or a seminar in state politics; (3) P.Sc. 509 (Metropolitan Politics) or a seminar in local politics; (4) P.Sc. 536 (Intergovernmental Relations); (5) P.Sc. 511 (Political Development), P.Sc. 515 (Political Economy of Marxist Socialist States), or a seminar in the politics of industrial democracies; (6) area seminars including P.Sc. 510 (Comparative Politics — Western Europe), P.Sc. 513 (Latin American Politics), P.S. 519 (Comparative Politics — Sub-Saharan Africa), P.Sc. 561 (Political Systems of China, Japan, and Korea); (7) P.Sc. 521 (International Relations).

The topical specialization component consists of 12 required hours. The following specializations are offered:

1. Energy, Environmental and Natural Resources Policy
2. National Economic Growth, Distribution, and Income Maintenance Policies
3. Communications Policy
4. Participation, Self-Management, and Labor Policy
5. Mediation, Arbitration, and Conflict Management
6. Human Rights Policies
7. Legal Policy
8. Foreign and Defense Policy
9. Human Resources and Social Policy
10. Land Use and Growth Management Policies
11. Science Policy

Course work in the specialization may include a maximum of 3 hours of P.Sc. 699 (Graduate Research Topic) and a maximum of 3 hours of P.Sc. 599 (Topics in Political Science).

Specific courses within each list must be selected in consultation with a special advisor, and any departure from the lists must have the approval of the program administrator.

The administrator of the M.A. program shall appoint advisors for each specialization who conduct qualifying interviews with students in that specialization and work out their degree plans with them during their first semester in residence. Students may change their specialization during their first year in the program but must then draw up a new degree plan with an appropriate specialization advisor.

The internship must be within the area of specialization. The departmental director of internships assists students in securing relevant internship positions.

The M.A. thesis is a research report on a policy problem and provides a concrete demonstration of the analytical skills, intellectual perspective, and substantive knowledge acquired in course work. When possible, the practical experience gained in the internship will be utilized in the thesis. As a general rule the research report will be somewhat shorter (but not less analytical) than the standard M.A. thesis. The thesis must be supervised by the thesis advisor and the second reader, both of whom must be rostered in the student's area of specialization. The thesis advisor and the second reader must be associated intimately with the thesis from its inception and in no case after the student begins writing. The completed draft of the thesis must be in the hands of all readers at least four weeks prior to the comprehensive-final examination.

Each candidate is required to take a comprehensive-final examination after the other requirements for the degree have been completed. This examination may be given near the end of the last semester of residence while the student is still taking required courses for the degree, provided satisfactory progress is being made in

those courses. When possible, comprehensive-final examinations taken during the summer should be scheduled during the week prior to the beginning of the fall semester. At no time will the oral examination be scheduled until the thesis is found substantially acceptable to the first two readers. The oral examination covers the entire program and will last approximately two hours. Satisfaction of the examination requires the affirmative vote of each of the three committee members.

PSYCHOLOGY

Office in Muenzinger Building, Room D244
Campus Box 345
Professor Lyle E. Bourne, Chairman

BACHELOR'S DEGREE REQUIREMENTS

A major in psychology requires a minimum of 30 hours with grades of *C* or better. Required courses or courses to count in the 30 hours may not be taken pass/fail. *In addition*, the average of all work in psychology must be at least 2.0. A grade of *D* in a required psychology course will not fulfill the requirement although the college will accept the credit hours.

Psychology majors must complete each of the following requirements:

1. Psy. 100.
2. Psy. 210.
3. At least one course from each of the following lists:
   a. Psy. 414, 416, 420.
   b. Psy. 430 *or* 431 (but not both), 440, 445, 485.
4. At least two courses from the following list:
   c. Psy. 405 and/or 410. If only one is taken, one of the following courses must also be taken: 409, 425, 438, 468.
5. Psy. 400 or 451.

Transfer students must take at least one course from requirements 3a, 3b, and 4 in *this* department on the Boulder Campus.

Students intending to major in psychology are advised to include college algebra in their lower division schedules.

GRADUATE DEGREE PROGRAMS

Departmental Requirements

Students wishing to pursue graduate work in psychology leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section of this catalog. The M.A. is considered a step to the Ph.D., and students who do not intend to pursue the latter degree are not admitted. Following are special departmental requirements.

Requirements for Minors in Psychology

For the M.A. degree a minimum of 6 hours is required as a minor.

The prerequisite for a minor in psychology is 9 hours of undergraduate psychology.

Statistics cannot be included in either prerequisites or requirements for minors in psychology.

Doctor's Degree

Prerequisites. Students who wish to become candidates for the Ph.D. degree must show evidence of having covered the work equivalent to that required for a master's degree.

Language Requirements. No foreign language is needed for the Ph.D. beyond the one required by the Graduate School.

RELIGIOUS STUDIES

Office in Woodbury Building, Room 205
Campus Box 292
Associate Professor Rodney Taylor, Chairman

HISTORY AND PERSPECTIVE

The academic study of religion began at the University of Colorado, Boulder as a program in 1970. Since then it has grown to full departmental status, with B.A. and M.A. degrees and a diverse and productive faculty with leadership roles in a number of fields. The curriculum includes the study of Mesoamerican and Native American religions, Buddhism, Hinduism, Taoism, Confucianism, Judaism, Islam, and Christianity. A variety of theoretical and methodological perspectives and approaches are utilized throughout the curriculum and they are critically and extensively considered in special courses. Particular emphasis is placed on the study of indigenous American religions. Colorado is an excellent place for such work because of its geographic location and easy access to sites and contexts in the American West, Southwest, and Mesoamerica. In addition to ongoing courses, special lecture series, and research-oriented projects such as the Templo Mayor Archive (maintaining a complete record of the excavation of the great Aztec temple in Mexico City), the department, in cooperation with other disciplines, sponsors special summer seminars on various topics for graduate students, college teachers, and other professionals with an interest in religious dimensions of the history and culture of the Americas.

BACHELOR'S DEGREE REQUIREMENTS

1. Satisfaction of the regular college requirements for the Bachelor of Arts degree.
2. At least 36 hours in courses on religion, including R.St. 162, 260, 262, and 499.

MASTER OF ARTS IN RELIGIOUS STUDIES

Degree Requirements

The Master of Arts in religious studies requires the satisfactory accomplishment of the following:

1. At least 24 hours of graduate level course work, plus a thesis (4-6 hours), must be completed. The course work must include R.St. 690, Theory and Method in the Study of Religion. Students must outline their programs of study under the guidance of a faculty

committee. Up to 9 hours of course work may be taken outside the department consistent with the student's special needs and interests.

2. A satisfactory reading knowledge of a foreign language appropriate to the chosen field of specialization must be demonstrated.

3. Prior to thesis work, a written comprehensive examination of approximately 6 hours in length must be passed.

4. An acceptable thesis must be written and, after approval of the final draft of the thesis, an oral examination dealing with the subject matter of the thesis must be passed.

SLAVIC LANGUAGES AND LITERATURES

Office in McKenna Building, Room 16
Campus Box 279
Professor C. Nicholas Lee, Chairman

The department offers a major in Russian, emphasizing language, literature, and linguistics. The aim of the curriculum is to equip students to read, write, speak, and understand Russian on a level allowing communication with natives and other users of the language. Before registering for a course, students should consult with a departmental advisor concerning appropriate placement. Students interested in Russian should consider a double major in order to increase their career opportunities. Prospective teachers might combine Russian with a major in another foreign language, while those preparing for a career in government service should benefit from a combination of Russian and a social sciences major. Faculty members in other departments who have expertise in areas where important Soviet research is being done can advise students on the way Russian study relates to their specialty.

COURSES IN TRANSLATION

The Department of Slavic Languages and Literatures offers a number of courses in translation. These courses generally require no previous study in the language, history, or culture of the area involved, and are open to all interested students, whether majors in this department or not.

Russ. 221-222 (Introduction to Russian and Soviet Culture) may be counted as a first-year course sequence to satisfy the college humanities requirement. The second-year humanities requirement may be satisfied by any two-semester 400-level Russian or Ukrainian literature in translation sequence.

BACHELOR'S DEGREE REQUIREMENTS

Russian

Majors normally complete 35 hours beyond the first year or 30 hours beyond the second year. Courses that must be taken in residence are Russ. 401-402, one 400-level author, period, or genre course taught in Russian, Russ. 481 and 492. Further information may be found on the major sheet, which may be obtained from the department.

Language Placement. One year of high school Russian is usually considered equivalent to one semester of college Russian. Thus a student with two years of high school Russian should enroll in Russ. 201 or 211. Students who think that they should be placed at a level different from the normal one should consult the department for advice.

Note: the preplacement coding on the advisement card is intended as a guide, and students may begin their college Russian at a level below the preplacement level without loss of credit, or above the preplacement level, if the department so recommends; thus it is very important to consult with the department before registering.

Students studying Russian may earn credit for courses taken in the summer or during the academic year in the U.S.S.R. after consultation with the department. Information on such programs may be obtained through the Office of International Education.

GRADUATE DEGREE PROGRAM

The department offers an M.A. program in Russian. Students who wish to enter the department's graduate degree program should consult not only the following description of requirements for the master's degree, but also the Graduate School section and the detailed announcements and reading lists published by the department.

Master's Degree

Prerequisites. Knowledge of the Russian language (in most cases this prerequisite is satisfied by four years of college Russian or its equivalent) and a general knowledge of Russian history and literature.

Course Requirements. In general, students working toward the M.A. degree in Slavic are advised to follow Plan II (see the Graduate School section of this catalog); however, with the permission of the department, a thesis program (Plan I) may be followed.

Plan II. Before admission to candidacy a student must complete at least 30 semester hours of course work distributed among either three major fields or two major and two minor fields. With departmental permission, a major field may be constituted from related courses in more than one minor field.

A major field consists of not fewer than three courses in 19th-century or 20th-century Russian literature.

A minor field is made up of two or more courses from a related field of study, such as Russian or East European history, comparative literature, general linguistics, etc.

The choice of major and minor fields must be made in consultation with the department's graduate advisor.

Examination. A qualifying examination may be required during the first semester of resident study to determine whether the prerequisites have been satisfied.

After admission to candidacy, a student must pass a comprehensive examination, usually consisting of a written and an oral part. This examination will be conducted partly in Russian and will cover the reading list as well as course work.

Language Requirement. Before admission to candidacy, the M.A. student must demonstrate a reading knowledge of French or German. This requirement may be satisfied in any of the following ways:

1. By presenting three semesters of college-level credits in the language (or three units of high-school work).
2. By passing the Graduate School ETS Language Test.
3. By passing a departmental examination of comprehension of a text in linguistics or criticism of moderate difficulty in the language chosen.

SOCIOLOGY

Office in Ketchum Building, Room 219
Campus Box 327
Professor Ray P. Cuzzort, Chairman

BACHELOR'S DEGREE REQUIREMENTS

Students are required to take a minimum of 30 semester hours in sociology. A maximum of 45 semester hours may be taken. All hours in sociology being counted toward the major must be with grades of *C* or better; at least 18 hours of these courses must be in upper division credit. Pass/fail grades are not acceptable in satisfying the 30 semester hours for a sociology major. Not more than 8 semester hours of independent study may be counted toward the 30 semester hours in the major and not more than 16 hours may be counted toward the bachelor's degree.

Courses required for the major are Introduction to Sociology I and II (Soc. 211 and 212), plus one of the following 6-credit-hour courses: Research Methods in Sociology (Soc. 463) and Field Experience in Sociology (Soc. 464). Students should contact the departmental office for further clarification of major requirements.

The department offers special concentrations within sociology: Social Psychology, Social Conflict, and Criminology and Criminal Justice. For further information regarding these concentrations, students may contact the department office in Ketchum 219 or write to Campus Box 327 at the University.

GRADUATE DEGREE PROGRAMS

Departmental Requirements

Students wishing to pursue graduate work in sociology leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section of this catalog.

The following are additional requirements for admission to the graduate degree programs of the department:

1. A combined grade point average of at least 3.0 (*B*) for all courses in sociology undertaken as an undergraduate or graduate student prior to admission.
2. Satisfactory scores (as determined by the department) on the Graduate Record Examination including both the verbal and quantitative sections and at least one advanced test. This examination may be taken at any location in the United States certified by the Educational Testing Service and the results may be sent to the department by the Educational Testing Service or the institution administering the examination.

Master's Degree

The department offers two types of M.A. degrees:

1. A general M.A. earned through one of two plans:
   a. Twenty-four semester hours of course work at the 500 level or above; an M.A. thesis (6 semester hours); an M.A. comprehensive final examination.
   b. Thirty semester hours at the 500 level or above; an M.A. comprehensive final examination. This plan may be selected by a candidate only on recommendation of the department.

Both plans require the candidate to meet departmental theory, methods and statistics course requirements.

2. An M.A. with a concentration in either social conflict or criminology and criminal justice. The student in Social Conflict may elect either Plan A or Plan B above and must meet the course requirements of both the department and the concentration. For information regarding these concentrations, contact the departmental office in Ketchum 219 or write to Box 327 at the University.

The Doctorate

A detailed description of the Ph.D. program is given in the *Graduate Handbook* available from the graduate secretary of the department. The main requirements are:

1. Minimum of 54 semester hours of approved graduate work, *all of which must be 500 level or above.* At least 24 of the 54 hours must be taken in the Sociology Department of the University of Colorado at Boulder.
2. The following required courses must be included in the 54 hours minimum: 6 semester hours of sociological theory (Soc. 500 and 501); 12 semester hours of methods and statistics (including Soc. 502 and 503); and 3 semester hours of research practicum (Soc. 504, 505, 506, 507, and possibly 592).
3. By the time a student accumulates 24 hours of graduate credit in the department, he or she must pass the preliminary examination.
4. Students must also pass the comprehensive examination. They become eligible for this examination only after they have satisfied requirements 1, 2, and 3 above.
5. Students must demonstrate at least second-year college proficiency in a foreign language.
6. The student must write a Ph.D. dissertation.
7. Satisfying requirements 1-6, the student must pass the Ph.D. final examination.

All inquiries about the graduate programs of the department should be addressed to Chairman, Committee on the Graduate Program, Department of Sociology.

SPANISH AND PORTUGUESE

Office in McKenna Building, Room 126
Campus Box 278
Professor Anthony Lozano, Chairman

Students who have completed a Level III high school Spanish or Portuguese course have automatically satis-

fied the college graduation requirement in foreign language. This requirement may also be satisfied by completion of Span. or Port. 211 or by demonstration of equivalent proficiency by placement test. Students who have studied Spanish in high school and wish to continue with the language will be placed by examination. A student may not receive credit for a course at a lower level than that into which he is placed.

BACHELOR'S DEGREE REQUIREMENTS

1. A total of 35 credit hours in Spanish courses (at the 200 level or above), including the following minimum distribution: (a) *at least* 9 hours in upper division courses primarily devoted to language theory and practice (Span. 301-302, 303-304, 305, 306, 401-402, 495); (b) *at least* 8 hours in upper division literature courses including *at least* one course treating Spanish peninsular literature and one treating Spanish American literature; (c) *at least* 12 hours in courses numbered 400 or above, taken on the Boulder Campus.

2. A total of not more than 6 hours from the following courses may apply to the Spanish major: Span. 211-212, 400.

3. An additional 6 hours in courses from one or more of the following areas: (a) courses listed in the Latin American Studies program (e.g., history, art history, political science, etc.); (b) courses in Chicano Studies; (c) linguistics; (d) upper division courses in another foreign language or comparative literature; (e) Port. 101-102.

4. A major with emphasis on International Spanish for the Professions is offered with the same requirement as paragraph 1, except that 12 hours in business Spanish courses (303-304, 406-407) will be substituted for the literature courses. (See department for additional requirements. This is a controlled enrollment program with limited space. The student must apply for admission at the beginning of the fourth semester.)

Students planning to acquire certification for teaching at the secondary level should note that the School of Education will require Span. 495 (Methods of Teaching Spanish), taught in the fall only, and that the 3 credit hours earned in that course will count toward the major and will be subject to the 45-hour maximum from one department allowed by the College of Arts and Sciences for the B.A. degree. This means that students who begin the major program with Span. 101 and who intend to include secondary certification in their B.A. program *must* include Span. 495 in their electives in Spanish.

To be admitted to practice teaching of Spanish, majors must take the language-skills tests of the Modern Language Association Proficiency Tests for Teachers and Advanced Students of Spanish and make satisfactory scores or take equivalent tests administered in the department.

Students wishing to receive teaching certification in Spanish must take Span. 305 and 306.

Students must see a departmental advisor prior to registration for their final semester. Failure to do so may result in a delay of their graduation. Students considering entering graduate school for an advanced degree in Spanish, either at the University of Colorado or at any other institution, should see a departmental advisor as early as possible.

The department strongly recommends that all majors include some study in a Spanish-speaking country in their major programs. The University of Colorado offers full-year and semester programs in San Jose, Costa Rica, Mexico, and Seville, Spain; a year-long program in Lima, Peru. For students who have completed Port. 212 or demonstrated equivalent proficiency, a semester program in Rio de Janeiro is available. Credit earned will normally count toward satisfaction of the major requirements, but the student should see an advisor before enrolling in a foreign program to assure full transfer of credit. Credit for work done in special programs offered by foreign universities will be evaluated on an individual basis. It should be noted that courses taken abroad and designated as Spanish will also be subject to the 45-hour maximum rule of the College of Arts and Sciences.

Students interested in study abroad will find further information under Special Educational Opportunities.

Students who present transfer work or credit earned in CU Study Abroad programs to satisfy major requirements will be expected to complete their last 12 credits, including at least 6 at the 400 level, on the Boulder Campus.

For comparative literature, Chicano studies, Latin American studies, and linguistics courses see those sections.

GRADUATE DEGREE PROGRAMS

Departmental Requirements

Students wishing to pursue graduate work in Spanish leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section of this catalog. Application for admission should include official statements of the Graduate Record Examinations. Students with exceptional educational backgrounds and recommendations who have not had an opportunity to take these tests may be admitted with the understanding that they will take them at the earliest opportunity.

Master's Degree

Prerequisites. The following are required for graduate study in Spanish:

1. Competency in speaking, understanding, reading, and writing Spanish.

2. A general knowledge of Hispanic literature and civilization.

Language Requirement. The student will demonstrate as early as possible, but at least one full semester before taking comprehensive examinations, a communication knowledge (as defined by the Graduate School) of a foreign language other than Spanish.

Areas of Concentration. The Master of Arts in Spanish is offered in two areas of concentration; one with an emphasis on literature, and one with an emphasis on language and linguistics.

Minor Fields. For the major in Spanish, the student may elect two courses (4-6 hours) in a minor field. The following fields of minor concentration are recommended: comparative literature, anthropology, linguistics, English, education, Latin American studies, fine arts, philosophy, history, methodology, Greek, Latin, music, or another language or literature.

Required Courses. For the literature emphasis, Span. 642 (History of the Spanish Language) is a required course. For the M.A. with an emphasis on language and linguistics required courses in addition to the above are 640 (Seminar: Spanish Linguistics, Phonology), 641 (Seminar: Spanish Linguistics, Syntax), and 643 (Seminar: Hispanic Linguistics).

Examinations. A comprehensive written and oral final examination will be given during the student's last semester of residence.

Doctor's Degree

Prerequisites. Fluency in speaking, understanding, reading, and writing Spanish; a general knowledge of Hispanic literature and civilization.

Residence Requirement. Ph.D. students must complete a minimum of one academic year in residence on the Boulder Campus (excluding summer) within the four years immediately preceding the date on which they present themselves for the Ph.D. comprehensive examinations.

Language Requirement. The student will demonstrate as early as possible, but at least one full semester before taking comprehensive examinations, a communication knowledge (as defined by the Graduate School) of one foreign language and a reading knowledge of a second language in addition to Spanish. The languages will be chosen by the student in consultation with the advisory committee.

Areas of Concentration. The Ph.D. in Spanish is offered in three areas of concentration: (1) Spanish peninsular literature; (2) Spanish-American literature; (3) Spanish language and linguistics.

Required Courses. Students in all areas of concentration are required to take Span. 642 (Seminar: History of the Spanish Language).

THEATRE AND DANCE

Office in Theatre Building, Room 201
Campus Box 261
Professor James M. Symons, Chairman

BACHELOR'S DEGREE REQUIREMENTS

Majors are available for the B.A. and B.F.A. degrees in dance and theatre. Students are urged to consult with an undergraduate advisor in the appropriate field to obtain both advice and the most current information concerning program opportunities and expectations.

Dance

Students majoring in dance must complete 45 hours in the dance area. In addition to this requirement students must take 6 elective credits in theatre. Courses fulfilling college requirements as well as general electives are to be chosen in consultation with and approved by a department advisor. All normal college requirements must be met. Students are advised that more than 124 hours may be needed for graduation. The following courses are required for the dance major:

	Semester Hours
Dnce. 133 or 134. Intermediate Jazz	1
Dnce. 181-188. Dance Techniques: Ballet	2
Dnce. 191-198. Dance Techniques: Modern	12
Dnce. 151. Dance Techniques Recreational Dance Forms	1
Dnce. 214. Dance Improvisation	2
Dnce. 290. Beginning Composition	3
Dnce. 314. Movement Analysis (Prer., anatomy)	3
Dnce. 380. Rhythmic Analysis and Accompaniment	2
Dnce. 381. Musical Resources for Dance	2
Dnce. 413. Creative Dance for Children	3
Dnce. 415. Methods of Teaching	3
Dnce. 390. Intermediate Dance Composition or Dnce. 490. Advanced Dance Composition	3
Dnce. 491. History and Philosophy of Dance	3
Dnce. 492. Dance in the 20th Century	3
Dnce. 493. Dance Production	2
Electives in Theatre	6

Dance courses numbered 141-146 do not normally count toward the major.

Theatre

The B.A. in theatre is designed to meet the needs of students seeking a liberal arts education with a major focus on theatre. The program consists of a basic core of 45 credits in theatre, 3 credits in dance, and 6 credits in dramatic literature (54 total credits). Specific requirements include:

	Semester Hours
Thtr. 230. Acting: Beginning	3
Thtr. 231. Text Analysis for Performance	3
Thtr. 276. Introduction to Stagecraft	3
Thtr. 471. History of Theatre I	3
Thtr. 472. Theatre of Asia	3
Thtr. 474. Directing	3
Thtr. 481. History of Theatre II	3
Thtr. 489. Problems in Theatre:	3
Plus a choice of one of the following:	
Thtr. 377. Introduction to Costuming	3
Thtr. 482. History of Costume I	3
Thtr. 487. History of Costume II	3
Plus 6 hours of credit in theatre practicums, to include:	
Thtr. 323. Practicum in Theatre Management	1
Thtr. 327. Practicum in Theatre Makeup	1
Plus 12 hours of electives in theatre	12
Plus 3 hours of dance	3
Plus 6 hours of dramatic literature	6

Students wishing to qualify for teaching certification should check in the department office as to the status of this option. A grade of *C* or better is needed in order to meet requirements for the B.F.A. degree.

Bachelor of Fine Arts Degree Requirements

The Bachelor of Fine Arts degree is offered in dance and in theatre (performance or technical theatre). These degrees meet the needs of highly talented students with professional objectives who desire and can profit from considerable specialization at the undergraduate level. Such a program is not in the best interests of all students and the departmental capacity to

provide the program is necessarily limited. Formal application for admission should be made in the sophomore year and those with real or potential interest in applying should identify themselves to the B.F.A. advisors as early in their college studies as possible. The requirements for the B.F.A. are listed below.

Bachelor of Fine Arts in Dance

The B.F.A. in dance is designed to meet the needs of highly talented students interested in a performing career. The program consists of a basic core of 63 credits in dance and 6 credits in theatre. Admission will be limited to insure the type of individual attention necessary for effective training. Interested students should identify themselves as early as possible and formal application should be made at the beginning of the third semester. Selection will be based on an audition-interview, demonstrated competency, motivation, and grade point average. In addition, transfer students must present transcripts to be evaluated by the dance faculty, three letters of recommendation, and a minimum of 12 credit hours taken at the University of Colorado, Boulder, before the application will be considered. *All normal college requirements must be met. Students are advised that more than 124 credits may be needed for graduation.*

Required Courses in Dance	*Semester Hours*
Dnce. 181-188. Dance Techniques: Ballet	8
Dnce. 191-198. Dance Techniques: Modern	16
Dnce. 133 or 134. Intermediate Jazz	1
Dnce. 214. Improvisation	2
Dnce. 290. Beginning Dance Composition	3
Dnce. 314. Movement Analysis (Prer., anatomy)	3
Dnce. 380. Rhythmic Analysis and Accompaniment	2
Dnce. 381. Musical Resources for Dance	2
Dnce. 390. Intermediate Dance Composition	3
Dnce. 413. Creative Dance for Children	3
Dnce. 415. Methods of Teaching	3
Dnce. 490. Advanced Dance Composition	3
Dnce. 491. History and Philosophy of Dance	3
Dnce. 492. Dance in the 20th Century	3
Dnce. 493. Dance Production	2
Dnce. 494. Dance Repertory	3
Dnce. 598. Studio Concert	3

Elective Courses in Dance

Students must elect a minimum of 4 credits.

Dnce. 181-188. Dance Techniques: Ballet	2-4
Other dance forms (Check current schedule of courses)	
Dnce. 133 or 134. Intermediate Jazz	1
Dnce. 151 or 152. Recreational Dance Forms	1
Dnce. 479. Dance Practicum (Credit for performance or special project)	1-3
Dnce. 930-940. Independent Study	1-3

Elective Courses in Theatre

Students must elect a minimum of 6 credits. The following courses are strongly recommended.

Thtr. 483. Touring Theatre Dance	6
Thtr. 486. Lighting (Prer., stagecraft)	3
Thtr. 479. Theatre Practice	3

Required Courses in Physical Education

P.E. 279. Kinesiological Anatomy	3
Additional course in physical education strongly recommended	
P.E. 454. Biomechanics of Human Movement (Kinesiology)	3

Bachelor of Fine Arts in Theatre

The B.F.A. in theatre offers preprofessional training to a limited number of highly talented students aiming at professional careers. Admission will be limited not only in terms of student capacity but also to insure the type of individual attention necessary for effective training. Interested students should identify themselves as early as possible to the B.F.A. advisors. Selection will be based on talent, academic record, motivation, and audition-interviews. A class is accepted only once a year (in November), and a student must be at least a sophomore to audition for admission to the B.F.A. program. All normal college requirements must be met and the program assumes a normal total of 124 credits for graduation.

A grade of *C* or better is needed in order to meet the requirements for the B.F.A. degree.

Theatre Performance

The major requirements consist of a broad base of 33 credits in theatre, followed by a specialized advanced sequence of courses totaling 34 hours in theatre, plus 5 in dance and 2 in music (i.e., 67 hours of theatre and 7 outside, equalling a grand total of 74 hours). The basic curriculum includes:

	Semester Hours
Thtr. 230. Acting: Beginning	3
Thtr. 231. Text Analysis for Performance	3
Thtr. 232. Acting: Intermediate	3
Thtr. 276. Introduction to Stagecraft	3
Thtr. 321. Practicum in Costuming	1
Thtr. 322. Practicum in Technical Theatre	1
Thtr. 330. Acting: Survey of Styles	4
Thtr. 471. History of Theatre I	3
Thtr. 472. Theatre of Asia	3
or	
Thtr. 489. Problems in Theatre	3
Thtr. 474. Directing	3
Thtr. 481. History of Theatre II	3
Thtr. 482. History of Costume I	3
or	
Thtr. 487. History of Costume II	3

ADVANCED SEQUENCE OF SPECIALIZATION

Spring, Sophomore Year

Thtr. 350. Studio I: Internal Acting Process	5
Dnce. 142. Beginning Modern Dance	1
PMus. 120. Voice Class	2

Fall, Junior Year

Thtr. 351. Studio II: External Acting Process	5
Dnce. 132. Beginning Jazz Dance (or substitute appropriate level)	1

Spring, Junior Year

Thtr. 450. Studio III: Master Class in Specialized Work Style	3
Thtr. 451. Studio IV: Elizabethan Acting Styles	4
Dnce. 280. Theatre Dance Forms	2

Fall, Senior Year

Thtr. 452. Studio V: Classic Acting Styles	4
Thtr. 424. Advanced Practicum in Acting (Rehearsal for Colorado Caravan)	1
Dnce. 102. Beginning Ballet (or substitute appropriate level of	

Dnce. 104, 106, 108)	1

Spring, Senior Year

Thtr. 453. UCB Touring Theatre	10
Thtr. 323. Practicum in Theatre Management	1
Thtr. 327. Practicum in Theatre Makeup	1

Students may be invited to participate in the Colorado Shakespeare Festival the summer following the junior or senior year; students are strongly encouraged to work at summer repertory companies when not working with CSF.

The college will only count 67 hours of theatre credits toward the 124 hours required for graduation (for the B.F.A. student). Students should note:

1. Students are encouraged to enroll concurrently in Thtr. 233 (Voice and Speech) and Thtr. 330 (Acting: Survey of Styles). However, B.F.A. students will not be able to count the 3 credits for Voice and Speech toward the 124 hours for graduation; should they elect to take the course, they would graduate with 127 hours.
2. The humanities requirement is half fulfilled by the required History of Theatre I and II sequence. The required Thtr. 231 (Text Analysis for Performance) can be matched with Engl. 130 (Introduction to Drama) or Thtr. 270 (Introduction to Theatre) to fulfill the other half. However, if a student elects to take Thtr. 270, those credits would have to be in excess of the 124 hour requirement.

Technical Theatre

Students interested in this program must obtain guidance and approval from a B.F.A. advisor, who can also provide detailed suggestions as to course sequences and the most effective planning of academic and work experiences semester by semester. Current advising sheets may be obtained in the departmental office. In general, the major curriculum consists of background work to provide a comprehensive understanding of theatre plus a sequence of specialization. Both types of courses are listed below, but in order to match training with needs, no degree will be approved unless worked out in consultation with the advisor.

Background Courses	*Semester Hours*
Thtr. 230. Acting: Beginning	3
Thtr. 231. Text Analysis for Performance	3
Thtr. 276. Introduction to Stagecraft	3
Thtr. 321. Practicum in Costuming	1
Thtr. 322. Practicum in Technical Theatre	1
Thtr. 323. Practicum in Theatre Management	1
Thtr. 324. Practicum in Acting	1
Thtr. 327. Practicum in Theatrical Makeup	1
Thtr. 471. History of Theatre I	3
Thtr. 472. Theatre of Asia	3
or	
Thtr. 489. Problems in Theatre	3
Thtr. 474. Directing	3
Thtr. 481. History of Theatre II	3
Thtr. 482. History of Costume I	3

Specialization

Thtr. 321. Practicum in Costuming	6
or	
Thtr. 322. Practicum in Technical Theatre	6
Thtr. 327. Practicum in Theatrical Makeup	1
Thtr. 376. Advanced Stagecraft	3
Thtr. 377. Introduction to Costuming	3
Thtr. 389. Problems in Theatre (Special Topics)	3
Thtr. 421. Advanced Practicum in Costuming	6
or	
Thtr. 422. Advanced Practicum in Technical Theatre	6
Thtr. 476. Scene Design	3
Thtr. 477. Costume Design	3
Thtr. 486. Stage Lighting Design	3
Thtr. 487. History of Costume II	3
Thtr. 489. Problems in Theatre (Senior Project)	4

GRADUATE DEGREE PROGRAMS

Departmental Requirements

Students wishing to pursue graduate work in theatre and dance for advanced degrees should read carefully both Requirements for Advanced Degrees in the Graduate School section and the following departmental requirements. Students should note that departmental requirements are sometimes more comprehensive than those minimums established by the Graduate School.

Prerequisites. Applicants are admitted to the graduate program in theatre and dance on the basis of their academic records and recommendations. Students admitted who are unable to offer a substantial number of semester hours of work in the area of their intended specialization or allied fields must expect that a significant number of additional courses and semester hours will be required of them in order to make up deficiencies.

Qualifying Examination. Every student must take a diagnostic examination upon entrance. This examination and all other information available are employed to design the best possible course of study for the student. The results of this examination might prompt the faculty to recommend that the student withdraw from the program.

Advisor and Graduate Committee. For every student who declares an intention to work toward an advanced degree, an advisor and committee will be designated so that a degree plan may be designed prior to the end of the first semester of residence.

All candidates for a degree have the responsibility of making certain that the appropriate persons or committees have been appointed to supervise the various steps in their graduate programs. Detailed instructions are available from the department.

Master's Degree

Course Requirements. All master's degree condid ates are required to complete Th.Dn. 601 or its equivalent.

Plan I With Thesis. After any undergraduate deficiencies have been removed, students under Plan I must earn 30 semester hours, all of which must be at the 500 level or above. Four to 6 thesis credit hours may be counted toward the 30-hour requirement.

Plan II With Project (Creative and/or Analytical). After any undergraduate deficiencies have been removed, students under Plan II must earn 30 semester hours, all of which must be at the 500 level or above.

Doctor's Degree

Doctoral candidates in theatre and dance will normally be expected to earn 40 semester hours of course work beyond the master's degree, all of which must be at the 500 level or above. Candidates will be required to complete Th.Dn. 601 or its equivalent.

Specific requirement will be determined by the candidate's advisory committee within the framework of Graduate School and departmental requirements and policies.

The Graduate School requires a fourth-semester proficiency in a foreign language or passing the GSFLT. Doctoral candidates should also consult the Graduate School description of dissertation hour requirements.

WOMEN STUDIES

Office in Ketchum 30
Campus Box 325
Associate Professor Joyce M. Nielsen, Chairwoman

Beginning its 11th year at the University, the Women Studies Program offers a transdiciplinary curriculum encompassing social sciences and humanities. Courses reflect the new scholarship on women: they focus on the interface of the public and private spheres of women's lives and on feminist issues such as gender identity, theories of inequality, women's language and literature, Third World women, and violence against women. Students may concentrate their studies by majoring in women studies solely or in conjunction with another discipline, through a newly developed women studies/psychology track, or by earning a Women Studies Certificate. The program houses a library and sponsors colloquia, workshops, and other cultural and educational events. *Frontiers: A Journal of Women Studies* is published in association with the program.

Students may earn the Ph.D. in women's history through the History Department.

BACHELOR'S DEGREE REQUIREMENTS

1. Satisfaction of the regular college requirements for the Bachelor of Arts degree.

2. A minimum of 40 credit hours with grades of C or better in women studies courses, 19 credits of which must be upper division. These 40 credit hours should be distributed as follows:

Women Studies Major Requirements

	Semester Hours
A.S. 110. Advance Expository Writing in Women Studies or Equivalent	3
Wm.St. 126. Introduction to Women's Literature	3
Wm.St. 200. Introduction to Women Studies	3
Wm.St. 201. Contemporary Issues	3
Wm.St. 202. Women, Culture, and Society[1]	3
Wm.St. 409. Feminist Theory	3
Choose one 300-level and one 400-level course from the following:	
Wm.St. 300. Practicum in Women Studies I	4
Wm.St. 304. Practicum in Women Studies II (Women Studies Curriculum Design)	4
Wm.St. 400. Senior Seminar-Special Topics (may be repeated)	3
Wm.St. 402. Research Seminar	3
And	
One lower division sociology or history Women Studies course (e.g., Hist. 298; Soc. 206)	3
And	
Women studies electives (6 hours in social sciences, 6 hours in humanities)	12
Total (19 - 20 hours must be upper division)	40

Women Studies Certificate Requirements

Wm.St. 200. Introduction to Women Studies	3
Wm.St. 201. Contemporary Issues	3
Choose one 300-level and one 400-level course from the following:	
Wm.St. 300. Practicum in Women Studies I	4
Wm.St. 304. Practicum in Women Studies II (Women Studies Curriculum Design)	4
Wm.St. 400. Senior Seminar-Special Topics (may be repeated)	3
Wm.St. 402. Research Seminar	3
Wm.St. 409. Feminist Theory	3
Women studies electives (6 hours in social sciences, 6 hours in humanities)	12
Total Hours	25

PREHEALTH SCIENCES

Students with vocational interest in a health field usually apply to that professional program after completion of one to three years of college work, which must include specific preprofessional courses. Most University of Colorado professional health programs are offered at the Health Sciences Center in Denver. Preprofessional work can be completed on the Boulder Campus, where preprofessional advising is available from faculty members and from the Health Sciences Advising Office in the Dean's Office.

Each student must recognize that admission to a preprofessional program on the Boulder Campus does not guarantee later admission to the professional program. At the time of actual application to the professional program, the student will be judged on several factors, including performance in undergraduate courses. For this reason, *no required course* may be taken on a pass/fail basis. Some fields require specific preprofessional examinations before application. For most fields, interviews are an essential part of the application process. In all cases, admissions committees will be concerned with the student's personal qualities, including: compassion, coping abilities, decision making, intellectual capabilities, realistic self-appraisal, sensitivity in interpersonal relations, and staying power (physical and motivational). In addition to formal course work, students should have experience in people-related activities (including medical activities), so that they can be more certain of their motivations for health careers.

The Physical Therapy Program accepts only Colorado and WICHE (Western Interstate Commission on Higher Education) state residents from Alaska, Hawaii, Idaho, Oregon, Nevada, and Wyoming.

All of the other professional programs at the University of Colorado have strong preference for Colorado residents. Students from other states usually can obtain at Boulder the preprofessional courses required by their state schools, but should check with those schools in advance. Students are encouraged to apply both to their

[1]Not required for students who declared a women studies major prior to fall 1984.

state schools and to private professional schools to increase their chances of gaining acceptance to the professional program of their choice.

During the preprofessional years, personal intellectual development will cause many students to change professional goals. Since traditionally there are more applicants for these programs than there are spaces available, many students will be forced to change goals because of nonacceptance to the field of their choice. Under the circumstances, wise students will plan college programs to give themselves the greatest flexibility in considering other vocations.

Most students in certain fields (dentistry, health administration, medicine) will complete an undergraduate degree before entering the professional program. Other fields (child health associate, dental hygiene, medical technology, nursing, pharmacy, physical therapy, etc.) do not require an undergraduate degree. Students actually entering these latter programs are not required to satisfy degree requirements on the Boulder Campus. However, wise students will, while working to satisfy preprofessional requirements, also protect themselves by satisfying requirements for an undergraduate degree at Boulder. Care in selection of courses will permit the same courses to be used to satisfy several sets of requirements. For example, Chem. 101 and 104 will satisfy minimal requirements for such fields as child health associate, dental hygiene, nursing, and physical therapy, but will not be accepted for the other health fields. On the other hand, Chem. 103, 106, 331, and 332 will permit the student to apply to any health program and will also satisfy degree requirements for any major requiring chemistry.

Students who plan to apply to medical or dental school or to the health administration graduate program may do so from any major. For example, premedical and predental students may be found majoring in both science and nonscience departments in the College of Arts and Sciences, as well as in such colleges as engineering, business, and music. Such students are therefore urged to examine carefully their academic strengths and weaknesses, as well as vocational alternatives, in planning a program of study. Generally, there is no advantage of one college or academic department over another in gaining admission to a professional program. Students who plan to apply to the other health sciences programs are not required to be as preprofessional majors in those fields in order to be eligible to apply to any of them. However, to be assured of receiving pertinent information and advising, such students should declare majors in the field of their primary interest. All students are urged to consult with advisors in their major department, as well as with advisors in the prehealth fields.

A summary of current preprofessional requirements for the University of Colorado programs follows, together with the number of openings in the program and information on the time the student normally applies. This information may change without notice. Students are therefore advised to obtain current requirements on the programs and admission requirements from the health sciences advisor, or from the program office at the Health Sciences Center. Transfer students who have completed the necessary preprofessional work should apply for admission directly to the desired program at the University of Colorado Health Sciences Center, Office of Admissions, 4200 East Ninth Avenue, Campus Box A054, Denver, Colorado 80262, or call (303) 394-7676. There are other medical fields which are not specifically available at the University of Colorado. Check with the Health Sciences Advising Office for details.

Child Health Associate

Minimum 90 semester hours.

Required	*Semesters*
Chemistry, general (Chem. 101, 104)	2
Biology (EPOB 121 and 123, 122 and 124, or MCDB 105, 106)	2
Psychology	2
Humanities	12 semester hours

Suggested: Behavioral and child psychology, cultural anthropology, English, sociology, Spanish.

The professional program requires 3 years, and a B.S. degree may be obtained at the end of the 1st year. At that time students may apply for acceptance into the M.S. degree program, which can be completed by the end of the third year.
Application deadline December 15; 20 positions. Many applicants will have more than minimal college requirements.

Dental Hygiene

Minimum 60 semester hours.

Required	*Semesters*
Expository writing	2
Mathematics (College Algebra, Math. 101)	1
Psychology	1
Speech (Comm. 101 or 102 or CDSS 200)	1
Sociology	1
Chemistry, general, with laboratory (Chem. 101, 104)	2
Biology, general, with laboratory (EPOB 121 and 123, 122 and 124, or MCDB 105, 106)	2

Application normally at beginning of sophomore year, deadline February 15; 20 positions open. Program leads to a Bachelor of Science in dental hygiene.

Dentistry

Minimum 90 semester hours; undergraduate degree normally obtained before entrance.

Required	*Semesters*
Chemistry, general (Chem. 103, 106[1])	2
Chemistry, organic (Chem. 331, 332[2])	2
Biology, general (EPOB 121 and 123, 122 and 124, or MCDB 105, 106)	2
Physics, general (with laboratory)	2
Mathematics (minimum college algebra and trigonometry)	2
Literature	2
Expository writing	1

Application normally between junior and senior years with deadline January 1; 32 positions open. Dental Admission Test required.
Out-of-state residents (particularly from WICHE states) may be accepted.

Health Administration

Requires baccalaureate or advanced degree, and aplicants should have GPA of 3.0 or better. Other requirements for admission include (1) score on the Graduate Management Admission Test (GMAT); (2) four letters of recommendation from professors or employers; (3) an

[1]For especially qualified students, Chem. 107, 108 may be substituted.
[2]For chemistry majors, Chem 335, 336 will be substituted.

essay on the student's career plan; and (4) a personal interview. For students who do not have an undergraduate degree in business, additional course work will be required in the Graduate School of Business Administration. The program is housed within the Graduate School of Business Administration, University of Colorado at Denver.

Application deadlines: for summer admission, March 1; fall admission, April 1; and spring admission, October 1. Program leads to a Master of Science in health administration.

MEDICINE

Most applicants will enter medical school with a baccalaureate degree or at least 120 hours.

Required	*Semesters*
Chemistry, general (Chem. 103, 106[1])	2
Chemistry, organic (Chem. 331, 332[2])	2
Biology, general (EPOB 121 and 123, 122 and 124, or MCDB 105, 106)	2
Physics, general, with laboratory	2
Mathematics (minimum college algebra and trigonometry)	2
Literature	2
Expository writing	1

Application normally between junior and senior years with deadline November 1. Students normally take the Medical College Admissions Test in spring of the junior year and should be completing science requirements at that time. Approximately 125 positions are open. Admission is usually limited to Colorado, Wyoming and Montana residents and to Native Americans from states adjacent to Colorado.

MEDICAL TECHNOLOGY

Minimum 90 semester hours required.

Required	*Semester Hours*
Chemistry, with laboratory, usually general chemistry (Chem 103, 106) and organic (Chem. 331, 332)	16
Biology, with laboratory. Must include microbiology and immunology (normally EPOB 340). Remaining credits from general biology (EPOB 121 and 123, 122 and 124, or MCDB 105, 106), physiology, anatomy, histology, or embryology	16
Mathematics. College algebra; familiarity with the principles of calculus is desirable	5-10

Recommended

Physics, with laboratory (usually Phys. 301, 302), biochemistry, physical chemistry, English, speech or communications, social sciences, physical education, foreign language, introduction to statistics.

Normal application in fall of junior year with application deadline January 1. University of Colorado students who are Colorado residents have priority for the program. Minimum science GPA 2.75; 21 positions open. Students must meet clinical training prerequisites established by the Board of Registry of Medical Technologists of the American Society of Clinical Pathologists and the American Society of Medical Technology. Program leads to degree of Bachelor of Science in Medical Technology.

NURSING

Minimum 60 semester hours.

Required	*Minimum Semester Hours*[3]
Biology, general, as prer. for microbiology and physiology (EPOB 121 and 123, 122 and 124, or MCDB 105, 106)	8
Microbiology (EPOB 340)	3
Human anatomy (EPOB 342)	3
Chemistry (Chem 101 and 104, Chem. 103 and 104, or Chem. 103, 106, 331)	8
Physiology (EPOB 343)	5
Sociology, general (Soc. 211)	3
General psychology (Psy. 100)	4
Developmental psychology (Psy. 264 plus Phys. Ed. 448 or Psy. 230 or 445)	6
Anthropology (Anth. 104)	3
Statistics	3
English composition (A.S. 100)	3
Humanities (two-semester sequence in literature, philosophy, art, music, foreign language, dance, fine arts, humanities, political science, history, or theatre)	6

The remainder of the 60 semester hours may be selected from any academic discipline with the exception of commercial and vocational courses and doctrinal courses in religion. Because of the number of science prerequisite courses, the beginning prenursing student has two choices: (1) take both chemistry and biology during the freshman year, or (2) take one of these courses, preferably biology, during the summer session either preceding or following the freshman year. Application during November of sophomore year with February 1 deadline; approximately 100 positions open. Program leads to a Bachelor of Science in Nursing.

PHARMACY

Although the School of Pharmacy is located on the Boulder Campus, two academic years of preprofessional study are required before admission to the professional program.

Required	*Semester Hours*
Chemistry, general (Chem. 103, 106)	10
Chemistry, organic (Chem. 331, 332)	8
Biology, general, with laboratory (EPOB 121 and 123, 122 and 124, or MCDB 105, 106)	8
Mathematics (college algebra and trigonometry or calculus)	5
Physics, general, with laboratory (Phys. 301)	5
Economics, micro (Econ. 202)	3
English composition	6
Communication, verbal	3
General education (20 semester hours)	
Psychology and/or sociology	6-8
Humanities	6-8
Natural or other sciences	6-8

Application during sophomore year, deadline March 1 or until quota is filled; 70 positions open. For prepharmacy advising, consult the School of Pharmacy, Ekeley Building, West 181.

PHYSICAL THERAPY

Minimum 90 semester hours required. The professional program at the Health Sciences Center constitutes the senior year.

Required	*Semester Hours*
Biological sciences	14
General biology (EPOB 121 and 123, 122 and 124, or MCDB 105, 106)	
Anatomy (human preferred—EPOB 342)	
Physiology (human preferred—EPOB 343) (prer., 1 yr. of chemistry)	
Humanities (3 hrs. must be in English composition)	12
Psychology	6
Social science	6
Kinesiology (P.E. 454)	3
Physics, general (recommended content to include mechanics, heat, electricity, magnetism, sound, heat and labs, usually Phys. 301, 302)	8
Chemistry, general, with laboratory (Chem. 101-104)	8

Only Colorado and WICHE students are eligible for the program. Application will be accepted in the junior year after completion of at least 75 hours and the majority of the prerequisite courses. The deadline for applications is January 2 for entrance in June of the same year; 32 positions available. Minimum GPA 2.5. For advising consult the Department of Physical Education. Program leads to a Bachelor of Science in physical therapy.

[1]For especially qualified students, Chem. 107, 108 may be substituted.
[2]For chemistry majors, Chem 335, 336 will be substituted.
[3]Because of Boulder Campus course differences, number of hours does not agree exactly with School of Nursing publications.

PREOPTOMETRY COURSE REQUIREMENTS

General biology or zoology (MCDB 105 and 106 or EPOB 121-123 and 122-124) ..... ½-1 year
General chemistry (Chem. 103 and 106 or Chem. 107 and 108) ..... 1 year
General physics (Phys. 301 and 302 or Phys. 111, 112, and 114) ..... 1 year
English (expository writing or creative writing and/or literature) ..... 1 year
College mathematics (Math. 101 or 101 and 102 or 110) ..... ½-1 year

There are additional course requirements, however, which vary with each school or college. You will need to check catalogs for specific schools to be certain of individual requirements. All schools require applicants to take the OCAT, which is given each spring and fall.

PREPODIATRY COURSE REQUIREMENTS

General biology (MCDB 105 and 106 or EPOB 121-123 and 122-124 plus upper division courses as desired) ..... 1-2 years
General chemistry (Chem. 103 and 106 or Chem. 107 and 108).. 1 year
Organic chemistry (Chem. 331 and 332 or 335 and 336 for chemistry majors) ..... 1 year
General physics (Phys. 301 and 302 or 111, 112 and 114) ..... 1 year
English (expository writing or creative writing and/or literature) ..... 1 year

Students should check catalogs for schools for the specific requirements. Application is made to all schools through AACPMAS, an application service. Applicants are required to take the MCAT, which is given each spring and fall.

PREVETERINARY MEDICINE COURSE REQUIREMENTS

General biology (MCDB 105 and 106 or EPOB 121-123 and 122-124) ..... 1 year
Cell biology (MCDB 312) ..... ½ year
Developmental biology (MCDB 465 and 466 or EPOB 374 and MCDB 466) ..... 1 year
Genetics (EPOB 320) ..... ½ year
Microbiology (EPOB 340) ..... ½ year
General chemistry (Chem. 103 and 106 or Chem. 107 and 108).. 1 year
Organic chemistry (Chem. 331 and 332 or Chem. 335 and 336) . 1 year
Biochemistry (Chem. 481 and 482 or 581 and 582) ..... 1 year
Calculus (Math. 130 or 135) ..... ½ year
Physics (Phys. 111, 112, and 114 or 301 and 302) ..... 1 year
English composition (Engl. 119 or Engl. 200 and others) ..... ½ year
Public speaking (Comm. 102) ..... ½ year

The above requirements are specific to Colorado State University. Students should check with other schools for their requirements. CSU also requires students to take the Graduate Record Examination morning tests in October of the year in which application is made.

PRELAW

The assistant dean of the College of Arts and Sciences serves as chairman of a faculty committee of advisors for students interested in the study of law. These faculty members who have a special interest and expertise in the theoretical and practical aspects of the law and judicial systems are available for consultation with all undergraduates on the Boulder Campus. See the Office of the Dean of Arts and Sciences for further information.

College of Business and Administration and Graduate School of Business Administration

INFORMATION ABOUT THE COLLEGE

Charles M. Lillis, Dean

History and Purpose

The College of Business and Administration and Graduate School of Business Administration serve the need for competent and responsible administrative personnel, for continued education of those already in such positions, and for research.

The college was admitted to membership in the American Assembly of Collegiate Schools of Business in 1938.

The college participates on a continuing basis in the Executive Program for the Gas Industry, the Institute for Organization Management, the Colorado School of Banking, the National Installment Banking School, the School of Bank Marketing, the School for International Banking, and many activities of the Center for Conference and Management/Technical Programs. The college also assists in the presentation throughout Colorado of a Certificate Program in Real Estate. The faculty also participate in many continuing education, government, and company educational programs.

The Executive-in-Residence program provides business leaders in residence to work with students and faculty during the school year.

The Business Alumni Advisory Council serves as a direct link with the business community to promote understanding, cooperation, and mutual gain in a variety of education-industry activities.

Career Opportunities

Graduates occupy positions and perform widely varied functions in:

Advertising
Banking
Consumer credit and mortgage financing
Credit administration
Financial management
Industrial selling and purchasing
Information systems
Insurance
International business
Investments
Management accounting
Management consulting
Marketing management
Marketing research
Minerals land management
Operations research
Personnel management
Production management
Public accounting
Real estate
Retailing
Selling and sales management
Traffic and distribution
Transportation
Wholesaling

Others hold positions of responsibility in fields as diverse as business journalism, public relations, city planning, chamber of commerce and trade association management, college administration, and government.

Facilities and Research Activities

The Business Building is a total educational environment designed for the specific needs of business students. The facilities include computer terminals, the William White Business Library, organizational laboratories, lounges, varied classrooms, all faculty and administrative offices, and the Business Research Division.

The college offers its undergraduate and M.B.A. programs on the Denver and Colorado Springs campuses also.

The Business Research Division provides facilities and trained personnel for research on business and economic problems. Established in 1915, the unit serves as the research arm of the college. The division serves Colorado and the surrounding region to improve the general economic welfare of the area and to gather and disseminate business and economic information; encourages research by faculty members and graduate students; and develops closer relationships among students, faculty, and businessmen.

Through its monthly publication, *The Colorado Business Review,* the division provides basic business information concerning Colorado. Other publications include compilations of business and economic data, industry surveys, studies of special problems in business management, and regional community studies.

Student Organizations

Opportunity for association in activities to stimulate professional interests and to gain recognition of scholastic attainment is provided by the following student organizations:

AIESEC, international business association

AAS, Association of Accounting Students

Beta Alpha Psi, national honorary and professional accounting fraternity

Beta Gamma Sigma, national honorary scholastic fraternity in business

Black Business Student Coalition

B.R.E.C., Buffalo Real Estate Club

CBSA, Chicano Business Students Association

CSPA, Colorado Society for Personnel Administration (Student Chapter), for students interested in personnel or industrial relations

CUAMA, student chapter of the American Marketing Association

Delta Nu Alpha, honorary transportation fraternity

Delta Sigma Pi, professional business fraternity

DBA Association, for doctoral students in business

Entrepreneurial Society, small business management association

Finance Club, student association of finance

ISO, Information Systems Organization

MBA Association, for master's students in business

MEIS, Minority Employment Information Service, nonprofit student organization to locate minority jobs

Phi Chi Theta, professional business and economics fraternity

S.A.M., Student Association of Management

S.A.M.L., Student Association of Minerals Landmen

Sigma Iota Epsilon, professional and honorary management fraternity

Student Board

This is the student governing body of the College of Business, and functions as a liaison between the students and the administration. The board aids in the formulation of policies and represents the students' interest in many different areas. The board consists of 13 representatives who are elected from the student body and who serve two semester terms. Three board members, normally officers, are required to serve on the College of Business Discipline Committee.

Graduation Recognition Ceremony

Each December and May the Dean's Office and the Student Board sponsor a Recognition Ceremony honoring the graduating class. This is in addition to the University-wide commencement. Graduates and their families are invited to attend.

Scholarships

Each year the college awards a number of departmental and general scholarships. Generally, business scholarships are for students who have completed business course work at the University. The amounts of the awards and the number of awards vary each year. For additional information students may contact the Office of Undergraduate Studies.

ACADEMIC POLICIES—UNDERGRADUATE

The academic policies, rules, and regulations of the college given below are in effect at the time this catalog is printed. All students are responsible for knowing and following the provisions set forth in this catalog. Any questions concerning these provisions are to be directed to the college office. The college cannot assume responsibility for problems resulting from a student's failure to follow the policies stated in the catalog or from misadvice given by someone other than a staff member of the college. Similarly, students are responsible for all deadlines, rules, and regulations stated in the *Schedule of Courses.* All rules and regulations are subject to change. Any questions should be directed to the Office of Undergraduate Studies.

Academic Ethics (Dishonesty, Cheating)

Students are expected to conduct themselves in accordance with the highest standards of honesty and integrity. Cheating, plagiarism, illegitimate possession and disposition of examinations, alteration, forgery, or falsification of official records, and similar acts or the attempt to engage in such acts are grounds for suspension or expulsion from the University. Any reported act of academic dishonesty may be referred to the College of Business Disciplinary Committee at the discretion of the associate dean, a member of the instructional staff, or other appropriate University representative.

In particular, students are advised that plagiarism consists of any act involving the offering of the work of someone else as the student's own. It is recommended that students consult with their instructors as to the proper preparation of reports, papers, etc., in order to avoid this and similar offenses. Official college procedures concerning academic ethics are maintained in the Office of Undergraduate Studies.

Adding and Dropping Courses

Business classes may be added only during the first three days that classes are in session.

See the General Information section for University-wide Drop/Add policy.

Administrative Drop. Instructors may recommend to the Office of Undergraduate Studies that students who fail to meet expected course attendance or prerequisites be dropped from the courses.

Advising and Records

All business students receive their academic counseling from a staff of advisors in the Office of the Dean. During the semester, advisors are available Monday through Friday from 9:00 to 11:30 a.m. and 1:00 to 3:00 p.m. During preregistration and registration periods, the advisors are available at the registration area. Individual advising and scheduling is not possible during registration periods. Advising and scheduling assistance should be obtained throughout the semester.

Students may look at their progress sheets any time during advising hours, and a copy will be provided upon student request. Students are expected to assume responsibility for planning their programs in accordance with college rules and policies.

Students are encouraged to discuss with the faculty of the college the various majors available as well as career opportunities.

Attendance Regulations

Classroom attendance is left to the discretion of the instructor. Students are responsible for determining each instructor's policy on attendance.

Credit

To receive credit, all courses must be listed on the student's dean's page by the Office of Admissions and Records. Credit is then evaluated by the College of Business to determine degree acceptability.

Courses completed at any University of Colorado campus are credited toward degree requirements, if appropriate to the degree program.

TRANSFER CREDIT

The College of Business reserves the right to disallow any credit that is not appropriate degree credit as determined by the college.

Credits in business subjects transferred from other institutions will be limited to the number of credit hours given for equivalent work in the regular offerings of the University. Only work from regionally accredited institutions will transfer to the college. In general, the college will limit transfer credit for business courses taken at a lower division level to such courses as the college offers at that level. A maximum of 60 semester hours of credit may be accepted from a two-year school.

Actual equivalent courses usually may be substituted for required courses. However, students must verify with advisors that courses are equivalent. Careful checking is required. A course given at another institution may have the same name and same textbook as a required business course and still be taught with a nonbusiness emphasis or other variations that give it little value for business.

Business students desiring to take work at another institution or another campus of the University of Colorado and apply the work toward the B.S. degree in business must have prior approval of the College of Business. Generally, only elective credit is acceptable in transfer from other institutions once the student has enrolled in the college.

All courses in the area of emphasis must be taken at the University of Colorado unless written approval is given by the appropriate division head and the director of undergraduate studies. Transfer students must take a minimum of 30 hours of business courses in residency after admission to the College of Business. For a detailed explanation of transfer credit, see the General Information section.

CORRESPONDENCE CREDIT

Required business courses and area of emphasis courses cannot be taken by correspondence. All correspondence courses must be evaluated and have prior approval to determine their acceptability.

CREDIT BY EXAMINATION

Advanced Placement (CEEB). For students who make scores of 3, 4, or 5, college credit will be given where appropriate.

College Level Subject Examination Credits (CLEP). College credit for approved CLEP may be considered, providing the scores are at the 67th percentile or above. Specific information is available in the office of the dean.

Generally, CLEP credit is only appropriate for (a) pre business requirements and (b) nonbusiness electives. A maximum of 6 hours of credit in any one course area is allowed. CLEP may not be used in course areas where credit has already been allowed. General examinations are not acceptable.

Credit for CLEP must have prior approval in writing by the Office of Undergraduate Studies.

ROTC CREDIT

Students who are enrolled in and complete the ROTC program may apply a maximum of 12 semester hours of advanced ROTC credit toward nonbusiness elective requirements and toward the 120-semester hour total degree requirement for the B.S. degree in business. Students must be enrolled as official ROTC students in order to receive degree credit for ROTC courses. No credit toward degree requirements is granted for basic (freshman and sophomore) ROTC courses. The ROTC advisor can provide more detailed information.

SPECIAL SOURCES OF CREDIT

The college reserves the discretion of accepting or rejecting all special sources of credit which do not have prior approval of the dean. A maximum of 6 hours of theory courses in physical education, recreation, or dance can be accepted toward graduation.

Up to 6 hours of experimental studies, independent studies, and other nontraditional types of credit will be accepted as degree credit. Prior approval is required if the work is to be applied as degree credit. A maximum of 3 hours of this type of credit may be taken in any one semester. Normally, such classes as ROTC, teacher education, teaching methods, orientations, practicums, and workshops are not acceptable. Certain classes such as music, band, choir, art, A.S., and C.I.S., might be counted as part of the 6 hours, providing prior approval is given. Failure to have all such courses approved prior to enrolling may result in loss of credit. For detailed information see Model Degree Program, Curriculum Note 7.

Independent Study Credit. Junior or senior business students desiring to work beyond regular business course coverage may take variable credit courses (1-3 semester hours) under the direction of an instructor who approves the project, but the student must have prior approval of the dean.

Information and request forms are available in the Office of Undergraduate Studies.

To receive credit for independent study and experimental studies courses, students must obtain the dean's approval prior to registering for the courses. Further information and forms are available in the Office of Undergraduate Studies.

Cooperative Education. No credit is given for work experience, internships, or cooperative education programs. See Model Degree Program Curriculum Notes for additional information concerning elective credit.

STUDY ABROAD CREDIT

Study abroad programs are available for students who are interested in international business or in cultural experiences abroad. One such program is the London Seminar in International Finance, a month-long, 6-credit-hour program held each summer in the financial district of London, England. The seminar is open to juniors and seniors in the College of Business and Administration who have completed at least one course in international finance or international trade.

Transfer credit from study abroad programs is applied as nonbusiness elective credit. Students planning to attend study abroad programs must meet with a College of Business advisor, Business Building Room 230, and have their course selections approved prior to leaving campus.

More specific information about these opportunities is available from the College of Business and Administration or from the Office of International Education.

NO CREDIT

Because of space limitations, business classes may not be taken on a no credit basis.

Grading Policies

See the General Information section for University-wide grading system and pass/fail policy.

Pass/Fail. Students in the college may not use courses taken on a pass/fail basis to satisfy required business or nonbusiness courses, or business elective courses. Nonbusiness electives only may be taken on a pass/fail basis. A maximum of 16 hours of pass/fail credit may be applied toward the B.S. degree in business; transfer students may take 1 hour of pass/fail for every 8 hours successfully completed at this institution. Pass/fail determination must be made within the first two weeks of the semester and is irreversible. A maximum of 6 hours pass/fail may be taken in any one semester.

Failed Courses. Failed courses may be repeated, but the *F* will be included in the grade point average.

Incomplete Grades. The *only* incomplete grade given in the college is *IF*. An *IF* grade is given only when documented circumstances clearly beyond the student's control prevent the student from completing the course. Generally, students should make up the missing work and not retake the entire course. They should not register for the class a second time, and the work should be made up with the instructor giving the *IF*. All *IF* grades must be made up within one year, or the *IF* will be changed to a grade of *F*.

GRADE CHANGES

Final grades as reported by instructors are to be considered permanent and final. Grade changes will be considered only in cases of documented clerical errors, and must be approved by the associate dean.

Honors Program

Upon recommendation of the faculty, students who demonstrate superior scholarship are given special recognition at graduation.

Students must achieve an overall grade point average of 3.3 and a grade point average of 3.5 in all business courses taken at the University of Colorado *to be considered* for *cum laude.*

Those who achieve an overall grade point average of 3.5 and a grade point average of 3.7 in all business courses taken at the University of Colorado *will be considered* for *magna cum laude.*

BETA GAMMA SIGMA

Membership in Beta Gamma Sigma is an honor which must be earned through outstanding scholastic achievement. Such membership is the highest scholastic honor that a student in a school of business or management can attain.

To be eligible for Beta Gamma Sigma membership, students must rank in the top 5 percent of their junior class, the top 10 percent of their senior class, or rank in the top 20 percent of those students receiving master's degrees. Also, students completing all requirements for the doctoral degree conferred by a business school are eligible for Beta Gamma Sigma. It should be noted that Beta Gamma Sigma chapters may be chartered only in those schools of business and management accredited by the American Assembly of Collegiate Schools of Business.

Registration for Business Courses

Students may register only for those courses for which they have the stated prerequisites. Junior standing is required for all business courses numbered 300-499. Priority is given to students officially in the business program.

Students enrolled in a section of a business course, but attending a different section, will receive a final grade of *F* for nonattendance. Students attending classes for which they are not enrolled will not be added after the Add period is over.

Scholastic Load

The normal scholastic load of an undergraduate in business is 15 semester hours with a maximum of 17 hours during the fall/spring semesters. A maximum of 6 hours may be taken during a five-week summer session with not more than 12 hours total during the ten-week summer session and a maximum of 3 hours during the interim session.

Standards of Performance

Students are held to basic standards of performance established for their classes with respect to attendance, active participation in course work, promptness in completion of assignments, correct English usage both in writing and in speech, accuracy in calculations, and general quality of scholastic workmanship.

In general, examinations are required in all courses and for all students, including seniors.

To be in good standing, students must have an overall grade point average of not less than 2.0 (C=2.0) for all course work attempted, and a 2.0 for all business courses attempted. This applies to work taken at all University campuses. Physical education activity courses and remedial course work are not included in the overall average.

When semester grades become available, students below the acceptable standard will be notified of (1) probationary status or (2) suspension. *Students are responsible for being aware of their academic status at all times and late grades and/or late notification does not waive this responsibility.* College rules governing probation and suspension are as follows:

1. Any student whose overall grade average, or business course average, is less than 2.0 shall be placed on probation immediately. A student may be removed from probation when the overall average and the business average have been raised to 2.0.
2. Students shall remain on probation for up to four semesters as long as they maintain normal degree progress each semester as determined by the college *and* obtain no grade below a *C*. Such probationary status may continue a maximum of four terms, providing these provisions have been met. Please note that students may be on probation a maximum of four semesters during their entire academic careers at the College of Business, and probationary terms are not necessarily consecutive. Summer is considered a term. Failure to meet probationary provisions will result in suspension.
3. Indefinitely suspended students may attend the University of Colorado summer session in order to improve their grade average in the area of deficiency, *but may not attend any division of the University during the regular (fall and spring) semesters, and may not attend classes in the interim sessions or the Evening Division.*
4. A student who has been under indefinite suspension for one calendar year may apply for readmission to the College of Business and Administration. Generally, a suspended student must attend summer session and remove all grade deficiencies before being considered for readmission for the regular academic year. If readmitted, that readmission will be on a probationary status. After being readmitted under such probationary status, any student who fails to comply with the requirements of their probation will be subject to permanent suspension.
5. Any student who is placed on suspension more than once will be permanently suspended from the College of Business and may not attend *any* division of the University of Colorado.
6. Students who have been suspended at any time in the past by the College of Business will be automatically suspended if their overall average, or business average again falls below 2.0.
7. Any student earning all failing grades or no academic credit for the semester will not be permitted to register without the dean's approval.
8. Official combined degree students are required to maintain the same standard of performance as College of Business students in order to be continued in the combined business program.

Withdrawal

Students may withdraw without discredit at any time *prior* to the start of the final examination period.

Students who withdraw during the semester are not assured admission the following semester but will be considered on an individual basis, according to the space available.

UNDERGRADUATE DEGREE PROGRAMS

Planning the Business Program

FRESHMEN

Prospective students are encouraged to complete strong academic programs in high school. A minimum of four academic units should be completed *each year* with special emphasis given to writing, mathematics, and science skills. For a detailed explanation of the high school preparation desired, see the General Information section.

TRANSFER STUDENTS

Transfer students are expected to demonstrate proficiency in writing and mathematics. Prospective transfer students should complete courses equivalent to those taken by the University of Colorado business freshman and sophomore. See the model degree program.

Intrauniversity Transfer

A large number of students admitted to the College of Business each year are intrauniversity transfers. An undergraduate student who is enrolled on the Boulder Campus of the University and who wishes to transfer to the College of Business may submit a completed Intrauniversity Transfer Application to the college upon completion of at least 15 semester hours of graded course work at the University of Colorado. October 1 is the deadline for spring admission and March 1 for fall admission. The college will consider each application based upon the number of spaces available, the quality of the student's academic work, and the courses completed.

Combined Programs and Double Majors

Official combined programs are available only in conjunction with the College of Engineering, the College of Design and Planning, the School of Journalism, and the School of Pharmacy. Combined and double degree programs require approval of the deans of both colleges. Before a combined degree student will be admitted to courses in the College of Business, the student must obtain permission and complete an Application for Admission form from the College of Business. Failure to do so may preclude the student from taking any business course.

Students receiving two degrees, one of which is business, must complete at least 150 semester hours of course work. Such programs are considered five-year programs. Students enrolled in other colleges which require business courses as a part of their curricula will be admitted to business classes on a space available basis.

Requirements for the B.S. (Business) Degree

The student alone is responsible for the fulfillment of these requirements. Questions concerning graduation should be directed to the college Office of Undergraduate Studies (Room 230).

GRADUATION

Prospective graduates must file an Application to Graduate with the dean's office and request a senior audit before registering for their last semester. Failure to do so will delay graduation. Also, students desiring to change their area of emphasis after the senior audit has been completed must have the change approved by the graduation supervisor no later than the first week of class of their final semester. Changes after that time will delay graduation.

GENERAL REQUIREMENTS

The Bachelor of Science (Business) degree requires:

1. *Total Credits.* A minimum of 120 acceptable semester hours of credit, of which at least 54 hours must be in nonbusiness courses (including 9 hours of upper division work) and at least 51 hours in business courses. The remaining 15 hours may be in either.

The college reserves the right to disallow any credit that is not appropriate academic credit as determined by the college.

2. *Residence.* Completion of at least 30 semester hours of business, usually in the senior year, after admission to the College of Business, and to include the 12 hours in the area of emphasis.

3. *Grade Average.* A minimum scholastic cumulative grade average of 2.0 (*C*) for all courses attempted at the University acceptable toward the B.S. (Business) degree, 2.0 for all business courses, and 2.0 in the four required areas of emphasis courses.

DEGREE PROGRAM

The following sequence of courses is a *guide* to registration. Due to course availability the order of courses taken may vary. Students should fulfill all course prerequisites.

Freshman Year	*Semester Hours*
A.S. 100, 101, 102, 103, 104, 110. Composition (Note 1)	3
Oral Communication (Note 2)	3
Math. 107 and 108. Mathematics (Note 3)	6
P.Sc. 110. American Government	3
Additional political science, 100-300 level	3
Soc. 211. Introductory Sociology, 119, 191, 250, Anth. 104	3
Natural science (Note 4)	6
Nonbusiness electives (Note 7)	3
	30

Sophomore Year	
Econ. 201, 202. Macro/Micro Economics (Note 5)	8
Psy. 100. General Psychology (Note 5)	4
Socio-humanistic elective (Note 6)	3
I.S. 200. Business Information Systems and the Computer	3
Q.M. 201. Business Statistics	3
Acct. 200. Introductory Financial Accounting	3
Nonbusiness electives (Note 7)	6
	30

Junior Year	
B.Law 300. Business Law	3
Mk. 300. Principles of Marketing	3
Fin. 305. Basic Finance	3
Or.Mg. 330. Introduction to Management and Organization	3
Pr.Mg. 300. Production and Operations Management	3
Nonbusiness electives (Note 7)	3
Business electives	6
Either business or nonbusiness electives (Note 7)	6
	30

Senior Year	
B.Ad. 450 or 452. Business Policy	3
B.Ad. 411. Business and Society or B.Ad. 410. Business and Government	3
Area of emphasis	12
Business electives	3
Either business or nonbusiness electives (Note 7)	9
	30
Minimum to graduate	120

Curriculum Notes

1. Recommended for freshmen, but due to space limitation may have to be taken during the sophomore year.

2. The following courses will fulfill this requirement: Comm. 101, 102, 215, 231, 260, and 420.

3. Math. 107 and 3 hours of college calculus are required. There are no course substitutions for Math. 107. Math. 108, 130, 135, or 136 will fulfill the calculus requirement. No credit is given for college algebra.

4. Natural sciences include general college level chemistry, physics, biology, astronomy, physical geography, physical anthropology, geology, earth science, and physical science.

5. A minimum of 3 semester hours each of macro/micro economics and introductory psychology is required. The additional hour earned in each of these courses will apply as nonbusiness elective credit.

6. Three hours selected from the following courses:
   a. History course, 100-200 level
   b. Psychology of Adjustment, Psy. 230; Social Psychology of Social Problems, Psy. 245; Child and Adolescent Psychology, Psy. 264; Psychology of Contemporary Women, Psy. 270; Social Psychology, Psy. 440; Psychology of Personality, Psy. 445
   c. Introduction to Philosophy, Phil. 100; Philosophy and Society, Phil. 104; Major Social Theories, Phil. 220
   d. Introduction to Sociology I, Soc. 211; Deviance, Soc. 119; Contemporary Social Issues, Soc. 191; Social Problems and Social Change, Soc. 250; Principles of Anthropology II, Anth. 104

   Group d courses are acceptable only if not used to fulfill the sociology requirement.

7. *Elective Credits.* Elective credits should be selected carefully, as not all classes are acceptable. Generally, to be acceptable, electives must be taught by regular University of Colorado faculty, must have a form of assessment such as a term paper and/or examinations, and must be regular classroom-type courses. Course coverage must be college-level, not repetitious of other work applied toward the degree, must be academic as opposed to vocational/technical, and must be part of the regular University offerings.

Specifically, the college will accept:

a. A maximum of 6 hours of physical education theory, recreation, and dance theory, and
b. A maximum of 12 hours of advanced ROTC providing the student is enrolled in the program and completes the total program, and
c. A maximum of 6 hours of approved independent study, experimental studies, choir, band, music lessons, and art lessons.

The college will *not* accept physical education activity, recreation, workshops, orientations, dance, teaching methods, practicums, certain teacher education classes, and certain classes offered by the Center for Interdisciplinary Studies and Arts and Sciences.

The above examples are not exclusive, but are intended to provide guidelines. The College of Business reserves the right to disallow any credit that is not appropriate academic credit as determined by the college. For further information, contact the Office of Undergraduate Studies.

Combined Programs

Numerous career opportunities exist for persons trained in both a specialized field and management. For this reason students may be interested in combined programs of study leading to completion of degree requirements concurrently in two fields. Such combined programs have been arranged for engineering and business, pharmacy and business, environmental design and business and may be arranged for other professional combinations as well.

The two programs of study proceed concurrently, terminating together with the awarding of two degrees. Normally, at least five years will be needed for such combined programs. No substitutions are allowed in this program. A minimum of 150 semester hours is required for all combined programs.

Students desiring to transfer from combined programs to the College of Business must apply and will be considered as intra-university transfers.

For students in combined programs, the requirements for the degree in business are as follows:

1. An application for admission to the combined program, which must be filed with the College of Business and approved by the deans of both colleges.
2. Completion of at least 48 semester credits in business and economics, to include Econ. 201 and 202 (6 semester hours), required courses in business (30 semester hours), and a business area of emphasis (12 semester hours).
3. Completion of at least 30 of these semester hours at the University of Colorado while concurrently enrolled in the College of Business.
4. Completion of nonbusiness requirements in mathematics, communications, and the social and behavioral sciences in a degree program approved in advance by the College of Business. In addition, for some courses and areas of emphasis, there are prerequisite requirements which must be met.
5. At least a 2.0 grade point average must be earned in all courses undertaken in the College of Business, the area of emphasis, and the University of Colorado.
6. Any combined degree student who does not make reasonable progress toward the completion of the business degree requirements, as determined by the College of Business, may be dropped from the program.
7. The number of students accepted in any combined degree program may be numerically limited and is dependent upon existing demand each semester.

Shown below is the combined engineering-business program. For other combinations, students must consult with the business dean's office.

The requirements for all combined business and engineering programs are as follows:

Required Nonbusiness Courses	*Semester Hours*
Phys. 111. General Physics	4
Math. 130, 236. Calculus and Linear Algebra	10
Econ 201. Principles of Macro Economics	3
Econ. 202. Principles of Micro Economics	3
Engl. 120/130/140. Introduction to Fiction/Drama/Poetry	6
Political science elective (100-200 level)	3
P.Sc. 110. The American Political System	3
Psy. 100. General Psychology	3
Socio-humanistic elective selected from business list	3
	38

Required Business Courses	
Acct. 200. Introduction to Financial Accounting	3
I.S. 200. Business Information and the Computer	3
Q.M. 201. Business Statistics	3
Mk. 300. Principles of Marketing	3
Fin. 305. Basic Finance	3
Pr.Mg. 300. Production and Operations Management	3
Or.Mg. 330. Introduction to Management and Organization	3
B.Law 300. Business Law	3
B.Ad. 410. Business and Government; or B.Ad. 411, Business and Society	3
B.Ad. 450. Business Policy (Cases and Concepts in Business Policy); *or* B.Ad. 452 (Small Business Strategy, Policy and Entrepreneurship)	3
Specified courses in an area of emphasis in one of the following fields: accounting, information systems, finance, international business, marketing, minerals land management, production and operations management, organizational management, personnel-human resources, public agency administration, real estate, small business management, or transportation and distribution management. All work in the area of emphasis must be taken at the University of Colorado College of Business.	
Areas of emphasis	12
	48

AREA OF EMPHASIS

Each candidate for the B.S. (Business) degree must complete the prescribed courses in an area of emphasis comprising a miminum of 12 semester hours taken at the University of Colorado. A 2.0 average is required for the four required area courses.

Students so desiring may accomplish the effect of a dual area of emphasis by careful selection of courses and use of elective hours for the second area.

Accounting

Accounting courses are offered in several fields of professional accountancy at the intermediate, advanced, and graduate levels. They provide preparation for practice in one or more of the following fields:

- Financial accounting
- Auditing
- Managerial accounting
- Tax accounting
- Data processing and control systems
- Teaching and research

In all of these fields a thorough knowledge of the social, legal, economic, and political environment is needed. A high degree of analytical ability and communication skill is indispensable. Courses in English composition, speech, and ethics and logic are desirable. Courses in statistics and information systems, beyond the required College of Business core courses, are highly recommended.

The undergraduate area of emphasis in accounting consists of 12 hours beyond Acct. 200 and 202:

Required Courses	*Semester Hours*
Acct. 322. Intermediate Financial Accounting I	3
Acct. 323. Intermediate Financial Accounting II	3
Acct. 332. Cost Accounting	3
Acct. elective	3
	12

Students planning to pursue accounting as a career usually take more than the required 12 hours. Many students take a total of about 30 hours of accounting, often taking two courses each semester in their junior and senior years. Students should work closely with accounting faculty in planning their accounting programs.

Students planning to take a CPA examination should take about 30 hours of accounting and be well prepared in statistics, business law, finance, and economics.

Graduate study in accounting is receiving increasing emphasis by professional organizations and employers. Students meeting admission requirements should consider continuing their education at the graduate level.

Business Education

A doctoral program only is offered in conjunction with the School of Education. Consult the School of Education graduate advisor for information concerning the program.

Finance

The principal areas of study in finance are financial management, monetary policy, banking, investments, and insurance.

Finance is intended to give understanding of fundamental theory pertaining to finance and to develop ability to make practical applications of the principles and techniques of sound financial management in business affairs. Every endeavor is made to train students to think logically about financial problems and to formulate sound financial decisions and policies.

It is necessary to understand the importance of finance in the economy and the functions and purposes of monetary systems, credit, prices, money markets, and financial institutions. Emphasis is placed on financial policy, management, control, analysis, and decision making. Numerous opportunities are to be found with financial institutions and in the field of business finance.

Required Courses	*Semester Hours*
Acct. 202. Introduction to Managerial Accounting	3
Fin. 401. Business Finance I	3
Fin. 402. Business Finance II	3
Fin. 433. Investment and Portfolio Management	3
Fin. 455. Monetary and Fiscal Policy	3

Recommended Elective Courses

Fin. 440. International Financial Management	3
Fin. 453. Bank Management	3
R.Es. 454. Real Estate Finance	3
Ins. 484. Principles of Insurance	3

It is also recommended that finance majors take one or more additional accounting courses.

Students should note that all finance courses are not offered during the summer session.

Information Systems

The information systems area is designed for those who wish to prepare themselves for professional careers in data processing/information systems in business and government. The student develops those technical skills and administrative insights required for the analysis of information systems, and the management of data processing operations. The emphasis is on management information systems—systems for the collection, organization, accessing, and analysis of information for the planning and control of operations. The automation of data processing also is studied extensively.

Required Prerequisite Courses	*Semester Hours*
I.S. 200. Business Information Systems and the Computer (B.Ad. 200)	3
Q.M. 201. Business Statistics	3
I.S. 220. Business Programming I: Structured COBOL	3
I.S. 221. Business Programming II: Structured COBOL and Physical File Organization Techniques	3

Area of Emphasis Courses

I.S. 465. System Analysis and Design I	3
I.S. 466. System Analysis and Design II	3
Any two of the following four courses:	
Q.M. 300. Intermediate Statistical Analysis for Decision Support	3
I.S. 330. Operations Research for Decision Support	3
I.S. 350. Logical Data Structures and Database Management Systems	3
I.S. 470. Computer and Information Technology	3
Pr.Mg. 440. Production and Inventory Planning and Control	3

International Business

In recent years, companies have completely reoriented their thinking, planning, and operations to capitalize on the opportunities offered in the world marketplace. Every phase of business operation is affected by this reorientation, and individuals who offer the appropriate skills, training, and orientation are in great demand.

The program reflects the basic principle that effectiveness in international business is based on a thorough training in business administration. The international business program provides the opportunity to build on these skills.

Other courses emphasizing international affairs may be elected from the following departments: anthropology, economics, geography, history, political science, psychology, and sociology.

Students should note that B.Ad. 440 is offered only in the spring semester and the prerequisite is 6 hours of the required courses.

Required Courses	*Semester Hours*
Econ. 440. International Economics and Policy	3
plus *three* of the following courses:	
B.Ad. 440. International Business Seminar	3
Fin. 440. International Financial Management	3
Tr.Mg. 458. International Transportation	3
Mk. 490. International Marketing	3

A second area of emphasis in business is highly recommended. The course requirements for the second area can be included as part of the business and free elective hours. Foreign language study is also recommended.

It is important for students who expect to be involved in international business to have an understanding of international relations, which may be gained in study abroad programs. Information on study abroad programs may be obtained from the Office of international Education. The College of Business will evaluate credit earned in such programs and determine degree acceptability.

Marketing

Marketing is concerned with analyzing the market for a product or service, planning and developing that product, determining the most appropriate distribution channels, pricing the product, and promoting it. The administrative policies and practices of any well-managed firm should be marketing-oriented toward the consumer.

The career opportunities in marketing reflect the businessman's awareness of the importance of this field. Today many individuals are rising to top executive positions by the marketing route. There are more executive and other job opportunities for women in the marketing field than in any other single area outside teaching or secretarial work. One out of every four people gainfully employed in this country is in a marketing position.

Career opportunities abound in personal selling, advertising, sales management, marketing research, retailing, wholesaling, marketing by manufacturers, international marketing, etc.

Required Courses	*Semester Hours*
Mkt. 330. Marketing Research	3
Marketing electives (beyond Mk. 300)	9

Students should note that the required course, Mk. 330, is not offered during the summer session.

Minerals Land Management

A student who plans to complete an area of emphasis in minerals land management should comply with the following outline in regard to courses, hours, restrictions, and options. These are in addition to the required core courses and nonbusiness courses. No required courses (business or nonbusiness) may be taken pass/fail. It is suggested that those who plan to pursue minerals land management as an area of emphasis select a second area of emphasis.

Specific Required Courses	*Semester Hours*
Geol. 101. Introduction to Geology	4
Chem. 101 or 103. General Chemistry	4
Geol. 102. Introduction to Geology	
or	
Geol. 153. Geological Development of Colorado and the West	4
R.Es. 300. Principles of Real Estate	3
Acct. 202. Managerial Accounting	3
Acct. 441. Income Tax Accounting	3

A minimum of 6 hours of the following upper division geology or geography courses taken in conjunction with the courses listed above, of which a minimum of 3 hours must be geology. Other relevant geology and geography courses may be approved, if appropriate, by petition to the department.

Geol. 309. Petroleum Technology (offered only at Denver Campus)	4
Geol. 436. Glacial Geology	3
Geol. 495. Natural Catastrophes and Geologic Hazards	3
Geol. 496. Mineral Resources in World Affairs	3
Geog. 306. Map Interpretation	3
Geog. 406. Geographic Interpretation of Aerial Photos	3

Required Area of Emphasis Courses—College of Business

The following courses comprise the area of emphasis:

Fin. 401. Business Finance I	3
R.Es. 473. Legal Aspects of Real Estate Transactions	3
M.L.M. 485. Minerals Landman Administration	3
M.L.M. 495. Oil-Gas and Mineral Law	3

Minerals Landman Administration and Oil-Gas and Mineral Law are to be taken after all lower division requirements have been completed and the completion of 90 semester hours of work toward the M.L.M. major. These courses are open only to students who are regularly enrolled in the College of Business and Administration.

Suggested Electives

R.Es. 430. Residential and Income Property Appraising	3
Econ. 476, 478. Economics	6
B.Law 412. Business Law	3
C.E. 221. Plane Surveying	3
C.E. 323. Photogrammetry and Control Surveys	3
I.S. 220. Data Processing	3
I.S. 350. Database and Information Systems	3

Organization Management

The organization management curriculum provides the foundation for careers in supervision and general management in a wide variety of organizations. It develops understanding of and skill in management practice, including employee motivation, managerial leadership, developing productive organizations, and dealing with labor unions.

Required Courses	*Semester Hours*
(The following two courses)	
Or.Mg. 335. Managing Individuals and Work Groups	3
Or.Mg. 437. Managing Complex Organizations	3
and	
(At least two of the following)	
PHR 434. Labor and Employee Relations	3
PHR 438. Personnel Administration: Employment	3
PHR 439. Personnel Administration: Legal and Social Issues	3
PHR 441. Personnel Administration: Planning, Development, and Compensation	3

Recommended Electives in Addition to the Above

Pr.Mg. 440. Planning and Control Systems in Production and Operations Management	3
Pr.Mg. 444. Work Design, Measurement, and Productivity Management	3
Pr.Mg. 447. Policy Analysis in Production and Operations Management	3
Pr.Mg. 460. Purchasing and Materials Management	3
B.Ad. 470. Small Business Management and Operation	3
Acct. 332. Cost Accounting	3

Personnel-Human Resources Management

Personnel-human resources management offers opportunities for students to develop professional competence in the areas of personnel administration and labor relations. Students gain understanding and skill in developing and implementing personnel systems including recruitment, selection, evaluation, training and motivation of employees, and union-management relations.

Required Courses	*Semester Hours*
(The following four courses)	
PHR 434. Labor and Employee Relations	3
PHR 438. Personnel Administration: Employment	3
PHR 439. Personnel Administration: Legal and Social Issues	3
PHR 441. Personnel Administration: Planning, Development, and Compensation	3

Recommended Electives

Or.Mg. 335. Managing Individuals and Work Groups	3
Or.Mg. 437. Managing Complex Organizations	3
Pr.Mg. 444. Work Design, Measurement, and Productivity Management	3
Acct. 332. Cost Accounting	3
I.S. 350. Database and Information Systems	3
Q.M. 300. Intermediate Statistics	3
Soc. 478. Sociology of Work Organization	3
Econ. 161. Labor Economics	3
Psych. 485. Principles of Psychological Testing	3
Psych. 487. Personality Assessment	3

Production and Operations Management

The area of emphasis in production and operations management is designed to prepare students for professional careers in production planning and control, inventory management, and purchasing, in both manufacturing and service organizations.

Emphasis in the program is placed upon current practices in these professional fields and upon the knowledge and skills required for entry-level jobs.

The outlook for jobs in this area continues to be strong in the 1980s. This placement is aided by the student chapter of the American Production and Inventory Control Society and work intern programs provided to qualified students. Participation in live case research and consulting projects with local organizations is usually an integral part of this course of study.

Students whose major areas of emphasis are information systems, transportation management, or engineering will find the production management 400-level courses to be particularly well related to their course of study. Students should plan schedules carefully, as required courses are not offered every semester.

Required Courses	*Semester Hours*
(The following three courses)	
I.S. 330. Operations Research	3
Pr.Mg. 440. Planning and Control Systems in Production and Operations Management	3
Pr.Mg. 447. Policy Analysis in Production and Operations Management	3
(One of the following courses)	
Pr.Mg. 444. Work Design and Measurement	3
Pr.Mg. 460. Purchasing and Materials Management	3

Recommended Electives

I.S. 220. Information Systems: Introduction to Data Processing	3
Or.Mg. 335. Managing Work Groups	3
Or.Mg. 437. Managing Complex Organizations	3
PHR 434. Labor and Employee Relations	3
PHR 438. Personnel Administration: Employment	3
Tr.Mg. 450. Transportation Operations and Management	3
Mk 485. Physical Distribution Management	3
Acct. 332. Cost Accounting	3
Q.M. 300. Intermediate Statistics	3

Students planning to take the APICS (American Production and Inventory Control Society) certification examinations should consult with an advisor to determine which elective courses should be taken.

Public Agency Administration

Public agency administration is designed for a career in management of governmental or other nonprofit service organizations. The curriculum in public agency administration provides a foundation of core courses upon which the student can construct an area of emphasis which will focus on the type of service organization he desires to enter upon graduation.

Required Courses	*Semester Hours*
Acct. 480. Business and Governmental Budgeting and Control	3
PHR 438. Personnel Administration: Employment	3
I.S. 330. Operations Research	3
Business elective approved by area director	3

Real Estate

Real estate requires knowledge of real estate investments, urban land economics, real estate law, appraising, finance, taxes, management, sales, and accounting. Real estate is one segment of the economy where it is still possible for persons to be their own bosses whether they are brokers, appraisers, developers, syndicators, or property managers.

Required Courses	*Semester Hours*
R.E. 300. Principles of Real Estate Practice	3
R.E. 430. Residential and Income Property Appraising	3
R.E. 454. Real Estate Finance	3
R.E. 473. Legal Aspects of Real Estate Transactions	3
R.E. 401. Real Estate Development or R.E. 433. Real Estate Investments	3

It is strongly recommended that any student planning to sit for the Colorado broker's examination take all six of the real estate courses. Additional preparatory courses for a real estate career are:

	Semester Hours
Arch.E. 240. Building Construction	3
M.L.M. 485. Minerals Landman Administration	3
Fin. 455. Monetary and Fiscal Policy	3
Acct. 441. Income Tax Accounting	3
Fin. 433. Investment and Portfolio Management	3
Mk. 310. Salesmanship	3
Mk. 320. Consumer Behavior	3
Mk. 470. Sales Management	3
B.Ad. 470. Small Business Management and Operation	3
Ins. 484. Principles of Insurance	3

Students should not take Arch.E. 240 until checking that the required percentage of their courses is in business.

Small Business Management and Entrepreneurship

Small business management provides understanding, knowledge, and skills in organizing and managing small business. The emphasis is on the managerial aspects of the wide range of activities required of the entrepreneur.

A second area of emphasis in business is highly recommended. The course requirements for the second area can be included as part of business or free electives.

It is recommended that students take B.Ad. 452 (Small Business Strategy, Policy and Entrepreneurship) in satisfying their business policy requirement. Additional courses in management, finance, accounting, and marketing should be planned in consultation with the advisor to serve individual career needs.

Required Courses	*Semester Hours*
B.Ad. 470. Small Business—Management and Operation	3
(Two or three of the following four courses)	
Fin. 401. Business Finance I	3
Acct. 332. Cost Accounting	3
PHR 438. Personnel Administration: Employment	3
Mk. 480. Marketing Strategies and Policies	3
The fourth course may be selected from the following:	
PHR 434. Labor and Employee Relations	3
Pr.Mg. 440. Production and Inventory Planning and Control	3
Recommended Electives	
Pr.Mg. 447. Policy Analysis in Production and Operations Management	3
Tr.Mg. 450. Transportation Operation and Management	3
Pr.Mg. 460. Purchasing and Materials Management	3
Mk. 485. Physical Distribution Management	3
Fin. 402. Business Finance II	3

Transportation and Distribution Management

The curriculum in transportation management includes the role of transportation in society and the problems of traffic management within specific industries as well as the management of firms in the transportation industry, such as airlines, urban transit firms, trucking firms, and railroads. International transportation management problems and policies are analyzed.

One of the recommended elective courses may be substituted with permission of the advisor for one of the required courses if there is a schedule conflict, if the course is not available, or if a student demonstrates a career need for such a course.

Required Courses	*Semester Hours*
(Any four of the following six courses)	
Tr.Mg. 450. Transportation Operation and Management	3
Tr.Mg. 452. Problems in Surface Transportation Management	3
Tr.Mg. 456. Air Transportation	3
Tr.Mg. 457. Urban Transportation	3
Tr.Mg. 458. International Transportation	3
Mk. 485. Physical Distribution Management	3
Recommended Electives	
PHR 434. Labor and Employee Relations	3
Tr.Mg. 451. Survey of Transportation: Law and Freight Claims	3
Pr.Mg. 460. Purchasing and Materials Management	3
Mk. 490. International Marketing	3

GRADUATE DEGREE PROGRAMS

The graduate program leading to the Master of Business Administration degree is offered through the Graduate School of Business Administration. Graduate programs leading to the Doctor of Business Administration and Master of Science are offered through the University's Graduate School. Master's degree programs in business are accredited by the American Assembly of Collegiate Schools of Business. Daytime master's courses are offered in Boulder. Evening master's courses are offered in Denver and Colorado Springs.

Requirements for Admission—Master's Programs

Admission to the master's programs will be determined by the following criteria:

1. The applicant's total academic record. (The bachelor's degree must be from a regionally accredited college or university.)

2. The applicant's scores on the Graduate Management Admission Test (GMAT). This test is given four times each year at numerous centers throughout the world. For information and to make application for the test, write to the Educational Testing Service, P.O. Box 966, Princeton, New Jersey 08541.

In general, students failing to meet minimum standards are not admitted on provisional status. Seniors in this University who have satisfied the undergraduate residence requirements and who need not more than 6 semester hours of advanced subjects and 12 credit points to meet their requirements for bachelor's degrees may be admitted to the Graduate School of Business Administration by special permission of the director of graduate studies. They must meet regular admission criteria and submit complete applications by deadlines listed below.

The application, GMAT scores, two official transcripts (not student copies) from *each* college attended, and a nonrefundable application fee ($40 for M.B.A.; $20 for M.S.) must be submitted by April 1 for summer admission, by May 1 for fall admission, and by November 1 for spring admission or until the quota is filled.

Applications received after these dates will receive lower priority.

Personal interviews are not required or encouraged.

The mailing address for all applications regardless of campus is:

Graduate School of Business Administration
Campus Box 419
University of Colorado
Boulder, Colorado 80309

BACKGROUND REQUIREMENTS

Students applying for graduate programs in business need not have taken their undergraduate degrees in business. For those students the M.B.A. or M.S. degree programs provide a series of 3-semester-hour fundamental background courses. These include: B.Ad. 501 (Acct.); B.Ad. 502 (Stat.)[1]; B.Ad. 503 (Mkt.); B.Ad. 504 (Mgt. and Org.); B.Ad. 505 (Fin.); B.Ad. 506 (Bus. Law); B.Ad. 507 (Mgt. Sci.); and B.Ad. 508 (Macro and Micro Econ.). In addition, all graduate students are required to take either B.Ad. 500 (Sources of Information and Research Methods—1 semester hour) or pass a qualifying examination. Only admitted graduate business students are allowed in these courses.

In order to waive the relevant graduate fundamental courses, students must have completed equivalent courses at a regionally accredited university with grades of *C* or better.

	Semester Hours
Introduction to Accounting (Financial/Managerial)	6
Statistics	by qualifying examination only
Principles of Marketing	3
Introduction to Management and Organization	3
Finance	3
Business Law	3
Operations Research	3
Principles of Economics (Macro/Micro)	6

Remedial work is required of all applicants accepted for the M.B.A. and M.S. programs who do not have the mathematical and programming skills.

Master of Business Administration

The Master of Business Administration program is devoted to the concepts, analytical tools, and communication skills required for competent and responsible administration. The administration of an enterprise is viewed in its entirety and within its social, political, and economic environment.

In addition to the background requirements for a master's degree listed above, the candidate for the M.B.A. degree must complete the specific requirements of the M.B.A. curriculum (30 semester hours) as follows:

CORE REQUIREMENTS	*Semester Hours*
a. *Functional Courses*	
Two of the following four functional courses are required: Fin. 601, Mk. 600, Pr.Mg. 640 (Logistics), and I.S. 645. At least one of these shall be either Fin. 601 or Mk. 600. Candidates with either marketing or finance undergraduate or graduate majors shall not take the corresponding functional course to fulfill this requirement	6
b. *Business and Its Environment*	
B.Ad. 610. Business, Government, and Society	3
c. *Analysis and Control*	
B.Ad. 615. Business and Economic Analysis	3
B.Ad. 620. Administrative Controls (Accounting students should substitute Acct. 533)	3
d. *Human Factors*	
B.Ad. 640. Organizational Behavior	3
e. *Planning and Policy*	
B.Ad. 650. Administrative Policy	3
AREAS OF EMPHASIS (Three courses)	9
Total	30

Areas of emphasis include accounting, finance, management science/information systems, marketing, organization management, personnel-human resources management, production and operations management, and transportation management. (Students who have undergraduate degrees in business with majors in finance or marketing normally are not allowed to select the same fields for areas of emphasis.)

For student taking an area of emphasis in accounting, Act. 322, 323 and 332 or their equivalent are prerequisites for all graduate level accounting courses. Acct. 533 is substituted for for B.Ad. 620. Acct. 628 and two other graduate-level accounting courses are required in the area of emphasis.

Requirements for an area of emphasis in finance are Fin. 601, and two of the following three courses — Fin. 602, 633, or 655.

Requirements for an area of emphasis in marketing are Mk. 600, 605, and one additional graduate marketing course.

Candidates pursuing their area of emphasis in management science normally elect either a decision science option or an information systems option. Those electing the decision science option will normally take Mg. Sc. 601, 602, and Q.M. 620. Those electing the information science option should consult the information systems advisor. Typically, I.S. 220 and I.S. 221 will be required prerequisite courses. C.S. 210 and C.S. 310 are recommended.

Students taking other areas of emphasis should consult the division head concerning the requirements.

No thesis is required in the M.B.A. program. In the total program there must be a minimum of 30 semester hours of graduate course work and a minimum of 24 semester hours of course work at the 600 level. Independent study is normally not acceptable for credit in the final 30 semester hours of the M.B.A. program.

JOINT J.D./M.B.A. DEGREE PROGRAM

Objective

The purpose of the joint degree program is to allow students admitted to both the School of Law and the Graduate School of Business Administration to obtain both the Juris Doctor (J.D.) and the Master of Business Administration (M.B.A.) degrees in not more than four years of full-time study.

[1]Students entering any of the graduate programs are required either to take B.Ad. 502 (Fundamentals of Business Statistics) or to pass a qualifying examination covering this subject matter.

The program is designed to train students for careers in which business administration and law overlap. Only those students who are convinced that the combined studies are important to their career plans and who have the backgrounds which will enable them to handle the rigorous and concentrated course of study should attempt the joint program.

Admission

To be eligible for the joint J.D./M.B.A. degree program of the law school and the business school, a student must apply separately to and be admitted by each of the two schools under their respective admission procedures and standards.

Students may elect the joint degree program at the time of initial application to both schools; or students enrolled in the applicable degree program of either school may, during their year of study under the degree program of that school, apply for admission to the other school and elect to be enrolled under the joint program.

Course of Study

A student enrolled in the joint degree program may commence studies under the program in either the law school or the business school. However, a student in the joint program in law is required by the law school to take the first year of the Juris Doctor curriculum as a unit exclusively in the law school. Otherwise the student may take courses in the business school or in the law school, or both, as the student may desire and as may be necessary to meet the requirements of the degree programs of the two schools.

No student in the joint degree program shall be allowed to take fewer than 9 semester hours or more than 16 semester hours during any term (excluding summer terms) without receiving the consent of the program advisor in each school in which courses are being taken.

Credit for Courses Taken

The law school will grant credit toward the Juris Doctor degree for up to 9 semester hours of acceptable performance in graduate level courses taken by a joint degree program student at the business school, and up to 12 semester hours of credit for such performance if 3 of such semester hours are in B.Ad. 501, Fundamentals of Accounting. A student must earn a grade of $B-$ or higher in the business school course in order for the performance to be acceptable for law school credit.

The business school will grant credit toward the Master of Business Administration degree for up to 9 semester hours of acceptable performance in law school courses taken by a joint degree program student, will waive any business law course requirement, and will waive or otherwise modify other requirements so that a joint degree program student will be able to obtain the M.B.A. degree with not more than 46 semester hours of business school course credit exclusive of credit given for law school courses under the program. A student must have earned a grade of $C-$ or equivalent in the law school course in order for the performance to be acceptable for business school credit.

Termination of Joint Degree Enrollment or of Good Standing

Students in the joint degree program who do not maintain the academic or ethical standards of either school may be terminated from the joint degree program. Students in good standing in one school, but not the other, *may* be allowed to continue in the school in which they are in good standing. However, students who do not complete the joint degree program will be required to meet the regular degree requirements (J.D. or M.B.A.) which were in effect when they entered the program for that degree.

For additional information concerning the joint degree program see the program advisors in the School of Law and the Graduate School of Business Administration.

Master of Science

The Master of Science degree affords opportunity for specialization and depth of training within a particular major field and a related minor field.

MAJOR FIELDS

For detailed information concerning requirements and recommended programs for each of the major fields, students should consult the following professors:

Accounting	Professor Johnson
Finance	Professor Melicher
Health administration (Denver only)	Professor Kurowski
Management science and information systems	Professor Jedamus
Marketing	Professor Buchanan
Management and organization	Professor Morrison

MINOR FIELDS

With the approval of the student's advisor and the director of graduate studies, minor fields may be chosen from business subjects, or from other graduate departments.

Fields available in the College of Business for selection as a minor are:

- Accounting
- Finance
- Health administration
- Management science and information systems
- Marketing
- Organization management
- Personnel-human resources management
- Production and operations management
- Transportation and distribution management

MINIMUM REQUIREMENTS

The minimum requirements for the M.S. degree, after all undergraduate background deficiencies have been removed, may be met by Plan I or Plan II.

The student's degree program should have approval in advance by the advisory committee and the director of graduate studies.

Plan I. The requirement is 30 semester hours of graduate credit including a thesis (4 to 6 hours credit) based upon original research by the candidate. A minimum of 21 semester hours credit is required of all candidates and, including the thesis, must be earned in a major field. Not fewer than three courses, normally 9 semester

hours, must be completed in a minor field. A minimum of 16 hours must be at the 600 level.

Plan II. A minimum of 30 semester hours of graduate-level course work must be completed. Requirements must be met in both a major and a minor field. No thesis is required. Of the 30 semester hours of graduate-level course work, a minimum of 16 hours must be at the 600 level.

All M.S. students must pass written comprehensive examinations covering major and minor fields during the last semester they are enrolled. The candidate's committee may require an oral final comprehensive examination subsequent to the written examination.

General Information—Master's Programs

Advising. All graduate students should report first to the graduate student advisor in the Office of Graduate Studies for the purpose of ascertaining deficiencies and principal field of interest. The division heads of each area serve as faculty advisors.

During the first term of residence, each student should prepare a degree plan. This plan, with appropriate signatures, should be filed in the Office of Graduate Studies.

Course Load. The normal course load for graduate students is 12-15 semester hours.

Minimum Hours Required. A candidate for a master's degree in business must complete a minimum of 30 semester hours of graduate work plus any deficiencies. A maximum of 6 semester hours of graduate work can be transferred from another AACSB accredited master's program.

Comprehensive Examination. A comprehensive examination is not required for students pursuing the Master of Business Administration degree program. Each candidate for a Master of Science degree is required to take a comprehensive-final examination during the final semester the student is enrolled. Students must be registered when they take this examination. Comprehensive examinations are given in November, April, and July.

Minimum Grade Point Average. A minimum cumulative grade point average of 3.0 must be achieved in courses taken after the student's admission to the graduate program. Effective fall semester 1974 courses taken as a special student at the University of Colorado which will be used to satisfy degree requirements will count towards the overall grade point average for students who are later admitted to any graduate program in business. If the cumulative grade point average falls below 3.0, a student will be placed on academic probation and given one regular semester (summer terms excluded) in which to achieve the required 3.0 cumulative average. Failure to achieve the required average within the allotted time period will result in dismissal.

The grade of *D* is not a passing grade for graduate students. A student may repeat a course once for which he or she has received a grade of *D* or *F*. Both the original grade and the grade for the repeated course count in the computation of the grade point average.

To earn a grade of *W* (withdrawal) in a course, a student must be earning a grade of *C* or better in that course. Students will not be permitted to withdraw from courses after the tenth week of the semester.

An *IF* grade shall be a valid grade only until the middle of the second semester (summer terms excluded) following that in which the grade of *IF* is given. By the end of that interval, the instructor concerned shall have turned in a final grade of *A, B, C, D,* or *F*. If no reports are received from the instructor within the allotted time the *IF* shall be converted to an *F*.

Time Limit. All graduate courses, including the comprehensive-final examination, should be completed within five years. Courses completed earlier will not be accepted for the degree unless validated by a special examination. Candidates for the master's degree are expected to complete their work with reasonable continuity.

Doctor of Business Administration

The highest level of formal study available in business administration is afforded by the Doctor of Business Administration (D.B.A.) program. It is intended to develop both the breadth and depth of comprehension, the understanding of related disciplines, and the command of research methodology required for graduate and undergraduate university teaching, for high level staff positions, and for research careers in these fields. The positions for which a D.B.A. program helps prepare the student demand the highest level of excellence in intellectual attainment. The requirements of the program are therefore severe and the standard exacting.

Field requirements for the D.B.A. degree at the University of Colorado are broadly conceived and are designed to encourage study in the cognate disciplines. Candidates' degree programs are prepared in detail after a careful review of their career objectives and a thorough appraisal of their preparation.

REQUIREMENTS FOR ADMISSION—D.B.A. PROGRAM

To preserve the individualized character of the D.B.A. program and its quality goals, the number of candidates is closely limited, and candidates are admitted only after careful screening. Applicants must submit a $20 nonrefundable fee with their applications.

The graduate committee of the school, in reviewing applications, will consider:

1. The applicant's undergraduate and graduate academic records.
2. The applicant's scores on the Graduate Management Admission Test. For information and to make application for the test, write to the Educational Testing Service, P.O. Box 966, Princeton, New Jersey 08541.
3. Recommendations from not fewer than three persons qualified to advise the committee concerning the applicant's capacity for doctoral study and research.
4. Information obtained from the applicant concerning his or her career objectives.

Students are admitted for study in specific major field for doctoral work.

5. The mailing address for all applications is:

Graduate School of Business Administration
Campus Box 419
University of Colorado
Boulder, Colorado 80309

REQUIREMENTS FOR DEGREE—D.B.A. PROGRAM

Students in the doctoral degree program must fulfill the following requirements:

Prerequisites. Completion of the graduate fundamentals courses for the M.B.A. program as outlined in this catalog.

Advising. The newly accepted D.B.A. student should counsel with the divisional doctoral advisor to determine courses for major and minor fields. Assignments of faculty members working with doctoral students on their programs should be decided upon by the end of the first semester. The committee shall include two members from the students dissertation field and at least one member from each other field of specialization, with one faculty member, normally from the dissertation field, to act as chairman of the Advisory Committee.

At the end of the first term of residency, each student should prepare, with the approval of the Advisory Committee, a degree plan. The signatures of the division (department) heads of the dissertation field and other field(s) will be required on all degree plans and applications for candidacy for D.B.A. students. The signature of the division head of the dissertation field signifies the approval of the entire degree plan. The plan with appropriate signatures should be filed in the Office of Graduate Studies.

Qualifying Examinations, usually in the form of faculty interviews, are normally given prior to enrollment in the program, or during the first two months. These examinations are given in the student's major area for the purpose of insuring the candidate's qualifications, progress, and needs in the program. The results of the examination will be used to advise and qualify the candidate for further work at the doctoral level.

Fields of Study. Preparation in two or more fields of study, including:

1. One of the following fields in business, which must be the dissertation area:

Accounting	Management science and information systems
Administrative policy	Marketing
Finance	Organization management

2. One or more other fields, which may be in the above business fields or an approved and related field outside the College of Business and Administration.

Analytical and Conceptual Tools. Demonstration of the required level of competence in:

1. Quantitative analysis for business decisions. Students must demonstrate competence in mathematical and statistical processes as applied to business decision making. Minimum competence in quantitative analysis will normally be gained by completing B.Ad. 502, B.Ad. 507, and Q.M. 620. With approval, this requirement may be met by taking Educ. 503 and Educ. 600 or Psych. 587 and 588 in lieu of B.Ad. 502 and B.Ad. 507.

2. Microeconomic and macroeconomic theory: at least one course each in intermediate microeconomic and macroeconomic theory (Econ. 407 and 408), one graduate-level course in economics to be approved by the student's advisory committee, and a course in business conditions (B.Ad. 660).

3. Dissertation research methodology: (B.Ad. 790, Doctoral Seminar in Dissertation Research, and the research internship would be expected to provide this competence).

Research Internship. Doctoral students are required to participate in a research internship under the direction of a faculty member. The research internship is decided upon with the student's program committee. At the end of each of these research internships, a research paper is presented to the faculty member and to all faculty members in the area of emphasis of the doctoral candidate.

Credit by Transfer. Resident graduate work of high quality earned in another institution of approved standing will not be accepted for transfer to apply on the doctorate until after the student has established in the Graduate School a satisfactory record in residence. However, such credit must be transferred before the student makes application for admission to candidacy for the degree. Such transfer will not reduce the minimum residence requirement at this University, but it may reduce the amount of work to be done in formal courses.

Requests for transfer of credit to be applied toward an advanced degree must be made on the form specified for this purpose and submitted to the Graduate School.

The maximum amount of work which may be transferred to this University for the D.B.A. degree is 10 semester hours.

Residence. The minimum residence requirement is six semesters of scholarly work beyond the attainment of an acceptable bachelor's degree. As the word is used here, residence is not limited to, or defined as, mere attendance in campus classes. Residence may be earned for course work completed with distinction, for participation in seminars, and for scholarly research performed on campus or elsewhere under the auspices of the University of Colorado. Not less than two consecutive semesters of full-time academic work on the Boulder Campus are required. Full-time employment outside the University is prohibited during this residency period.

Not more than two semesters of residence credit toward a D.B.A. degree may be allowed for an acceptable master's degree.

All students in the doctoral program are expected to be full-time students on the Boulder Campus (at least during residency and prior to completing comprehensive examinations). Courses at the 600 level or above are expected to be taken on the Boulder Campus. Doctoral students are expected to be available to participate in colloquia and other informal academic discussions. One year of residency must include two consecutive academic (not summer) semesters on the Boulder Campus, the timing to be determined by the student's program committee.

Course Load. During each semester in one academic year a student must carry a minimum course load of 8 semester hours. Each semester's work must include at least three courses on the Boulder Campus. (This academic year normally will satisfy two full semesters of residence credit.) During this academic year the student's total nonstudy work load of any kind, on-campus or off-campus, must not exceed half time.

Minimum Grade Point Average. It is expected that high standards of academic excellence (a minimum grade point average of 3.3) will be maintained in all work undertaken; *C* is not a passing grade.

To drop a course without discredit a graduate student must be earning a grade of *C* or better in that course.

It is recommended that all students be employed in a teaching or research capacity in the College of Business and Administration or the Graduate School of Business Administration. Doctoral students are not encouraged to be employed elsewhere during full-time residency.

Admission to Degree Candidacy. A student must make formal application for admission to candidacy for the D.B.A. degree on forms supplied by the Office of Graduate Studies in the first month of the semester in which the comprehensive examination is to be attempted.

Comprehensive Examination. Before admission to candidacy for the D.B.A. degree, the student must pass a comprehensive examination in the dissertation field and the other field(s) of specialization. This examination may be oral, written, or both, and will test the student's mastery of a broad field of knowledge, not merely the formal course work he has completed. The oral part of the examination is open to any member of the faculty.

The written part of the examination will be evaluated by such faculty members as determined by the division in which the field is undertaken.

The oral part of the examination shall be conducted by an examining board consisting of at least five members, and shall follow the written exam as soon as practicable. A successful candidate must receive affirmative votes from the majority of the members of the examining board. In case of failure, the examination may be attempted once more with the approval of and after a period of time determined by the examining board.

Comprehensive examinations for the D.B.A. degree will be given twice each year: in November and April. A student may attempt the examination during the last semester of residency while still taking required courses for the degree provided satisfactory progress is being made in those courses. It is strongly recommended that adequate time for review be allowed. Therefore, a student might be well advised to consider taking the comprehensives during the semester following completion of all course work.

All field examinations must be attempted during one examination period and the student must be registered at the time of the examination.

Dissertation. A dissertation based upon original investigation and showing mature scholarship and critical judgment as well as competence in the use of methods and tools of research, must be written on a subject approved by the candidate's dissertation committee. The Dissertation Committee shall consist of at least three members, normally two from the dissertation field and one from the other field(s) of specialization. One member, normally from the dissertation field, will act as chairman of the Dissertation Committee. Membership of the Dissertation Committee may be the same as, or different from, the membership of the student's Advisory Committee.

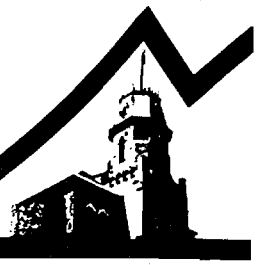
A student must register for a total of 30 semester hours of doctoral dissertation credit with up to 10 credits in any one semester. The specific number must be approved by the student's advisor. Not more than 10 of these credits may be obtained before the semester the student takes the comprehensive examination.

Dissertation credit does not apply toward the 30 semester hours of required credit specified in Article VII, Section 2, of the Rules of the Graduate School, and will not be included in calculating the student's grade point average.

One formally approved, printed or typewritten copy of the dissertation and two original abstracts must be filed in the Graduate School Office at least two weeks before the date on which the degree is to be conferred. A second formally approved, printed or typewritten copy of the dissertation must be filed in the Office of Graduate Studies, Graduate School of Business Administration.

Final Examination. After the dissertation has been accepted by the Dissertation Committee, a final examination on the dissertation and related topics will be conducted. This examination will be wholly or partly oral. The oral portion will be open to anyone. The examination will be conducted by a committee of at least five members. It will consist of the candidate's Dissertation Committee.

College of Design and Planning,
Environmental Design Division



INFORMATION ABOUT THE COLLEGE

W. Mike Martin, Resident Dean

Scope and Purpose

The College of Design and Planning is comprised of seven divisions. The Division of Environmental Design and the Center for Environmental Design Education and Research are located on the Boulder Campus. The graduate divisions of Architecture, Landscape Architecture, Planning and Community Development, Urban Design, and the Center for Community Design and Development are located at the Denver Campus.

Designers and planners of the physical environment in recent years have moved into expanded roles and responsibilities. Changes in breadth of concern and scope of service have brought together the architect, the landscape architect, the urban and regional planner, the technologist, and the interior designer, who address the complex problems encountered in today's physical environments. Lines of demarcation among these professions are being minimized and interdependence among them increased.

These requirements necessitate a broader base of educational experience including not only a background for design technique, but also an increased association with and understanding of the physical, natural, and social sciences. The social and economic determinants of contemporary life, the complexities of urbanization and the allied problems of transportation and population, the effect of business and governmental activity, changing availability of resources, human values, and rapid technological advances all require of the environmental designer a broad educational base to meet present needs and anticipate future environmental change.

To fulfill its mission, the college provides the student with an educational experience that is founded in the humanities, the sciences, and the arts. This background provides the technical and aesthetic perspectives for designing and planning the constructed environment. It brings to the practicing professional an opportunity for continuing education and a means of keeping abreast of cultural and technological change. It encourages a better informed public through academic experiences for students other than those majoring in the environmental design professions.

Preparation for professional service through careers in one of the design and planning fields is partially fulfilled through academic experiences. Accordingly, the University of Colorado has expanded its offerings to provide an undergraduate degree in environmental design and a series of professional graduate degrees allowing specialization in particular areas of concern, e.g. architecture, landscape architecture, planning and community development, etc.

Full professional status in most environmental design fields requires a minimum of five to six years of academic experience and three years of practical experience followed by state registration or licensing through a professional examination. Completion of the four-year curriculum allows those who do not wish to pursue further academic work or full professional status the opportunity to pursue paraprofessional careers in private practice, government, and corporate service in design and planning related activities.

Organization

The College of Design and Planning is organized into six programs. At the undergraduate level there is a four-year environmental design program leading to a Bachelor of Environmental Design degree within the Division of Environmental Design. At the graduate level there are programs in architecture, urban design, landscape achitecture, urban and regional planning and community development, and interior design. The environmental design undergraduate degree program is offered on the Boulder Campus, and the graduate degree programs are offered at the Denver Campus. (See the bulletin of the University of Colorado at Denver for details on the graduate program.)

The Center for Environmental Design Education and Research (CEDER) provides technical assistance in architectural and graphic design planning and community development to community groups, individuals, and organizations. In addition, it offers special education programs for professionals and others. The center is a nonprofit organization.

In response to a growing number of community needs, design services for a variety of projects including the development of community design guidelines, planning surveys, housing, and parks have been generated through CEDER.

Students, clients, and professional volunteers are offered a creative learning experience through active group and citizen participation. All learn to identify and assess their particular needs throughout the design

process, and through this approach, neighborhood and individual goals are translated into effective design programs.

The Center for Environmental Design Education and Research stimulates broad involvement within the community, and interested members are offered an opportunity to volunteer. While professionals gain a better understanding of community problems, design students receive training and practical experience in defining, managing, and resolving community problems.

Facilities

Facilities for academic programs at Boulder are provided in the Environmental Design Building. On its lower floors are administrative and faculty offices, lecture rooms, and exhibit space.

A media center, workshop, darkroom, and drawing studios supplement design studios, which are available throughout the building. Space is provided within the design studios for all students for academic use during the entire semester. These facilities are available to the student throughout the day and evening.

A computer center with computer graphic capabilities and a photographic laboratory are available to students.

Recognition of Scholarship

As a professional school, the College of Design and Planning provides an atmosphere for study and creative investigation in which the attainment of quality is held in the highest esteem. In recognition of high scholarship and professional attainment, the college grants honors at graduation in two categories: honors and special honors. At an annual awards program, scholarships, prizes, and awards are given to outstanding students and faculty.

Scholarships, Loans, Awards, and Prizes

SCHOLARSHIPS

Several scholarships to students in the Division of Environmental Design are awarded upon recommendation of the faculty of the school. In 1961 the Educational Fund of the Colorado Chapter, American Institute of Architects, was incorporated by appropriate action of its executive committee. The purpose of this fund is to advance education in architecture by the granting of scholarships, prizes, and financial aid to deserving students in architecture and to architects interested in research programs directly related and of value to the architectural profession.

The original Educational Fund was founded in January 1934 by William E. Fisher, F.A.I.A.; George H. Williamson, F.A.I.A.; Fred E. Mountjoy, A.I.A.; William H. Bowman, A.I.A.; and Robert K. Fuller, F.A.I.A. Kenneth R. Fuller, son of the founder, now serves as secretary of the fund and, acting with the president and vice president of the Colorado Society, American Institute of Architects, forms the board of directors of the fund. This board has granted scholarships annually to students and alumni of the College of Design and Planning.

Scholarships and prizes have been awarded also by other organizations in the building industry. Such awards have been made by Blumcraft of Pittsburgh, the Monarch Tile Company, the Portland Cement Association, the American Concrete Institute, the Producers' Council, Dow Chemical Company, and the Colorado Masonry Institute. Other scholarships are the Robert C. Sandoval, C. Gordon Sweet, Robert K. Fuller, Temple Hoyne Buell, and Arthur A. and Florence G. Fisher Scholarships.

The Dana Soper Memorial Scholarship. This $2,000 grant, started in 1973, is awarded to a second-year student in environmental design based upon the following criteria: proven academic performance, personality and character, contribution to the college, and professional potential.

In addition, dean's honors and scholarships are available to resident students of the state of Colorado on a funds-available basis.

Exhibits, Lectures, Trips, and Study Abroad

The regular academic program of the Division of Environmental Design is supplemented by visiting lecturers who make valuable contributions to the education of the student. Exhibits, both local and traveling, are displayed within the teaching facility of the division and are open to its students, the general student body, and the public.

Field trips are organized as a part of regular class activity or as an extracurricular program.

The Division of Environmental Design cooperates with other divisions of the University in the presentation of the annual Creative Arts Program held each summer on the Boulder Campus.

It is possible also for qualified students to study abroad and receive elective course credits toward graduation. Please see the Environmental Design Office and the International Education Office for more information.

UNDERGRADUATE DEGREE PROGRAM

The baccalaureate program in environmental design offers students an opportunity to develop skills as designers within the context of a strong general education. While developing skills and a knowledge base in environmental design, the students enrich their understanding of the sciences, humanities and social sciences, and bring this understanding back into the design process.

Requirements for Admission

Candidates for regular admission to the Division of Environmental Design of the College of Design and Planning are expected to meet the general requirements for admission to the University and the particular requirements of the Division of Environmental Design.

All credentials presented for admission to the University of Colorado become the property of the University of Colorado and must remain on file permanently.

FRESHMAN STUDENTS

Freshman applicants are required to present 16 units of acceptable high school work including the following:

English (composition, literature, grammar)	4
Mathematics (college preparatory)	3
Physics	1
Biology	1
Social studies and humanities (additional units of English, history and literature are included in the humanities)	2
Foreign language (both units in a single language)	2
Fine arts (studio)	1
Academic electives	2
Total	16

A unit of work in high school is a course covering a school year of not less than 36 weeks, with five periods of at least 40 minutes each per week. (Two periods of manual training, domestic science, drawing, or laboratory work are equivalent to one period of classroom work.) The 16 required units are equivalent to 30 points. High school is interpreted as the 9th, 10th, 11th, and 12th grades. Fractional units of value less than one-half unit will not be accepted. Not less than one unit of work will be accepted in a foreign language, elementary algebra, plane geometry, physics, chemistry, or biological science.

Acceptable English units are courses in literature, composition (including all composition given as part of a basic English course), grammar, speech, and journalism. All modern and classical languages are acceptable as foreign language units.

Applications should be submitted early since the Division of Environmental Design has an enrollment limit.

TRANSFER STUDENTS

Qualified students transferring from other institutions as well as those seeking admission from another division of the University of Colorado will be accepted into the Division of Environmental Design. Former students who have attended another college or university for one semester (12 hours or more) will be considered transfer students. Since the Division of Environmental Design has a transfer quota, all qualified students are not guaranteed admission. Transfer students must have attained a 2.75 cumulative grade point average in all previous college work. All course work except the last term, if in progress, must be completed and on the official transcript sent for admissions consideration. Transfer students should make application to the Office of Admissions. Applicants must meet the general requirements for admission to the University of Colorado. Students who possess a bachelor's degree in another discipline are encouraged to apply for one of the graduate programs in the college instead of pursuing an additional bachelor's degree.

Prerequisite courses for application include college calculus or statistics, a college science course with a laboratory (physics, chemistry, or biology), expository writing, a fine arts painting or drawing course, a course in the social sciences, and a course in the humanities (such as history, art history, or philosophy). Students interested in an architectural emphasis should take college calculus and physics with a laboratory. For a planning emphasis, statistics is recommended.

Normally students should transfer prior to the third year of college-level work; all transfer students will be required to take the four semesters of design studio within a minimum of 53 credits in the Division of Environmental Design.

Letters of intent and recommendation must accompany the application. It is the responsibility of the student to be sure transcripts and other application materials are complete at the Admissions Office located in Regent Administrative Center. Only complete application files will be considered for admission.

A maximum of 60 semester hours taken at a two-year college may be applied toward the baccalaureate degree. A minimum of 53 credits taken in the division is required for graduation.

Course Requirements

The course requirements for the Bachelor of Environmental Design are as follows:

Required Professional Courses	*Semester Hours*
Env.D. Design Studio, 100/200/300/400 (four semesters in sequence)	24
Env.D. Media, 220/one approved 320 or 420 level course	6
Env.D. Natural Science/Technology, 235/ 330 or 331 or 350 or 351	6-8
Env.D. Societal Science, 215/ 315 or 316	6
Env.D. History/Theory, 105/275/ one 470 level course	9
Minimum	53

Breadth Electives ..... 20 minimum

One approved course from each area:
Mathematics, physical and life sciences (with lab), social science, language arts (A.S. 100), visual communications, and humanities. Consult the division listings for courses approved in each category. The mathematics, physical and life sciences, and language arts requirements must be completed before starting upper division Env.D. courses, i.e., courses numbered 300 or above.

Support Electives ..... 15 minimum

Students must take at least 15 credits of approved course work outside of the division that support their emphasis area. Nine of the 15 credits must be in upper division (300 and 400 level) courses.

General Electives 40

Students may select general electives from any department, including offerings from other colleges as well as the Division of Environmental Design. Not more than 77 credits of Env.D. courses can be counted towards graduation.

Total hours required for graduation 128

A maximum of 17 credits is recommended for the first semester. Permission to take more than 17 credits in any given semester or fewer than 12 credits may be granted only by written petition.

Students intending to pursue graduate studies in architecture should plan to take the following courses:

Env.D. 401/402-6. Achitecture Studio I and II
Env.D. 420/421-3. Architectural Graphics I and II
Env.D. 450/451-3. Environmental Systems I and II
Env.D. 452/453-2. Architectural Structures I and II
Arch. 470/471-3. History of Architecture

Combined Programs and Double Majors

Official combined programs are available only in conjunction with the College of Business. Combined and double degree programs require approval of the deans of both colleges. Before a combined degree student will be admitted to courses in the College of Business, the student must obtain permission and complete an Application for Admission form from the College of Business.

The course requirements for the combined environmental design and business degree demand the completion of more than 128 credit hours. For the specific requirements, consult the Division of Environmental Design office.

Grade Point Average

Students must have a cumulative grade point average of 2.0 for all courses attempted at the University of Colorado after admission to the Division of Environmental Design. A grade of *C* or better is required in all Env.D. courses comprising the minimum 53 credits for graduation and for the breadth electives.

Residence Requirement

A student must complete the 53 credits of required professional courses in the major from the College of Design and Planning and be in residence for the last semester of the senior year.

Academic Policies—Undergraduate Course of Study

The undergraduate course of study in the Division of Environmental Design is four academic years in length and leads to the degree Bachelor of Environmental Design. Some students devote more than this specified time to completion of the program.

Students should confer with their academic advisor regarding specific academic standards for repeating studio and other Division of Environmental Design courses.

INDEPENDENT STUDY POLICY

Only environmental design students at the 300 or 400 level of design are ordinarily permitted to obtain independent study credit. No substitution for any design studio is permitted.

A complete prospectus of what is expected, how it shall be carried out, and what the end product might be must be submitted to the supervising faculty member no later than five days after the official beginning of a semester. Approval of the prospectus must be granted by the faculty member and the resident dean before an add card for that course is given to the student involved. Students should make arrangements during preregistration or well *before* the semester begins.

Only students who have completed all first- and second-year NST/SS/media/physics/math/English or other required courses are permitted to take an independent study. This is minimum; other requirements could be established depending on the proposed topic. Only students with a 3.0 grade point average or better are permitted to take an independent study. No independent study credit is given if financial or any other compensations are being earned by the student. Not more than 3 hours of independent study credit during one semester and not more than a total of 6 are given for the entire time the student is enrolled, unless permission is given by the resident dean.

A student may choose to take up to 6 credits on an independent study basis, exclusive of credits earned as a teaching assistant or research assistant. A student who wishes to take more than 6 credits must have the approval of the resident dean.

PASS/FAIL CREDITS

A student may choose to take up to 15 credits toward the degree in environmental design on a pass/fail basis. These credits must fall in the category of open electives. The following types of courses may not be taken on a pass/fail basis: breadth electives, support electives, and any course taken within the college.

SPECIAL EDUCATIONAL OPPORTUNITIES

Advanced placement and college credit may be granted on the basis of the College Entrance Examination Board's Advanced Placement Tests. For students who have taken an advanced placement course in high school and who make scores of 4 or 5 in the CEEB's Advanced Placement Examination, advanced placement as well as college credit will be granted. College credit granted will be treated as transfer credit without a grade, but will count toward graduation and the meeting of other specific requirements for which it is appropriate.

GRADE POINT AVERAGE REQUIREMENTS AND SCHOLASTIC SUSPENSION

As a general rule, students who fail to meet the minimum grade point requirements (2.0) in the fall semester of any year will be permitted to continue their studies during the spring semester. Scholastic records of students will be reviewed as soon as possible after the close of the spring semester, and students will be informed in writing if they are to be suspended.

The normal period of suspension is two regular semesters (one academic year, excluding the summer term). However, students suspended a second time will be reinstated only under unusual circumstances. Students who believe that their situations warrant a departure from these normal stipulations may petition for reinstatement. The committee will look with favor on such petitions only if the student's total grade point average exceeds the required 2.0, if marked improvement in academic work is indicated by the student's record, or if there are unusual circumstances that have contributed to the student's academic difficulties. Deadlines for petitions will be specified in the letter of suspension.

Academic work undertaken at another institution while the student is under suspension from the University of Colorado will not be credited toward a degree in the Division of Environmental Design without special permission by the resident dean. Students should also

be aware of the fact that if they enroll for as many as 12 semester hours at another institution, regardless of their status in the University of Colorado, they must apply as transfer students if and when they wish to return to the University. The Division of Environmental Design does not give incomplete grades (*IW* or *IF*) for incomplete work. Only extreme emergency situations warrant an extension of time for the appropriate letter grade to be awarded for a course.

ATTENDANCE REGULATIONS

Students are expected to attend classes regularly and to comply with the attendance regulations specified by their instructors. At the beginning of each semester the instructor shall inform the students of policies governing attendance in his or her classes.

Students who miss a final examination for illness or other good reasons must notify the instructor or the director of the Division of Environmental Design no later than the end of the day on which the examination is given.

TRANSFER CREDITS

Credits in subjects transferred from other institutions to the University of Colorado will be limited to the number of credit hours given or similar work in the regular offerings at the University of Colorado. Exceptions to this regulation may be made by the resident dean upon written petition.

In general, the Division of Environmental Design does not accept vocational/technical course work in design, graphics, or construction as meeting specific course requirements of the program; nor does its consider such course work acceptable toward the division's elective requirements. Only in exceptional circumstances may a student petition the Executive Committee of the college to request a transfer of such credits. A student may, however, ask that vocational/technical course work be considered as a basis for waiving a specific course in a required sequence. A student waived from a course must still complete the required number of credit hours in that course content band.

A grade of *C* or better is required in any course for which credit is granted in transfer from another institution to the University.

UNIVERSITY CAMPUSES

Certain professional and nonprofessional courses are available on the University's Denver Campus. These credits are applicable toward residence requirements only when earned after admission to the college.

Students in residence on the Boulder Campus in the Division of Environmental Design may take work on the Denver Campus with the approval of the resident dean of the college on a space-available basis.

ENVIRONMENTAL DESIGN AND THE ROTC PROGRAM

Students matriculating in the Division of Environmental Design are eligible to participate in the ROTC programs on the Boulder Campus.

Students interested in such programs should contact the professor in charge of the ROTC program of their choice (army, navy, air force), and also the resident dean of the Division of Environmental Design for information on residence and curriculum requirements for graduation. Credit for ROTC courses may be given upon faculty recommendation to a maximum of 8 hours. Such credit is given only if the student completes all requirements of the four-year ROTC program.

CONVOCATIONS

All students registered in the Division of Environmental Design may be required to attend convocations and special lectures scheduled throughout the year.

RETENTION OF STUDENT WORK

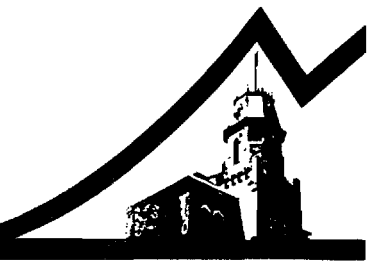
The Division of Environmental Design of the College of Design and Planning reserves the right to retain any student project submitted in fulfillment of class requirements for whatever period of time it deems necessary. This retained work is used to provide accrediting agencies with tangible evidence of performance, to serve as additional visual aid material in presentation to other students, and to make possible meaningful exhibits for study by design students, non-design students, staff within the University, and the general public.

GRADUATE PROGRAM

The College of Design and Planning at the Denver Campus (UCD) offers five graduate programs: the Master of Architecture, Master of Architecture in Urban Design, Master of Interior Design-Interior Architecture and Space Planning, Master of Landscape Architecture, and Master of Urban and Regional Planning-Community Development. The graduate programs allow for advanced experience.

Graduate students in all of the graduate programs are accepted at the Denver Campus of the University of Colorado. Facilities are in the Bromley Building and include classrooms, a library, administrative offices, faculty offices, a darkroom, model shop, and drawing and design spaces for students.

School of Education



INFORMATION ABOUT THE SCHOOL

Richard L. Turner, Dean

Purpose

The School of Education provides study and research opportunities for persons involved in teaching and the study of education. Through its graduate and undergraduate certification programs, it prepares teachers, administrators, educational specialists, and researchers for all levels of education. Its faculty and students participate in research efforts which develop new knowledge and understanding of the educational process.

Scholarships and Awards

The School of Education has some scholarships and awards for its students which are administered through the school. Graduate students in education are eligible to compete for the Graduate School Fellowships, and both graduate and undergraduate students are eligible to apply for University-wide financial assistance. The following are available exclusively to students in education:

The Elizabeth Anne Wilson Memorial Assistantship. Awarded each year to an outstanding graduate student with an emphasis in elementary education.

Clifford G. Houston Graduate Scholarship Fund. Limited to graduate students in counseling and student personnel work. Application must be made to chairperson of Educational Psychological Studies.

The Emery and Evelyn Fitzsimmons Stoops Scholarship is awarded yearly to an outstanding student in education. Competition for the award is automatically open to students having a 3.5 or better grade point average.

The Harry M. Barrett Memorial Scholarship. Granted by Kappa Delta Pi and limited to seniors preparing to teach, the scholarship varies in amount from $25 to $50 per year.

Applications for these awards should be made on forms available from the Office of the Dean, Education 124, prior to March 1 of each year for the summer or academic year following that date.

Student Organizations

The Associated Students in Education is an organization which represents the undergraduate certificate-seeking student body. Its officers are elected each fall, and they serve as liaison between the students in certification programs and the Associated Students of the University of Colorado. The organization also performs vital advising and student assistance functions.

The Association of Graduate Students in Education is a similar organization for graduate students. Its officers are selected in the fall. Honorary societies in education include Kappa Delta Pi and Phi Delta Kappa.

Advising

Undergraduate students may obtain certification and advisor information in Education 247 (Office of Field Experience).

Graduate students are assigned individual advisors and are required to submit a formal program of studies, approved by those advisors, before the end of the first full term of study. (Graduate students may obtain program information from the Graduate Office, Education 130, or from their advisors.)

Certification

Each state, including Colorado, requires public school teachers to be certified as a qualified teacher by its state Department of Education. Certification requirements vary from state to state and from teaching area to area.

The University of Colorado at Boulder, through the School of Education, offers course work leading to initial certification (Type A) in:

- Elementary education
- Secondary education
  - Drama
  - English
  - Foreign language (French, Spanish, German, Russian, Latin)
  - Mathematics
  - Science
  - Social studies
- Elementary/Secondary (K-12)
  - Art
  - Music
  - Health and physical education
- Bilingual/ESL

Teacher certification at the University of Colorado, while administered by the School of Education, is an all-University function. Many academic departments provide course work which supports the varied options available to the teacher in training.

Underlying the University's program of teacher certification is the assumption that all teachers should:

1. Be professionally competent.

2. Possess personal qualities essential to effective teaching.
3. Have a liberal education.
4. Know well the subjects they teach.

The objectives of the University relative to teacher education are the following:

1. To provide programs of undergraduate and graduate studies designed to develop outstanding teachers, administrators, supervisors, guidance counselors, college teachers and administrators, and researchers.
2. To conduct and direct educational research and to engage in writing and related creative endeavors.
3. To identify and attract into the teacher education program students who possess the intellectual abilities, leadership potential, and personal qualities essential for effective teaching.
4. To cooperate with other state, regional, and federal agencies to improve educational programs.

Accreditation

The teacher certification program, both undergraduate and graduate, is fully accredited by the North Central Association of Colleges and Secondary Schools, by the National Council for the Accreditation of Teacher Education and by the Colorado Department of Education.

GENERAL INFORMATION FOR STUDENTS SEEKING TEACHER CERTIFICATION

Admission Procedures

This section applies to all students (with or without baccalaureate degrees) pursuing a teacher certification program. Students who transfer to the University of Colorado from other institutions must meet the requirements for admission as outlined in the General Information section of this catalog.

Students should be aware that quotas have been established for each area of endorsement in teacher certification; therefore, there may be times when not all students who meet minimum requirements will be admitted to the certification program. An interview may be required prior to admission. Both elementary and secondary students seeking certification will be required to pass screening examinations in prescribed areas.

STUDENTS ENTERING OR CURRENTLY ENROLLED AT THE UNIVERSITY OF COLORADO

Students seeking certification in the School of Education must be enrolled in an undergraduate degree program in one of the colleges or schools of the University. Freshmen interested in teaching should seek certification advising at the time of entrance or shortly thereafter. Other students should seek certification advising as soon as they become interested in a Teacher Certification Program. Members of the School of Education faculty will advise these students on certification requirements (subject area and education).

TRANSFER STUDENTS

Students who transfer to the University of Colorado from another accredited institution must apply for admission through normal University channels. They must enroll in a degree program in one of the colleges or schools of the University and also apply for teacher certification in the School of Education. The last 30 hours of course work for certification *must* be taken while the student is officially enrolled as a student in the University. Credit in student teaching will not transfer to the University of Colorado at Boulder.

FORMER STUDENTS

Former students may reenter the University according to general University policies; however, they must apply for entry into the Teacher Certification Program. Students previously admitted in education programs must also reapply for acceptance in the present certification program.

POSTBACCALAUREATE STUDENTS SEEKING CERTIFICATION

Students who already hold a bachelor's degree and wish to qualify for certification in elementary or secondary teaching must apply directly to the School of Education. Students desiring institutional recommendation for certification must complete at least 30 semester hours of work at the University of Colorado. They must fulfill the same certification requirements as undergraduate students. The actual number of required hours will depend on the courses already completed. The certification program involves a combination of courses at the University and off-campus educational experiences in cooperation with the public schools.

State Certification Requirements

Each state has requirements for certificating or licensing teachers. These requirements vary from state to state and change from time to time. Students who are interested in teaching in other states should familiarize themselves with the requirements of those states so that they may plan an appropriate degree program.

TEACHER CERTIFICATION

It is the student's responsibility to pick up an Advising Manual in Education 247 and become familiar with its contents. (Off-campus students may obtain a manual by writing to Teacher Certification Office, Box 249 UCB, Boulder, CO 80309.) Specific information for all certification areas are included in the Advising Manual.

At the undergraduate level the School of Education offers programs leading to elementary and secondary teacher certification. The School of Education awards a Diploma in Education to the student who simultaneously completes a bachelor's degree and a certification program at the University of Colorado.

Requirements for Initial Application to the Elementary and Secondary Certification Programs

Students may obtain application forms in the Field Experience Office, Room 247, Education Building, if the following requirements have been fulfilled:

1. A minimum of 56 semester hours completed with a grade point average of 2.50 at the University of Colorado, or at the institution granting the degree.
2. Designation of a major or a bachelor's degree from an accredited institution.
3. Completion of approximately two-thirds of the general education requirements as specified by the student's school or college.
4. Students enrolled in schools or colleges other than Arts and Sciences and those holding degrees are required to have courses in the humanities, the natural sciences, and the social sciences.
5. Students who hold degrees should make application by February 15 for fall admission and September 15 for spring admission.

General Education Requirements

At the University of Colorado, general education requirements for graduation may vary in the separate schools and colleges. However, all certification students, as well as students with degrees, must have a minimum of 40 semester hours in general education distributed in the broad areas of learning represented by the humanities, the natural sciences , and the social sciences.

Students seeking degrees at the University of Colorado should consult, as soon as possible, with an advisor in the college or school from which they expect to graduate. For advising in the certification program, students should bring transcripts and consult with an elementary education advisor or the appropriate subject area advisor in the School of Education. Students seeking certification in drama, French, German, Latin, Russian, Spanish, art, music, and health and physical education must see the designated advisor in their major department.

Majors in Academic Areas

Students enrolled at the University of Colorado, Boulder seeking both a bachelor's degree and certification in elementary or secondary teaching must complete a subject major or area-studies major in an academic department in the school or college in which they are enrolled. The School of Education does not offer degree programs at the undergraduate level. For Arts and Sciences majors 94 of the 124 semester hours required for graduation must be liberal arts course work. (The secondary certification program includes a minimum of 31 semester hours in the School of Education. The elementary certification program includes 37 hours in addition to the 94 semester hours in the College of Arts and Sciences: 34 in education, 2 in physical education, and 1 in music.)

The major selected is determined by the student's interest in teaching a certain subject or instructional level. Before selecting a particular major, students should see one of the certification advisors. *Secondary students need to be aware that in many subject areas the teaching major requires additional courses or more hours than the academic major.* Course requirements for teaching majors in English, mathematics, science, and social studies are explained in the advising manual available in Education 247. The requirements for teaching majors in other secondary fields are available in the offices of the certification advisors in other colleges and schools.

Basic Skills Test

1. *Communication.* During the sophomore or junior year, students must enroll in and complete the course Oral Communication for Teachers (Educ. 230) with a grade of *B* or better. If students do not receive a grade of *B* or better in Educ. 230 or a similar speech course, they are required to pass an oral speech test before they can begin student teaching.
2. All students must pass the California Achievement Tests (CAT) in spelling, English, and mathematics as mandated by the Colorado Department of Education (effective January 1, 1983). These tests are given four times each year. Times and places are announced each January by the School of Education. It is important that students be aware of the following regulations:
   a. Students must *take the tests before they are permitted* to go to any public school to complete requirements for the Teacher Education courses.
   b. Students must *pass* the tests *before* they begin student teaching.
   c. Students who do not receiving passing scores on the tests may take the tests three additional times.
   d. All persons taking the tests must register in the School of Education (Room 247) no later than one week prior to the testing date.
   e. A fee is charged for taking the test and for any retakes.

Degree Alternatives

While students will be enrolled in degree programs in other schools and colleges of the University, some degrees are more appropriate than others for those interested in teacher certification. This is especially true for those preparing to teach in the secondary schools. The University offers majors in subjects most commonly taught in the public schools; however, the state gives no teaching certificates in some academic fields. Therefore, students interested in a particular major should consult an advisor in the School of Education about selecting a teaching field.

College of Arts and Sciences

The College of Arts and Sciences is a four-year college that admits students as freshmen. Several undergraduate degrees are offered and may be pursued by students wishing to complete the typical major plan to teach on the elementary and secondary school level.

Requirements for the bachelor's degree in the College of Arts and Sciences vary somewhat, depending on the degree sought; therefore students are urged to study carefully the College of Arts and Sciences section to determine the requirements applicable to the particular degree they seek.

Academic Policies

Any student registered in the Teacher Certification Program who fails to maintain a 2.5 grade point average may be placed on probation or may be suspended for a period of one academic year. Readmission is then subject to conditions determined by the dean. The same conditions apply to students in other colleges and schools who have been admitted to the Teacher Certification Program.

GRADUATE STUDY IN EDUCATION

Graduate study in education at the University of Colorado is administered through the Office of the Associate Dean, School of Education, and all inquiries regarding programs should be directed to the following address:

Associate Dean
School of Education, Campus Box 249
University of Colorado
Boulder, Colorado 80309

A wide range of professional and academic interests is served by these areas. Detailed program materials are available from the School of Education Graduate Office, along with a *Graduate Student Handbook.* The areas of study are as follows:

Administration, Supervision, and Curriculum Development
Master of Arts
Educational Specialist[1]
Doctor of Education
Doctor of Philosophy

Advanced graduate study in administration, supervision, and curriculum. Also certification programs for building level and central office administration.

Instruction and Curriculum in the Content Areas
Master of Arts
Educational Specialist[1]
Doctor of Education
Doctor of Philosophy

Mathematics education, science education, English education, social studies education, language arts, reading (Ed.S. available), and general curriculum in elementary and secondary education.

Educational-Psychological Studies
Master of Arts
Educational Specialist[1]
Doctor of Philosophy

Educational psychology, guidance and counseling (Ed.S. available), school psychology (Ed.S. available), special education, educational technology, and instructional computing.

Research and Evaluation Methodology
Doctor of Philosophy

Methods of educational research and evaluation, including statistics, measurement, and qualitative methods.

Social and Multicultural Foundations
Doctor of Philosophy

Social foundations of education and bilingual and multicultural education.

Certification at Graduate Level

The University of Colorado at Boulder through the School of Education offers course work leading to certification in the following areas:

Administration
- Elementary principal
- Middle school principal
- Senior high school principal
- Superintendent

Guidance and counseling
Reading teacher and reading specialist
Media specialist
Special education
- Educable mentally handicapped
- Educationally handicapped

School psychology
- Speech correctionist/language specialist

Type B Certification
- Elementary education
- Secondary education
  - Art, bilingual/ESL, drama, English, foreign languages, mathematics, music, physical education, science, social studies, and speech

Graduate Programs at Three Levels

Graduate study in education is offered at three levels: Master of Arts (M.A.) degree, Specialist in Education (Ed.S.) degree (in limited areas) Doctor of Education (Ed.D. in limited areas), and Doctor of Philosophy (Ph.D.) degrees. Each level is discussed in the following pages. For many study areas, special advisory leaflets have been prepared which are available upon request from the School of Education Graduate Office. A detailed *Graduate Handbook* is available from the School of Education Graduate Office.

Application for Admission

Prospective students who believe that they may qualify for admission to a graduate degree program should request application forms from the Graduate Office, School of Education. The completed form should be returned to the Education Graduate Office, Campus Box 249. Prospective graduate students should also read the Graduate School portion of this catalog for additional information. *Application papers and all supporting documents (including GRE test scores for the doctoral degree programs—see below) must be in the Graduate Office at least six months before the opening of the term for which the student is applying.* The Miller's Analogy Test may be used in some M.A. program areas. (Check with the Education Graduate office for details.)

Applicants should request the Educational Testing Service to send their scores on the Aptitude Test (verbal and quantitative) of the Graduate Record Examination (GRE) to the Education Graduate Office. A doctoral applicant who has not taken the GRE should arrange to do so.

Maximum Load and Part-Time Study

A maximum of 15 semester hours in any one semester may be applied toward degree requirements. During

[1]The Educational Specialist Degree will be awarded only in conjunction with the Colorado Type D or E certificate.

the summer, 9 semester hours may be taken in a full summer session, 6 hours in a five-week summer term, and 3 hours in a three-week term. During the academic year, students will be regarded as having a full load if they are registered for not less than 5 semester hours in courses numbered 500 or above, or for thesis registration of 7 or 10 hours.

Quality of Work

For all graduate degrees an average of *B* or better is required in all work taken for the degree. Transferred credits are not included in calculating an average. A mark of *C* may not be used in a Ph.D. program.

Any graduate course in which a mark of *D* or *F* is reported is failed and must be repeated and passed if it is required in a student's degree program.

Students who do not maintain a *B* average or better may be suspended by the dean of the Graduate School upon the recommendation of the associate dean of the School of Education. Students may also be suspended from the Graduate School for continued failure to maintain satisfactory progress toward the degree sought.

Experience Required

With exceptions noted below, at least one year of teaching experience or an internship is ordinarily a prerequisite for admission to the master's or Ed.S. degree programs. However, teaching experience may sometimes be obtained during the period in which a student is studying for the degree. Graduate programs in secondary school guidance require completion of at least two years of teaching as a prerequisite to admission.

On the doctoral level, prior or concurrent experience appropriate to the field of specialization is required, except for degree programs which include an internship.

Teaching experience is not required as a condition of admission to programs, college student personnel work, counseling in agency settings, educational research and statistics, educational technology, and social and multicultural foundations of education. However, experience appropriate to these professional fields of specialization may be and usually is required in lieu of teaching.

Master of Arts in Education

The Master of Arts degree is available, comprising one academic year or more of graduate work beyond the bachelor's degree. The minimum residence requirement for the master's degree is one academic year or the equivalent, and it may be satisfied by two semesters in residence, or three full summer sessions, or any combination equal to two semesters. (For part-time credit toward meeting the residence requirement, see the Graduate School section of this catalog). The master's degree must be completed within five years (or six summers) of initial enrollment. The M.A. Plan II (nonthesis) degree requires a minimum of 30 semester hours. See Graduate School portion for discussion of Plan I and Plan II. Students may transfer 8 semester hours of work taken as a special student and work taken at other institutions.

Most program areas have outlined a recommended or required program of studies, and students pursuing a degree are expected to follow the appropriate program unless they have appropriate substitutions arranged in advance with their advisors. (Note: The master's program in guidance and counseling is designed to start in the summer only.) Pamphlets outlining the programs of studies in education are available from faculty or the Graduate Office in the School of Education.

In the final term of study (at least 10 weeks prior to graduation) each student must submit an Application for Admission to Candidacy for an Advanced Degree form. These forms are available in the Education Graduate Office. If a minor is included, the forms must first be signed by a representative of the student's minor department or program area. The forms must be signed by the student's advisor and submitted to the Education Graduate Office for School approval and then to the Graduate School for final approval. For time limits and other information see the Graduate School section under Master's Degree.

EDUCATION AS A MINOR FIELD

In M.A. programs providing for majors outside the School of Education, students may include education as a minor if both their major department and the associate dean in the School of Education approve. For master's degrees, a minor in education consists of at least 6 hours of study in related courses. Not more than 2 semester hours may be transferred from another institution.

Students who propose to minor in education must have had sufficient undergraduate work in education to prepare them for graduate study in the field. Appraisal of undergraduate preparation will be made by the associate dean.

Specialist in Education (Ed.S.)

The Ed.S. degree program affords opportunities for graduate study in limited areas relating to certification extending one year beyond a master's degree. Areas in which the specialist degree may be earned are curriculum, administration and supervision, instruction and curriculum in content areas, and education psychological studies. The program is intended to serve the needs and interests of a variety of career people in education who want specialized and up-to-date preparation beyond the master's degree but who do not plan to study for a doctorate.

ADMISSION REQUIREMENTS

Applicants for admission are required to have an acceptable master's degree and an undergraduate record which gives evidence of a good general education. The master's degree should be in a field which provides an appropriate foundation for the additional year of graduate study.

An undergraduate grade point average of 2.75 or better on a 4.0 scale is required, and/or an average of 3.0 or

better for the master's degree. *Students being admitted on a provisional basis must submit Graduate Record Examination scores for the verbal and quantitative sections.* (In some program areas the Miller's Analogy Test may be used. Students should ask about this in the Education Graduate Office.) At least one year or more of teaching or other appropriate experience is also required.

PROGRAM OF STUDY AND RESIDENCE

When applicants are admitted, they are notified of the appointment of a faculty advisor. The student and advisor formulate a program of study providing for 30 semester hours or more of course work. At least 4 semester hours must be at the 600 level.

Most program areas have outlined a program of studies appropriate for individuals pursuing Ed.S. study in their areas, and students are expected to follow those programs unless they have arranged appropriate substitutions in advance with their advisors. Pamphlets outlining the recommended programs of studies for the programs in education are available from faculty or the Graduate Office.

In the final term of study (at least ten weeks prior to graduation) each student must submit an Application for Admission to Candidacy for an Advanced Degree. These forms are available in the Graduate Office. If a minor is included, the forms must first be signed by a representative of the student's minor department or program area. Then the forms must be signed by the student's advisor and submitted to the associate dean and the Graduate School for final approval.

The Specialist in Education degree requires no thesis, but a final written comprehensive examination consisting of three four-hour sessions is required. The examination is typically given during the student's last term of study. However, it may be postponed until a later term providing the student registers for it and pays the required fee. A student who fails the comprehensive examination may request to be examined again after three months. Only one reexamination is permitted.

Two semesters, three full summers of study after the awarding of the master's degree, or a combination equivalent to two semesters in residence is required.

TRANSFER OF CREDIT AND TIME LIMITS

The same regulations governing transfer of credit and time limits apply to the Specialist in Education as indicated for the master's degree except that transfer institutions where the work was taken must offer the Specialist in Education or an equivalent or higher degree in order for credit to be applied to this degree.

Doctoral Study in Education

In addition to the information included here, the student is referred to the Graduate School section of this catalog.

Two types of doctoral degree programs in education are offered under the auspices of the Graduate School and the School of Education. Prospective doctoral students may apply for admission to either program, the choice depending chiefly on their professional or career objectives. The Doctor of Education degree (Ed.D.) is intended primarily to meet the needs of career people in education for advanced study, e.g., teachers in schools, school or college administrators, guidance counselors and student personnel directors, and college or university professors of education. For one who plans to teach in an academic subject matter department and not to be involved in teacher education, a Ph.D. in the major subject field would be preferable. The Ph.D. is also appropriate for one who plans a career as a university professor of education or as a director of educational research in a state or city school system.

Doctoral programs require a period of study and research of two academic years (four semesters) or more beyond a master's degree (or, in the case of some Ph.D. students, three years beyond a bachelor's degree). At least two semesters of full-time study in residence during one academic year are required; the remainder of the residence requirement may be satisfied by any combination of study in academic years or summer terms, subject to the definition of full load stated earlier. For an Ed.D. student whose program calls for certain specialized study at some other university, residence credit for one semester may be earned elsewhere and counted toward meeting the minimum residence requirement, if the advisor and the associate dean approve.

Since the Ed.D. and Ph.D. programs differ only in certain aspects of content and not in procedures, they are discussed together in the following sections. Such differences as currently pertain are clearly pointed out.

ADMISSION REQUIREMENTS

Applicants for admission to doctoral study are expected to have a good liberal arts background, approximately 18 semester hours of undergraduate credit in education (same as for master's applicants except as noted earlier), or a master's degree in education, and an undergraduate average of 2.75 or better on a 4.0 scale. An average of 3.0 or better is expected on all graduate work completed. Ed.D. applicants must have an appropriate master's degree, preferably in the field of their proposed doctoral studies or closely related. Ph.D. applicants are not in all cases required to have a master's degree, although it is generally deemed preferable. The decision rests with the program area faculty. At least two years of professional experience relevant to the applicant's proposed study is required for most programs.

Graduate Record Examination scores of 1000 or above (total on verbal and quantitative) are required for admission. To adjust for the different cultural experiences of some applicants, this standard may in certain instances be reduced on the basis of faculty judgment. An interview with a faculty admissions committee may be required.

DEGREE REQUIREMENTS

Doctoral students in some programs are expected to have had a course in statistical methods, a basic course in educational research, a graduate course in psychological foundations of education, and a graduate

course in social foundations of education. If they have not had such courses, advisors may require one or more of them *in addition to the courses approved for the degree sought.* All doctoral students[1] must include an intermediate statistics course (Educ. 600). All Ph.D. students must also include at least one advanced course in research methods (Educ. 601, 603, or 604), and this is required in some Ed.D. programs. Educ. 503 may not be used in the doctoral degree plan. Educ. 503 is, however, a prerequisite to Educ. 600; and both Educ. 504 and 600 are prerequisite to all three of the Ph.D. course options. Students who have completed course work equivalent to Educ. 503 or 504 as part of a prior degree may seek approval of the substitute courses.[2] Students may also satisfy the prerequisite by receiving a passing grade on competency tests administered by the REM chairman. With approval of a candidate's committee and depending on the type of doctoral research planned for the dissertation, a substitution of a two-course doctoral level *research* sequence in history, philosophy, or one of the social sciences may be substituted for the 600 series above. Graduate courses in other departments may be included in any degree program if they are approved by the student's advisor and committee.

Most program areas have outlined a program of studies appropriate for individuals pursuing study in their areas, and students are expected to follow that program unless they have arranged appropriate substitutions in advance with their advisors. Pamphlets outlining the recommended programs of studies for the programs in education are available from faculty or the Education Graduate Office.

Approximately 40 semester hours of course work beyond the master's degree is the normal requirement for either the Ed.D. or Ph.D. Applicants who are admitted without a master's degree can expect to have about 70 semester hours of course work in their programs.

Prior to taking the comprehensive examination, each student must submit an Application for Admission to Candidacy for an Advanced Degree. Application forms are available in the School of Education Graduate Office.

Near the end of the term when students complete their course work and if their advisors approve, they write a comprehensive examination. This 12-hour written examination is conducted by a committee nominated by the associate dean for instruction and appointed by the dean of the Graduate School. An oral examination may also be held if a student's committee requests it. The examination is focused chiefly on the student's area of specialization, conceived rather broadly. Students who fail the comprehensive examination may repeat it once, at a time to be determined by the examining committee.

In addition to the course work, a doctoral thesis for 30 semester hours of credit is required of each student. A student registers for Educ. 800 (Thesis) for the Ph.D. and Educ. 801 for the Ed.D., for three or more terms, but not more than 10 semester hours in any term; not more than 10 semester hours may be taken prior to the successful completion of the comprehensive examination. After the satisfactory completion of the comprehensive examinations, the student must register for 3 (requires permission of associate dean of the Graduate School at least two months in advance), 7, or 10 hours' continuous registration during fall and spring semester until the final defense. The student must be registered for 7 or 10 hours the semester the defense is completed. During the research for and the writing of a thesis, grades of *IP* (in progress) are reported; if the thesis is completed and accepted as satisfactory, a grade is reported for the student's record. When a student and the chairman of the advisory committee agree on a subject for the thesis, the student prepares a detailed prospectus and arranges for a meeting with the committee. (As a rule the advisory committee constitutes the thesis committee, but additional faculty in education and other departments may be asked to serve also.) When the committee approves the prospectus, the student may proceed with the research. Research involving human subjects must also have the approval of the University Committee on Human Research.

No continuing education work is permitted for either the Ed.D. or Ph.D.

TIME LIMITS

Ed.D. students are expected to complete their work and receive the degree within seven years beginning with the term of their first registration for doctoral courses. The time may be extended to ten years upon approval by the student's advisor and the associate dean, but credits more than seven years old must be validated by special examination. Transferred credit which becomes more than seven years old cannot be validated and hence cannot be counted toward meeting degree requirements. Ed.D. and Ph.D. students who do not complete their programs and receive the degree within four years of passing their comprehensive examination must retake that examination and pass it before they can take their final oral examination. See the Graduate School section for Ph.D. time limits.

When students have passed the comprehensive examination they are required to register each semester until the degree they seek is attained, and pay the standard fee as announced by the Graduate School.

The doctoral program in physical education is a cooperative program between the Department of Physical Education and the School of Education. Prospective students should consult both groups for advising.

CHECKING ON PROGRESS TOWARD A DEGREE

Doctoral study entails a long period of scholarly endeavor, which requires a time schedule. Students are responsible for meeting the deadlines involved.

OPPORTUNITIES FOR ASSISTANTSHIPS

The School of Education has a limited number of assistantships which are administered by the dean of the School of Education on the recommendations of chair-

[1]With approval and depending on type of doctoral research planned for the dissertation, a substitution of a two-course doctoral level *research* sequence in history, philosophy, or one of the social sciences may be substituted for the 600 series in education.

[2]A form certifying completion of an equivalent course may be obtained from the REM chairman upon submission of a transcript and catalog description.

persons of the divisions and director of teacher education. Some assistantships involve the supervision of student teachers; others involve helping professors in their teaching or research. Stipends (not tax-free) in amounts set by the University are paid for all assistantships. Appointments are usually made in terms of one-fourth time (10 hours a week) or one-half time (20 hours a week). Inquiries should be directed to the dean, School of Education.

College of Engineering and Applied Science

INFORMATION ABOUT THE COLLEGE

Office in Engineering Center AD-1

George J. Maler, Associate Dean for Undergraduate and Service Programs

Klaus D. Timmerhaus, Associate Dean for Graduate and Research Programs; Executive Director of the Engineering Research Center

The College of Engineering and Applied Science was established by the Board of Regents in 1893.

Through engineering, the resources of nature are used for the benefit of humanity and the environment. Engineers today are expected not only to be in the forefront of high technology, but also to be aware of the impact of this technology on their environment in both the social and humanistic sense. Engineering professional societies have committed themselves to the principle that as mankind gains the ability to build more powerful and useful devices, there must be a strong and successful effort to protect our natural resources and the environment.

An engineering career demands hard work; so does an engineering education. In return, engineers have excellent opportunities to work in various places, meet new challenges, or move into management. The engineer is generally well compensated with a variety of employment opportunities. Demand in various fields fluctuates, but when there is a surplus of certain kinds of engineers, there are usually attractive opportunities in other fields. Well-educated engineers have little difficulty in adjusting to these fluctuations.

The following programs in the college are now accredited by the Accreditation Board for Engineering and Technology (ABET): aerospace engineering sciences, architectural engineering, chemical engineering, civil engineering, electrical engineering, electrical engineering and computer science, and mechanical engineering. Degrees in applied mathematics, engineering physics, and computer science are offered by the College of Engineering and Applied Science in cooperation with the mathematics and physics departments of the College of Arts and Sciences. Accreditation by ABET has not been sought for the programs in applied mathematics and engineering physics as it is seldom required for graduates of these fields. An undergraduate degree in computer science has recently been initiated in the College of Engineering and Applied Science.

The need for professional registration depends on the field of engineering and the specific practice in that field. Engineers in private professional practice generally need to be registered; for those in the employ of others, registration is not generally necessary. Currently, registration is required in all states for the legal right to practice professional engineering. Although there are variations in the state laws, graduation from an accredited curriculum in engineering, subscription to a code of ethics, and four years of qualifying experience are required for registration. In addition, two days of examinations covering the engineering sciences and the applicant's practical experience are required in most states.

Within most departments several options are offered (for example, mechanics in mechanical engineering, and construction engineering in architectural engineering). Most departments offer options emphasizing bioengineering, premedicine, or computing aspects of their disciplines. Some options are oriented toward graduate study, others toward engineering practice.

A listing of the fields in which engineers work would have many entries. The following list by departments gives only a brief summary.

Aerospace engineering sciences prepare engineers for an industry that encompasses the design and construction of both commercial and military air and space craft. Advances in this technology have permitted the industry to enter also the fields of urban mass transit, undersea exploration, bioengineering, nuclear engineering, laser technology, and other emerging high technology fields. An aerospace engineer often works at the forefront of engineering with scientists in the fields of mathematics, physics, chemistry, biology, etc.

Applied mathematics meets the need of modern research, which is dependent upon advanced mathematical concepts. Almost all industries that are engaged in industrial and scientific research today need applied mathematicians, as do national laboratories such as NASA.

Architectural engineering prepares students for careers in the building industry and for research at the graduate level on building-related topics. This course of study fulfills the academic requirements for registration as a professional engineer.

The architectural engineering curriculum is recommended for those wishing to specialize within the building industry in engineering design, construction

and contracting, or sales engineering. The architectural engineering student may select any one of several areas of specialization offered: construction, environmental, structural, or building energy engineering and illumination.

Chemical engineers convert natural resources into industrial and consumer products in facilities that include refineries and gasification plants. Among their products are many that often are not identified with chemical engineering—oils, metals, glass, plastics, rubber, paints, soaps and detergents, foods, beverages, synthetic and natural fibers, nuclear and exotic fuels, medicines, and many others.

The department has recently revised and upgraded its bioengineering/premedical engineering program. It is very much interested in research directed toward ecologically sound development of chemical processes. It is moving into the newest area of high technology, the use of microorganisms to produce complex molecules, and is also working effectively on energy problems, and is stressing in its instructional program problems of energy conversion, such as coal gasification.

Civil and environmental engineering offers an interesting and challenging career to the student interested in the design and construction of buildings, bridges, dams, aqueducts, and other structures; in transportation systems including highways, canals, pipelines, airports, rapid transit lines, railroads, and harbor facilities; in the transmission of water and the control of rivers; in the development of water resources for urban use, industry, and land reclamation; in the control of water quality through water purification and proper waste treatment; in the construction and contracting industry; and in the problems concerned with man's physical environment and the growth of cities.

Computer science at Boulder offers the B.S., M.S., and Ph.D. degrees. The fields available through the program include programming languages, operating systems, numerical analysis, information systems, and the theories of computation. Master's graduates typically take positions as systems programmers for computer manufacturers or software firms, advanced applications programmers in scientific research firms, or technically oriented systems designers in a commercial or government environment. Ph.D. graduates typically take positions in industrial research laboratories or in university teaching.

Electrical engineering offers professional possibilities that include teaching and research in a university; research in development of new electrical or electronic devices, instruments, or products; design of equipment or systems; production and quality control of electrical products for private industry or government; and sales or management for a private firm or branch of government. Specialties within electrical engineering include the design of computer interfaces and computer software; electromagnetic fields, which are basic to radio, television, and related systems; communication theory and signal processing; electrical machinery; solid-state, integrated-circuit, and electron devices, energy and power, control systems, and others.

Electrical and computer engineering offers a program designed to provide entrance into the profession for students who wish to work in computer engineering. This includes design and construction of efficient software systems as well as an introduction to hardware design. One major present interest is in the area of microprocessors.

Engineering physics offers a program in which general knowledge of the diverse fields of physics provides the ability to deal with industrial problems that cannot be solved by a standardized procedure in a specialized field. The training prepares the student for a career in physics where there are many and varied opportunities in development work and industrial research. It is also basic for graduate work in physics for specialized training in research, and especially appropriate to space technology and research.

Mechanical engineering is very broad in scope, not identified with nor restricted to a particular technology, vehicle, device, or system but concerned with all such subjects, both individually and collectively. The objective of the undergraduate program is to prepare the student to meet and anticipate change, and to work with technologies as yet unknown. Typical starting assignments for the graduating senior include positions with nearly all industries. New emphasis includes computer-aided design/computer-aided manufacturing (CAD/CAM).

The industrial engineering option in mechanical engineering deals with the complex problems in fields that demand an integrated systems approach, such as manufacturing, health systems, and transportation. It utilizes mathematics, statistics, simulation, computer science, and operations research to maximize the productive utilization of resources while minimizing human effort. Because they are concerned with people as well as things, industrial engineers have become a prime source of management talent.

Educational Opportunities

Students have an opportunity to study engineering with professors who have national and international reputations and to work with superior facilities of the University of Colorado Engineering Center and Engineering Research Center. Recent years have seen the development of new instrumentation, integrated circuits, and solid state laboratories in electrical engineering, of several bioengineering laboratories, and the rapid computerization of these and other laboratories. All entering freshmen receive experience with digital computers. Each engineering department has laboratories suitable for research through the the doctoral or postdoctoral level and others for undergraduate instruction and experimentation. Some are noted in the Graduate School section of this catalog. Details may be obtained from the departments concerned.

Engineering Minorities Program

Members of ethnic minorities who are qualified to enter engineering programs are welcomed in all fields of engineering. The Engineering Minorities Office provides tutoring, advising, and friendly counseling to minority students who request them. Funding of the office

comes from gifts from private industry, and its innovative program has been widely studied by other universities. Enrollment of minority students is growing.

Prizes and Awards

Numerous prizes and awards are conferred upon outstanding students, usually during the honors convocation held during Engineers' Days each spring.

Honors at Graduation

In recognition of high scholarship and professional attainments, Honors, Special Honors, or With Distinction may be awarded at graduation (at the discretion of the Engineering Honors Council and Recognition Committee). These honors will be recorded on the diplomas of the graduates and will be indicated on the commencement programs. Grades earned during the last semester will not be considered. Transfer students to be considered for honors will be expected to complete a minimum of one-half of their work at the University of Colorado, Boulder. Grades earned at other institutions will not be considered. Transfer students must have completed at least 50 hours before their last semester. For Special Honors, a student will be expected to have an average of at least 3.80. Honors will be awarded for an average between 3.60 and 3.79.

Scholarships, Fellowships, and Loan Funds

Money contributed to the University Foundation for assistance to engineering students is deposited in appropriate accounts and used according to the restrictions imposed by the donors. Numerous industries match employee contributions or offer scholarships and fellowships. Those interested in contributing may contact the director of engineering development at the College of Engineering, (303) 492-7335, Campus Box 422. About 150 undergraduate scholarships and grants are conferred. Awards are based on academic progress, financial need, or both (see Financial Aid, General Information section).

For details students may contact the Office of the Dean.

International Education

Since engineers frequently work in foreign nations, it is desirable that some engineering students familiarize themselves with foreign cultures by study abroad. Especially active programs in engineering are maintained by the University and institutions that include the Ecole National des Ponts et Chaussees in Paris; the University of Stuttgart in Germany; the University of Zagreb in Yugoslavia; the Instituto Technologico y de Estudios Superiores de Monterrey, Mexico; and the University of East Anglia and the University of Lancaster in England. Students may complete one or two semesters of engineering education abroad (see International Education).

Student Organizations

The following honorary engineering societies have active student chapters in the College of Engineering and Applied Science:

Chi Epsilon, civil and architectural society
Eta Kappa Nu, electrical engineering society
Omega Chi Epsilon, chemical engineering society
Pi Tau Sigma, mechanical engineering society
Sigma Gamma Tau, aerospace society
Tau Beta Pi, engineering society

Student chapters of the following professional societies are well established:

American Institute of Aeronautics and Astronautics
American Institute of Architectural Engineers
American Institute of Chemical Engineers
American Society of Civil Engineers
American Society of Mechanical Engineers
Illumination Engineering Society
Institute of Electrical and Electronic Engineers
Society for Industrial and Applied Mathematics
Society of Manufacturing Engineers
Society of Women Engineers

The student SIAM chapter was the first in the country.

These societies meet frequently to present papers, speakers, films, and other programs of technical interest. A general student organization known as the Associated Engineering Students (AES), of which all students in the College of Engineering and Applied Science are members, has supervision of matters of interest to the whole group through the Control Board, its legislative body. With the advice of the engineering faculty, the AES publishes *The Colorado Engineer*.

The usual student activities and organizations, such as athletics, oratorical and debating societies, student publications, and musical, literary, and religious organizations, are open to students in all colleges and schools of the University.

Ethics

As members of the academic community, students have a responsibility to conduct themselves with the highest standards of honesty and integrity. These qualities are also vital to the engineering profession.

Academic penalties including suspension or expulsion will be imposed for the following acts, or intent to engage in such acts: plagiarism; the illegal possession and distribution of examinations or answers to specific questions; presenting work of another student as one's own work; performing work or taking an examination for another student; or the alteration, forgery, or falsification of official records. This listing is not complete; it includes only some types of academic dishonesty recently brought before the Academic Discipline Committee. Additional information on honesty, ethics, and student discipline is found in the *Student Survival Guide*.

ADMISSION REQUIREMENTS

Requisite Qualifications

The prospective engineering student needs to be able to work hard, must enjoy mathematics, and should have a keen interest in science and its methods. Sound curiosity about the principles governing the behavior of forces and materials and the ability to visualize structures and concepts are necessary prerequisites. The ability to express ideas in both written and spoken form is of primary importance.

Too often, high school students and others regard the mere ability to make things with the hands as an indication of engineering ability. Manual and mechanical skills are valuable, but without the mathematical and scientific faculties mentioned, are not suitable qualifications for an engineer.

This college seeks to identify applicants having a high probability of successful completion of their academic programs. Admission is based on evaluations of many criteria; among the most important are the general level of academic performance before admission and other evidence of motivation, potential, scholarly ability, and accomplishment. These are indicated by trends in the student's records, by letters of recommendation from teachers and others qualified to evaluate the student, by accomplishments outside academic work, and by other relevant evidence.

The Committee on Admissions will set detailed standards for admission annually and may consider applicants on an individual basis.

Freshman

In order to enroll, the student must meet the requirements of the College of Engineering and Applied Science and the Boulder Campus requirements described in the General Information section of this catalog.

SUBJECTS REQUIRED FOR ADMISSION

	Required Units[1]
English (literature, composition, grammar)	4
Algebra	2
Geometry	1
Trigonometry and higher mathematics	1
Natural sciences (physics and chemistry recommended)	2
Social studies and humanities (foreign languages, additional English, history, and literature are included)	3
Electives	3
	16

A unit of work in high school is defined as a course covering a school year of not fewer than 36 weeks, with five periods of at least 40 minutes each per week. (Two periods of manual training, domestic science, drawing, or laboratory work are equivalent to one period of classroom work.) This is equivalent to 180 actual periods per unit. Fractional credits of value less than one-half unit will not be accepted. Not less than one unit of work will be accepted in a foreign language, elementary algebra, geometry, physics, chemistry, or biology.

Electives may be chosen from any of the high school subjects (except physical education) which are accepted by an accredited school for its diploma and which meet the standards as defined by the North Central Association. However, not more than two units will be considered from drawing, shop, or other vocational work; courses that have descriptive geometry features may be considered for elective units beyond the recommended units.

Beginning students in engineering start their mathematics courses with analytic geometry and calculus. *Makeup courses carry no credit toward fulfilling graduation requirements but are recommended for all students not fully prepared to begin the regular mathematics sequence.*

In order to be prepared for the type of mathematics courses that will be taught, the student must be competent in the basic ideas and skills of ordinary algebra, geometry, and plane trigonometry. These include such topics as quadratic equations, graphic representation, simple systems of equations, logarithms, the trigonometric functions and simple applications, and the standard theorems of geometry including some solid geometry. Usually seven semesters are required to cover this material adequately in high school.

Recommendation. It is urged that principals and high school teachers and counselors recommending students to the College of Engineering and Applied Science consider only those students who have shown evidence of the character, seriousness of purpose, and scholarly attainments that will lead to success in this college's demanding programs. It is assumed in all cases that the students will have grades distinctly above average, especially in English, mathematics, and science. It is recommended that students take at least two units of a modern foreign language, given the international character of modern enterprise.

Starting in the fall of 1988, two units of the same foreign language will be required of all freshman applicants.

Transfer Students

Students transferring from other accredited collegiate institutions may be considered for admission on an individual basis if they meet the requirements outlined in the General Information section of this catalog and the freshman requirements for entering the College of Engineering and Applied Science.

Intrauniversity transfers within the same campus of the University to the College of Engineering will be considered on an individual basis if both of the following conditions are fulfilled:

1. Enrollment limitations permit.
2. The student's prior academic record must fulfill the admissions requirements of the College of Engineering and Applied Science.

Intercampus transfers of students from one campus of the University to another will be considered on an individual basis if the following conditions are fulfilled:

1. Enrollment limitations permit.
2. The student must have a minimum of 30 hours in an engineering curriculum at that campus, not counting transfer hours.

[1]Applicants not meeting these requirements will be considered on an individual basis. A student who is not prepared should expect to make up deficiencies. Beginning students must be prepared to start analytic geometry-calculus, which requires a knowledge of trigonometry. Students planning to do graduate work at the Ph.D. level are urged to take at least two units of a foreign language.

3. If an engineering student, the student must be in good academic standing with at least a 2.00 cumulative average for all courses attempted and for all courses that count toward graduation requirements. If the student is not an engineering major, his or her academic record must fulfill the admission requirements of the College of Engineering and Applied Science.

It is strongly recommended that incompatible campus academic sequences be completed before transferring campuses. Students contemplating a transfer should check with their departments on such sequences.

Both intrauniversity and intercampus transfers are subject to review and approval by a faculty committee which evaluates the applicant's qualifications for academic success in engineering subjects.

TRANSFER CREDIT

After a prospective transfer student has made application and submitted transcripts to the University of Colorado, the Office of Admissions issues a Statement of Advanced Standing listing those courses that are acceptable by the University standards for transfer. A copy of this statement is received by the Dean's Office after the student is admitted, and is made a part of the Dean's Office permanent record. The appropriate engineering faculty departmental representative will use this copy of the form to indicate which of those credits listed may be acceptable toward the graduation requirement in the College of Engineering and Applied Science, and will note the tentative acceptance of these credits by dating and initialing each acceptable course listed on the Statement of Advanced Standing. The student will be notified that the acceptance is tentative and is contingent upon the satisfactory completion of a minimum of 30 semester hours at the University of Colorado Boulder Campus before the credits may be officially applied toward the degree requirements. All transfer credit must be validated by satisfactory achievement in subsequent courses. *It is the responsibility of the transfer student*, after having completed the 30 semester credit hours at the University of Colorado Boulder Campus, *to request final validation of the credits* by the department *and to have this validation noted on the Statement of Advanced Standing* kept in the Dean's Office.

If at any time a student wishes to have a course not previously accepted considered again for transfer, the student should consult with the departmental transfer advisor and complete a petition to the dean through the department chairman. It is recommended that departments clearly identify transfer students in their records so that when the time comes to evaluate credits for graduation, the Dean's Office pages can be referred to for proper acceptance of transfer credits applicable toward degree requirements.

NONTRANSFERABLE CREDITS

Students desiring to transfer credits from engineering technology programs should note that such credits are accepted only upon the submission of evidence that the work involved was fully equivalent to that offered in this college.

Some technology courses are given with titles and textbooks identical to those of some engineering courses. These may still not be equivalent to engineering courses because of emphasis that is nonmathematical or otherwise divergent.

In order to assist engineering technology students with transfer problems, the following guidelines have been established:

1. Courses on basic subjects such as mathematics, physics, literature, or history may be acceptable for direct transfer of credit if they were taught as part of an accredited program for all students and were not specifically designated for technology students.

2. Students who have taken technology courses (courses with technology designations) that may be valid equivalents for engineering courses have these options:

   a. They may petition faculty advisors to waive the course. The requirement for a course can be waived if a student demonstrates that, by previous course work, individual study, or work experience he or she has acquired the background and training normally provided by the course. No credit is given toward graduation for a waived course, but a strong student may benefit from the waiver by being able to include more advanced work later in his or her curriculum. Other students may profit by taking the course at this college instead and thus establishing a fully sound basis for what follows.
   b. They may be given credit for a course if the course work was done at an accredited institution of higher education. The University of Colorado academic department involved may recommend to the Dean's Office that credit be transferred to count toward the requirements for a related course in their curriculum. Credit cannot be given for vocational/technical or remedial courses under rules of the University. (See general section on transfer of college-level credit.)
   c. They may seek credit for the course by examination. See Advanced Placement and College-Level Examination Program (CLEP) Credit.

WORK EXPERIENCE

It is the policy of the College of Engineering and Applied Science at the Univerisity of Colorado Boulder Campus that any credits accrued in the official records of the student that were awarded for work experience (or for co-op experience) will not apply as part of the 128 semester hours required for an engineering degree in the college.

Former Students

Former students must meet the requirements outlined in the General Information section of this catalog. Records made at collegiate institutions while the student was a member of the armed forces will not necessarily be a determining factor in a student's read-

mission to the University of Colorado, but all such records should be submitted. *Students who have withdrawn will have a dean's stop placed in their records and must obtain permission of the dean to reenroll in the College of Engineering and Applied Science.* They must then submit applications for admission for consideration by the Committee on Undergraduate Admissions of the college.

Students who interrupt their courses of study may be required to take any preparatory courses which have been added during their absence or to repeat courses in which their preparation is thought to be weak.

Advanced Placement

Advanced placement and college credit may be granted on the basis of the College Entrance Examination Board's Advanced Placement Tests. For students who have taken an advanced placement course in high school and who make scores of 4 or 5 in the CEEB's Advanced Placement Examination, advanced placement as well as college credit will be granted. Students who make scores of 3 may be considered for advanced placement and college credit by the department concerned. All advanced placement and transfer credit must be validated by satisfactory achievement in subsequent courses, in accordance with standard transfer policies of the college.

Advanced placement credit for the freshman mathematics courses in calculus and differential equations will be limited to not more than 4 hours each.

College-Level Examination Program (CLEP) Credit

Prospective students may earn college-level credit through the College-Level Examination Program (CLEP) examinations, provided that they score at the 67th precentile or above. Departments will advise students of the credits accepted for such courses. The number of credits so earned must be within the limits of the number of elective hours of the individual department. A list of subjects in which CLEP examinations will be accepted may be obtained at the College of Engineering and Applied Science. The currently approved list includes subjects in the fields of science, mathematics, and selected areas of the social sciences. (See also University regulations and instructions for obtaining additional information.)

DEGREES

Undergraduate Degree Programs

The College of Engineering and Applied Science offers four-year courses leading to the Bachelor of Science degree in:

- Aerospace engineering sciences
- Applied mathematics
- Architectural engineering
- Chemical engineering
- Civil engineering
- Computer science
- Electrical engineering
- Electrical engineering and computer science
- Engineering physics
- Mechanical engineering

Varied programs and options are offered in each of the above areas.

Joint Degrees

Joint Bachelor's Degrees in Engineering and in Other College Academic Programs at the Boulder Campus. Arrangements to obtain joint bachelor's degrees in engineering and in the academic program of another college may be made through consultation with and approval of the appropriate deans and completion of a minimum of 30 additional semester hours beyond the largest minimum required by either college or school.

Bachelor of Science Degrees in Two Academic Departments of the College of Engineering and Applied Science at the Boulder Campus. Two Bachelor of Science degrees in engineering may be earned by obtaining the approval of both departments concerned and completing a minimum of 30 additional semester hours beyond the largest minimum required by either department (currently this would require a total of at least 158 semester credit hours). Transfer students desiring two bachelor's degrees must present a minimum of 60 semester credit hours taken at the University of Colorado College of Engineering and Applied Science (Boulder Campus), and must satisfy all other stipulations regarding total hours required and approval of all course work by both departments concerned. Of the 30 additional hours for the second degree, a minimum of 24 shall be in courses in the secondary academic department concerned or in courses approved in writing in advance by the department as substitutes.

Students desiring to pursue the double-degree program in the College of Engineering and Applied Science (Boulder Campus) must formally designate themselves double degree candidates by filing in the dean's office a petition signed by the chairmen of both departments concerned prior to enrolling for the last 30 hours of work to be completed for the double degree.

A decision to earn a joint degree should be carefully weighed, since qualified students can obtain a master's degree for the same number of credits (see Graduate Study in Engineering).

Joint Degrees in Business. A student in the College of Engineering and Applied Science may be able to obtain a combined B.S. degree in engineering and B.S. degree in business. (See Combined Business and Engineering Curricula.)

Post-Arts Degree. A graduate of the College of Arts and Sciences may obtain an engineering degree in four semesters if such liberal arts courses as science and mathematics and such engineering courses as graphics and certain specialized subjects have been elected.

Premedicine Option

Most engineering departments have an option by which a student may meet fully all requirements for entry into medical schools while also earning a degree in engineering. Engineering departments with this option will approve inclusion of appropriate biological and bioengineering courses in the student's program of technical electives.

The courses listed below are prescribed by medical schools and must be completed with superior grades. General overall requirements representative of those needed for entry into most medical schools are given. Students can meet these requirements by careful substitutions of electives in the engineering curriculum. In some cases where additional hours may be required, interested students should consult with the departmental chairman and the health sciences advisor on the Boulder Campus.

Expository or creative writing	1 sem.(3 sem. hrs)
General chemistry[2]	2 sem. (8-10 sem. hrs.)
Organic chemistry	2 sem. (8-10 sem. hrs.)
General biology or zoology[1]	2 sem. (8 sem. hrs)
Literature (in English)	2 sem. (6 sem. hrs.)
English composition	1 sem. (3 sem. hrs)
Physics	2 sem. and Lab (9 sem. hrs.)

Various bioengineering courses are listed in this catalog. Students are expected to show a thorough knowledge of chosen subjects and a true understanding of the problems presented and the solutions that have been advanced. In addition, students must acquire understanding of mankind through the study of social-humanistic subjects. The study of courses that will be taken in medical school is discouraged.

To complete a premedical program in the College of Engineering and Applied Science, it is strongly recommended that the student follow a full four-year college course and earn a B.S. degree.

The Admissions Committee of the School of Medicine at the University of Colorado Health Sciences Center welcomes inquiries and visits from prospective students, particularly at the time of their first interest in medicine as their chosen profession.

The requirements for premedical programs are indicated under the departmental headings.

Combined Business and Engineering Curricula

Undergraduates with career interests in administration may be able to complete all of the requirements for both a B.S. degree in engineering and a B.S. degree in business by extending their study programs to five years, including one or two summer terms. It may be possible to start earning the 48 semester credits required in the College of Business and Administration in the second, third, or fourth year, depending upon the curricular plan for the particular field of engineering in which the student is enrolled.

It is also possible for qualified graduates (with cumulative grade point averages of 3.00 or better) to complete the requirements for a master's degree in business within one year after receiving the baccalaureate degree in engineering. Before deciding upon the business option, a student should carefully consider, in consultation with departmental advisors, the relative advantages of the combined B.S. business-engineering curricula, the M.B.A. degree program of the Graduate School of Business Administration, and the M.S. degree program in the student's own discipline.

Combined business and engineering programs for which students may be able to qualify are available for students in all engineering departments.

An engineering student wishing to obtain a combined degree must submit a petition to both the College of Business and the College of Engineering and be approved by both colleges as a combined degree student. Failure to do so will preclude the student from taking any business courses.

For students in combined programs, the requirements for the degree in business are as follows:

1. Completion of at least 48 semester credits in business and economics, to include Econ. 201 and 202 (8 semester hours), required courses in business (30 semester hours), and a business area of emphasis (12 semester hours).
2. Completion of at least 30 of these semester hours at the University of Colorado while concurrently enrolled in the College of Business.
3. Completion of nonbusiness requirements in mathematics, communications, and the social and behavioral sciences in a degree program approved in advance by the College of Business. In addition, for some courses and areas of emphasis, there are prerequisite requirements which must be met.

Students should examine carefully the information on combined programs in the section of this catalog on the College of Business Administration. The section includes a listing of specific nonbusiness courses required for the combined degree program.

4. At least a 2.00 grade average must be earned in all courses undertaken in the College of Business and in the area of emphasis.
5. The bachelor's degree in business must be awarded at the same time as the engineering degree and will not be awarded separately.

PLANNING THE ENGINEERING PROGRAM

Freshman Year and Curriculum Choices

Fundamentals taught in the freshman year are of prime importance in the more advanced classes, and every effort is made to register beginning freshmen in the proper courses.

All freshman are urged to consult their instructors whenever they need help in their assignments and should feel free to consult with the deans and/or members of their staffs about their problems. During the freshman year, students not doing satisfactory work are required to consult with the dean or his assigned staff members.

It is strongly recommended that students avoid the likelihood of later scheduling problems by following the prescribed sequence exactly.

Courses Required in the Freshman Year. Course requirements for freshmen are detailed within the curriculum given under each department. The freshman is exposed to a broad university background, doing much early course work outside the College of En-

[1]See appropriate chairman for possible substitution of courses.

gineering and Applied Science in science, mathematics, and humanities. *Every student should read and follow the assigned curriculum carefully.*

A fifth year leading to the master's degree is strongly urged for students with above average ability who feel they can profit from additional study.

Advising and Records

Freshman students are advised by members of the engineering advising staff and by representatives from each academic department. These combined sources of help are readily available to assist students with academic, vocational, or personal concerns. *Students are assigned specific departmental advisors for academic planning and should consult with the departmental chairman or designated representative for assignment.* Additional advising information is contained in the College of Engineering *Student Survival Guide* for the current year. It may be obtained in the Dean's Office.

UNDERGRADUATE DEGREE REQUIREMENTS

1. The B.S. degree requires that not less than 128 semester hours in an acceptable curriculum be completed to the satisfaction of the department concerned.

The last 30 hours must be earned after admission and matriculation as an engineering degree student of the University of Colorado Boulder Campus. Many students will need to present more than the minimum hours because of certain departmental requirements and because they may have enrolled in courses that do not carry full credit toward a degree, for example, some ROTC courses (see, Credit for ROTC). Physical education and performance courses do not carry engineering credit.

A student is awarded a degree by a vote of the faculty of the College of Engineering and Applied Science after an academic department of the college determines that all of the requirements for the degree have been met. The diploma specifies whether the student graduated from the University of Colorado at Boulder, at Colorado Springs, or at Denver, The campus named is the one where the department recommending the student for the degree is located. Consideration will generally be given to designating the campus where the last 30 hours of course work were completed. However, the final decision on the campus designation is made by the awarding faculty.

2. The grade point average of an engineering student will include all academic courses attempted at the University of Colorado. A cumulative grade point average (GPA) of 2.00 is required for graduation. In addition, a CPA of 2.00, separately computed, must be achieved for all courses taken from the student's major department. The grades of *P* or *H* in honors courses and of *P* in pass/fail courses count toward graduation but are excluded from these computations. The *F* grade is included.

3. A basic computer course or equivalent is required by each department. (See departmental requirements.)

4. Each B.S. program requires a minimum of 18 hours in social-humanistic subjects. Half of the courses should be taken at the junior and senior level. These subjects should be taken from the following categories, with no more than half from any one of the three categories listed below.

a. Literature (including foreign literature either in the original or in translation) and philosophy.
b. Anthropology, economics, history, political science, psychology, and sociology.
c. Fine arts and music (critical or historical).

Qualified students will be permitted to take appropriate honors courses for social-humanistic courses.

Such courses as accounting, contracts, management, elementary foreign language, public speaking, and technical writing should be considered as technical and may be substituted for technical electives where applicable. *Students should consult their faculty advisors.*

5. Students should see also Requirements for Graduation and the general rules and policies of the University listed in this catalog.

6. Consideration can be given to substitution of equivalent courses for required courses. Students desiring such substitution must obtain verification in writing from their faculty advisors that courses actually are equivalent. Careful checking is required. *A course given at another institution may have the same name and same textbook as a required engineering course and still be taught with a nonmathematical emphasis or other variation that gives it little value for engineering.* (See Transfer Credit.)

7. All courses are not necessarily offered each semester. According to University rules, undergraduate courses having an enrollment of fewer than 20 students will be cancelled. Students can minimize scheduling problems by following closely the sequences given in the curricula of their departments. If a course is unavailable, a junior or senior showing definite need of it may be allowed to enroll for equivalent studies under the course number 900, Independent Study.

8. Students in applied mathematics and engineering physics should choose courses in the College of Engineering rather than the same courses cross-listed elsewhere, in order to be able to demonstrate a maximum depth in engineering to prospective employers.

9. There are no language requirements for the B.S. degree in engineering, but it is strongly recommended that students include language courses in their programs. With departmental approval, beginning language courses may be acceptable as technical electives, and later courses as literature.

10. See also the College of Engineering *Student Survival Guide* for the current academic year. It may be obtained in the Dean's Office (ERC-AD-1).

English

Communications skills are essential for every professional person and are particularly so for the engineer. The following courses are intended to develop the student's writing ability and to allow a close analysis of significant works of world literature in translation and

in English originals. It is not mandatory but is preferable that the courses be taken sequentially as shown.

Students who achieve a *B* average in two of the following English courses—120, 130, 140, 260, and 261—may take immediately thereafter any literature courses listed by the Department of English.

Also, engineering students have the option of taking humanities courses in the Integrated Studies Program of the College of Arts and Sciences as a substitute for introductory literature courses.

No social-humanistic credit will be given for courses dealing with English as a foreign language.

Electives

Engl. 120-3. Introduction to Fiction
Engl. 130-3. Introduction to Drama
Engl. 140-3. Introduction to Poetry
Engl. 150-3. Introduction to British Writers (not open to those who have credit in Engl. 252)
Engl. 160-3. Introduction to American Writers (not open to those who have credit in Engl. 266)
Engl. 190-3. Introduction to Shakespeare
Engl. 220-3. Modern Short Story
Engl. 221-3. Science Fiction
Engl. 260-3, 261-3. Introduction to World Literature (not open to students who have credit in Hum. 101, 102)
Engl. 252-3. Masterworks of British Literature
Engl. 253-3. Modern and Contemporary Literature
Engl. 290 to 298. Studies in Literature
Engl. 315-3. Report Writing (for engineering students, the course may be considered a technical elective)
Engl. 322-3. Folklore
Engl. 365-3, 366-3. Survey of American Literature
Engl. 368-3. Twentieth-Century American Literature
Engl. 397-3,398-3. Shakespeare
Engl. 465-3, 466-3. Studies in American Literature

Credit for ROTC

Some departments may allow their students limited amounts of technical elective credit for ROTC courses deemed to have suitable educational value. In no case may such credit exceed 6 credit hours. *Such courses may not be used to satisfy the 18-hour social/humanistic requirement.*

The faculty of the College of Engineering and Applied Science will not recommend an ROTC student for a bachelor's degree until the student has completed all ROTC requirements and is eligible for commissioning. Thus, ROTC students must attend their required summer camps and cruises and receive their commissions at or before the commencement exercises at which their degrees are conferred.

ROTC students who are working for degrees in both engineering and another area will be required to attend at least one summer session.

Requirements for Graduation

It is the student's responsibility to be certain that all the requirements are fulfilled, to file the intended date of graduation in the departmental office upon the completion of 96 semester hours applicable to the B.S. degree sought, to fill out a diploma card at the beginning of the next to the last semester before graduation, and to keep the departmental advisor and the dean's office informed of any change in plans.

In order to become eligible for one of the bachelor's degrees in the College of Engineering and Applied Science, a student, in addition to being in good standing in the University, must meet the following minimum requirements.

Courses. The satisfactory completion of the prescribed and elective work in any curriculum as determined by the appropriate department (see Undergraduate Degree Requirements) is required.

Students planning to graduate in December or May should complete an application form prior to the third week of the fall semester. Forms are available at schedule pick-up or in the Dean's Office, EC AD 1-1.

Incompletes and Correspondence Courses. All *incompletes* must be completed and all correspondence course grades must be officially received no later than three weeks prior to graduation. It is the student's responsibility to contact the instructor concerning the removal of *incomplete* grades.

Conferring of Combined Degrees and Degrees and Commissions. Conferring of such degrees is to be simultaneous. (See ROTC and Joint Degrees.)

Faculty Recommendation. The recommendation of the faculty of the department offering the degree and the recommendation of the faculty of the College of Engineering and Applied Science are required.

Commencement Exercises. Commencement exercises are held in December, May, and August.

Campus Designation on Diploma. See Undergraduate Degree Requirements, paragraph 1.

ACADEMIC RULES AND POLICIES

Credits

Students may receive credit for only those courses for which they officially registered, passed special examinations or correspondence courses, or transferred credits from other institutions. (See Advanced Placement, CLEP Credit, and Transfer Credit). Students who have had extensive experience equivalent to required courses should consult with the appropriate department.

Normal Course Schedule

Students should register for a normal course schedule (at least 12 credit hours) as outlined in the departmental curricula. Variations from the normal loads specified should be carefully planned and set forth in a petition approved by the appropriate faculty advisor and department. Students who are employed should consult with their advisors before each registration regarding course loads to be attempted. Guidelines for course load are available in the Dean's Office.

Sequence of Courses

Students should complete the courses in the department in which they are registered, according to the order shown in this catalog. Any course in which there is a *failure* or an unremoved *incomplete* should take precedence over other courses, however, each student

must register so that departmental requirements will be completed with the least possible delay.

A student who receives a grade of *D* in a course that is prerequisite to another may not register for the succeeding course without the permission of the department, the instructor of the succeeding course, and the Dean's office.

Students may enroll for as much as 50 percent of their courses in work that is not a part of the prescribed curricula. To exceed this limit, the approval of the major department and the dean of engineering must be obtained by petition.

Grading System, Pass/Fail, and Drop/Add Procedures

See the General Information section of this catalog for the University of Colorado uniform grading system and for additional pass/fail information and drop/add procedures. Also see the current *Schedule of Courses* and current *Student Survival Guide.*

GRADING SYSTEM

It is particularly important to note that in the College of Engineering and Applied Science, courses to be counted toward fulfilling the graduation requirement *cannot* be taken *no credit (NC). Once a course has been taken for no credit, the course cannot be repeated for credit.* An engineering student must petition for approval before enrolling for any course *NC.*

PASS/FAIL

The primary purpose for offering courses on a pass/fail grade basis is to encourage students, especially juniors and seniors, to broaden their educational experience by electing challenging courses without serious risk to their academic records. In general, pass/fail should be limited to 300- or 400-level courses. Below are specific pass/fail regulations for the College of Engineering and Applied Science.

1. A maximum of 15 pass/fail hours may be included in a student's total program. A maximum of 6 hours may be taken in one semester, but it is recommended that not more than one course at a time be taken pass/fail.
2. Courses that a student may elect to take pass/fail shall be designated and *approved in advance* by the student's major department and the Dean's Office. If courses not so designated are taken, the earned grade will be recorded in place of the *P* or *F* grade. An engineering student who has not designated a major field will not be allowed the pass/fail option without approval through the Dean's Office.
3. A transfer student may count toward graduation 1 credit hour of pass/fail for each 9 credit hours completed in the college; however, the maximum number of pass/fail hours counting toward graduation shall not exceed 15, including courses taken in the Honors Program under that program's pass/fail grading system.
4. Students on academic probation are not to enroll for pass/fail courses.

INCOMPLETES

The grade of *IF* (incomplete, failing) may be given by an engineering faculty member for circumstances beyond the student's control, such as a documented medical or personal emergency.

The grade of *IW* (incomplete, withdrawn) is not given by the faculty of this college. When the *IF* is given, the student, the Dean's Office, and the departmental office are informed, in writing, by the instructor of what the student is to do in order to remove the incomplete and when the tasks are to be completed. The instructor may assign only the *IF* grade. The student is expected to complete the course requirements, e.g., the final examination or term paper, within the established deadline and not to retake the entire course. The grade will be converted automatically to a grade of *F* after one year unless the specified work is completed. If, because of exceptional circumstances, the course must be repeated, approval by petition is necessary, and the student is required to notify the Office of Admissions upon its completion. Under no circumstances will a student be permitted to repeat a course at a campus of the University other than the one on which an *IF* was received.

DROP/ADD

Only under very extenuating circumstances will petitions for dropping courses be considered after the semester drop deadline. Students should consult the most recent *Survival Guide* for additional drop/add information.

Withdrawal

Students may withdraw from the University without penalty only during a brief period at the beginning of a semester. For details see material available during registration. If a student suspends work by officially withdrawing from the University, *permission must be secured from the dean to reenroll in the College of Engineering and Applied Science.* Students who interrupt their course of study may be required to take any preparatory courses that have been changed during their absence or to repeat any courses showing weak preparation. Students who withdraw may find it difficult to reenroll because of legislative ceilings on enrollments. They must reapply for admission. Their applications will be reviewed by the Committee on Undergraduate Admissions.

Class Standing

To be classified as a sophomore in the College of Engineering and Applied Science, a student must have passed 30 semester hours; to be classified as a junior, 60 hours; and to be classified as a senior, 90 hours of credit. All transfer students will be classified on this same basis according to their hours of credit accepted at the University of Colorado. This class standing does not necessarily reflect the academic level of the student's degree program.

Attendance

Successful work in the College of Engineering and Applied Science is dependent upon regular attendance in all classes. Students who are unavoidably absent should make arrangements with instructors to make up the work missed. Students who, for illness or other valid emergency, miss a final examination must notify the instructor and the Office of the Dean no later than the end of the day on which the examination is given. Failure to do so will result in an *F* in the course.

Policy on Academic Progress

The following is a statement of the Policy on Academic Progress in the College of Engineering and Applied Science.

An overall average of 2.00 or better, in hours taken at the University of Colorado toward graduation requirements, is necessary to remain in good standing in the College of Engineering and Applied Science. In addition, a grade point average of 2.0, separately computed for all courses taken from the major department is required for graduation. Grades earned *at another institution* are not used in calculating the grade point average at the University of Colorado. However, grades earned in another school or college within the University of Colorado will be used in determining the student's scholastic standing and progress toward the bachelor of science degree in the College of Engineering and Applied Science.

Students whose overall averages fall below 2.00 will be placed on probation for as long as they are enrolled in the College of Engineering and Applied Science, and will be so notified. If, at any time, the student's cumulative grade point average falls below 2.00, the student will be suspended from the college. Students also will be placed on academic probation if they have two consecutive semesters with semester grade point averages below 2.00, irrespective of their cumulative grade point averages.

The following is additional information and interpretation of the policy:

1. Students who have been suspended are suspended indefinitely and may not enroll at any University of Colorado campus during any regular academic year, September through May, but may enroll in summer sessions or Vacation College and/or may take *correspondence courses* for credit through the Division of Continuing Education. Suspended students *are not* permitted to enroll for Boulder evening or mini-college courses through the Division of Continuing Education.
2. Students who have been suspended may apply for readmission during the second semester following if they have by then brought their overall average up to a 2.00 through summer session, Vacation College, and/or correspondence work applying to engineering degree requirements as approved by a member of the Academic Progress Committee.
3. A student, upon satisfactorily completing at another college or university a minimum of 12 semester hours of work appropriate to an engineering curriculum subsequent to suspension, may apply for readmission as a transfer student.
4. Applicants for readmission to the University of Colorado cannot be assured readmission.
5. A student who has been placed on probation must thereafter complete full-time course loads of courses counting toward graduation requirements. Physical education courses do not count; if the student has previously completed 6 hours of ROTC courses, ROTC courses will not count; if 18 hours of social-humanistic subjects have been completed, further social-humanistic subjects will not count.
6. Students who have been on probation or suspension at any time in the past will automatically be suspended if their overall average again falls below a 2.00.

Details of the probationary and suspension status and of the conditions for return to good academic standing will be stipulated in the letters of probation and suspension. Information regarding these matters may be obtained in the Office of the Dean, Engineering Center AD 1-1.

Repetition of Courses

Students may not register for credit in courses in which they already have recieved grades of C or better. When a student takes a course for credit more than once, *all grades are used in determining the grade point average.* An *F* grade in the repetition of a required course necessitates a subsequent satisfactory completion of the course. *Students may not register for credit in any course which they have previously completed for NC* (no credit).

A student who has taken a course twice and earned grades no higher than *D* or *IF* must complete the course successfully on the third attempt or face the possibility of being placed on academic suspension.

Changing Departments

The forms necessary for transferring from one engineering department to another are available in the Dean's Office.

Other University Campuses

A student who needs to work at a part-time or full-time job while obtaining a college education, or who lives in the metropolitan areas of Denver or Colorado Springs, may prefer to attend the University of Colorado at Colorado Springs or the University of Colorado at Denver. The campus designation on the student's diploma and transcript correspond to the campus designation of the faculty recommending the student for a degree.

UNIVERSITY OF COLORADO AT DENVER

Three departments of the College of Engineering and Applied Science are located on the campus of the University of Colorado at Denver. Complete B.S. and M.S. degree programs are offered by the Department of Civil Engineering, the Department of Electrical Engineering and Computer Science, and the Department of Mechanical Engineering. The B.S. degree is also offered in

mechanical engineering and applied mathematics. Complete M.S. degree programs are offered in applied mathematics, as are many of the courses leading to the B.S. degree in engineering physics and other engineering fields. Many graduate courses in other fields are offered. The offices of the University of Colorado at Denver are located at 1100 14th Street in downtown Denver.

UNIVERSITY OF COLORADO AT COLORADO SPRINGS

Three departments of the College of Engineering are located on the campus of the University of Colorado at Colorado Springs (UCCS). Complete B.S. degree programs are offered in electrical engineering and computer science, and the M.S. degree is awarded in electrical engineering. Students may complete work for the Ph.D. and Master of Engineering degrees through the University-wide Graduate School. The UCCS Department of Mathematics is also a department of the College of Engineering and offers the B.S. and M.S. degrees in applied mathematics.

Summer Courses

Summer session courses are planned for regular students and for those who must clear deficiencies. Courses are offered also for high school graduates who wish to enter as freshmen and for those who need to remove subject deficiencies. For information about courses, students should write to the chairman of the department in which the courses are taught and for the *Schedule of Summer Courses* for the campus on which they plan to enroll.

Division of Continuing Education and Correspondence

Some courses are also available through the Division of Continuing Education, either through correspondence instruction or special courses.

Televised Courses

The Audiovisual College Education (ACE) Program provides graduate level courses for off-campus study by students at their work place. The ACE Program uses the televised candid classroom format in which selected regular campus courses of the University are held in specially equipped television classrooms. The candid classroom format is characterized by the unrehearsed and unedited video recording of all instruction and questions taking place in the classroom. The television signals are simultaneously broadcast via Instructional Television Fixed Service (ITFS) to students in the Denver Metropolitan Area (within range). Students studying via ITFS can question the instructor while the class is in session over phone lines connected into the classroom. The candid classroom sessions are also recorded on video cassettes which are sent immediately via United Parcel Service to students nationally. The off-campus students studying by videotape interact by telephone with the instructor, who consolidates questions to be answered in the next classroom session.

The ACE Program is one of the programs of the Center for Advanced Training in Engineering and Computer Science (CATECS), described elsewhere. For a special catalog of course offerings students may write the director of CATECS, Campus Box 435, Boulder, Colorado, 80309, or call (303) 492-6331.

GRADUATE STUDY IN ENGINEERING

The College of Engineering and Applied Science offers degree programs for the Master of Engineering (M.E.), Master of Science (M.S.), and Doctor of Philosophy (Ph.D.) degrees. There are degree programs in each of the following departments or fields:

- Aerospace engineering sciences
- Chemical engineering
- Civil, environmental, and architectural engineering
- Computer science
- Electrical engineering
- Mechanical engineering
- Mechanics

The Master of Science in applied mathematics is presented by the College of Engineering with the cooperation of the Department of Mathematics.

The Master of Science in telecommunications is presented jointly by the Department of Electrical Engineering, the Department of Communication, the Department of Political Science, and the Graduate School of Business Administration.

Graduate programs within each engineering department offer a variety of options, providing numerous alternative careers.

Programs with emphasis on special fields include civil engineering degrees focused on construction, energy conservation, geotechnical engineering, structures, water resources, and water quality. Computer science areas of strength include software tools, optimization, analysis of algorithms, and numerical analysis. Electrical engineering areas in which there are strong subject concentrations inlcude communications, computer science, microwaves, solid state devices, integrated circuits, electric power, and others. In mechanical engineering strong options are offered in mechanics and industrial engineering.

In most departments there is a choice among bioengineering, environmental engineering, energy and energy resources, or computer applications. Systems, process control, and dynamic flow are other strong areas.

Education for Practicing Engineers

The Master of Engineering degree permits graduate students flexibility in defining specialized interdisciplinary fields that meet their professional needs. This degree has standards fully equivalent to those of the Master of Science degree (See Master of Engineering).

The Center for Advanced Training in Engineering and Computer Science (CATECS) can assist working professionals in setting up study programs to meet individual goals under sponsorship of their employers. By providing liaison among the student, the employer, and the participating departments, CATECS makes it possible to set up acceptable programs of graduate study leading to a Master of Engineering degree. CATECS

puts great emphasis upon making graduate courses readily available in formats suitable for busy engineers and computer scientists. Through the resources of the three-campus College of Engineering and Applied Science, courses can be made available at the work place by television or on the campus, scheduled at convenient times. Classes can be conducted at the work place under contract with the employer.

For more information, prospective students should contact the office responsible for professional development at their work places or the director of CATECS, Campus Box 435, Boulder, Colorado, 80309, or call (303) 492-6331.

Graduate Work in Business

Undergraduates in engineering who intend to pursue graduate study in business may be able to complete some of the business background requirements as electives in their undergraduate programs. Seniors in engineering who have such intentions and appear likely to qualify for admission to graduate study in business may be permitted to register for graduate fundamentals courses designed to provide qualified students with needed background preparation in business. (See concurrent B.S. and M.S. degree programs.)

Concurrent B.S. and M.S. Degree Program in Engineering

Students who plan to continue in the Graduate School after completion of the requirements for the B.S. degree will usually find it advantageous to apply for admission to the concurrent degree program. This program allows the student who qualifies for graduate study and expects to continue for an advanced degree to plan a graduate program from the beginning of the senior year rather than from the first year of graduate study. The student can then reach sooner the degree of proficiency required to begin research and can make better and fuller use of courses offered in alternate years.

Application is made to the Graduate School through the department early in the second semester of the junior year (after completion of at least 80 semester hours). Admission to the Graduate School may be granted on completion of 110 semester hours. (See Seniors at the University of Colorado in the Graduate School section of this catalog.) Requirements are the same as for two degrees taken separately: 128 credit hours for the B.S. degree and 24 hours plus thesis (Plan I) or 30 credit hours (Plan II) for the M.S. or for the Master of Engineering degree. Social-humanistic requirements must be completed within the first 128 credit hours. A grade point average of 3.00 or better for all work attempted through the first six semesters (at least 96 credit hours) and written recommendations from at least two departmental faculty members are required.

All students will choose or be assigned faculty advisors to help them develop programs best suited to their present interests. Those in each program will be encouraged to pursue independent study on research problems or in areas of specialization where no formal courses are offered. A controlled substitution policy will be followed for courses normally required in the last year of the undergraduate curriculum. The program selected must be planned so that the student may qualify for the B.S. degree after completing the credit-hour requirements for the degree if the student so elects, or if the student's grade point average falls below the 3.00 required to remain in the program. In this case, all hours completed with a passing grade while in the program will count toward fulfilling the normal requirements for the B.S. degree. There will be no credit given toward a graduate degree for courses applied to the B.S. degree requirements; however, students who elect to exit at the B.S. level are still eligible to apply for admission to the Graduate School under the rules set forth in the Graduate School section of this catalog. Normally, however, these students will apply for admission to the Graduate School when all but 6 of the credit hours required for the B.S. degree have been completed and will be awarded the B.S. and M.S. degrees simultaneously upon meeting the requirements set forth for the concurrent degree program.

Graduate Degree for Science Majors

Science graduates who have good academic records and strong backgrounds in mathematics and physical science may be eligible for admission as graduate students in engineering or may be able to qualify with little extra course work. Preliminary information may be obtained from the Office of the Dean of engineering. In many cases, some financial support may be available for such students.

Master of Engineering, Master of Science, and Doctor of Philosophy Degrees

Students wishing to pursue graduate work in engineering leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees in the Graduate School section of this catalog. Some departments also have available explanatory material on their advanced degree programs.

Prerequisites. To enroll for an advanced degree in any department of the College of Engineering and Applied Science, candidates either must have previously earned a bachelor's degree in a curriculum that includes the necessary prerequisites for the branch of engineering in which they wish to specialize or qualify for the concurrent B.S. and M.S. program open to juniors. If the candidate's preliminary education was taken at some other institution, the degree of qualification for advanced work shall be determined by the department concerned and by the dean of the Graduate School.

Graduates of engineering technology programs should note that the equivalent of a B.S. degree in an appropriate engineering field is required for entry into the Graduate School. Because the goals and orientation of engineering programs differ from those of technology programs, technology graduates should expect to make up deficiencies before being admitted to graduate study in engineering. Students may not be admitted to the

Graduate School while making up deficiencies, but can enroll as special students.

For admission as a regular degree student, an undergraduate grade point average of at least 3.00 is normally required.

Language Requirement. No engineering department except mechanical engineering has a foreign language requirement, but Ph.D. candidates should note the communication requirement of the Graduate School, under which a foriegn language is required.

Graduate work in each department of the College of Engineering and Applied Science falls into two classes:

1. Courses that are offered for candidates who have chosen to major in the particular department or as a base for the Master of Engineering combined degree.
2. Courses that are offered as minors for candidates who have chosen their major in some other department.

Graduate students who plan to become candidates for the M.E., M.S., or Ph.D. degree are required to take a qualifying examination in the appropriate field of specialization during the first semester in which they are registered as candidates for a graduate degree. Individual departments should be consulted for the timing of this examination. The purpose of this examination is to enable the advisor and student to plan a suitable program of study.

Course Requirements. Graduate students majoring in any department receive no credit in the Graduate School for courses listed as required and undergraduate work in the same department. They may, however, receive graduate credit for advanced undergraduate courses in an engineering department other than that in which they receive the bachelor's degree, with the approval of the department granting the degree.

Availability of Courses. All courses are not necessarily offered every year. They are available only if there is sufficient demand. According to University rules, a graduate course, even though offered, will be canceled if the enrollment is less than five students. Some courses are offered in alternate years on the Boulder Campus and the Denver Campus; others usually at Boulder only, and some only at Denver. If a course is not available at either Boulder or Denver, a student showing urgent need for the material may apply for equivalent studies under the course titles of Independent Study or Selected Topics (see course description numbers 400, 500, and 600).

AEROSPACE ENGINEERING SCIENCES

Office in Engineering Center OT 6-16
Professor Marvin W. Luttges, Acting Chairman

BACHELOR'S DEGREE REQUIREMENTS

The primary objective of the aerospace engineering sciences curriculum is to provide sound general education in subjects fundamental to the practice of and research in this branch of engineering sciences. The major part of the first two years is devoted to the study of mathematics, physics, mechanics, chemistry, and the humanities. The last two years are devoted to professional courses in fluid dynamics, propulsion and energy conversion, flight dynamics, systems, analysis, materials and structures, space science, and bioengineering. Lists of especially coordinated groups of available technical electives can be obtained from faculty advisors for specialization in one of five subfields of aerospace engineering: (1) aeronautics, (2) computation, (3) materials and structures, (4) premedical/bioengineering, and (5) space science. (It is advisable for students who are interested in the premedical/bioengineering option to make their decisions early in their programs. Details of this option appear below.)

Students in the Department of Aerospace Engineering Sciences are encouraged to pursue special research topics of their own choosing during the junior and senior years. Course credit will be allowed for suitable studies under the courses designated as Aero. 461 or 462. This research is under the direction of a member of the departmental faculty. Students should contact the faculty member of their choice at the beginning of the semester.

Planning of graduate study for students having sufficient ability and interest should begin by the start of the junior year. Such a plan should consider the foreign language requirements of appropriate graduate schools and an advanced mathematics program included in technical electives consisting of M.E. 462, Math. 431/432, Math. 481, or Math. 443 (see Graduate Programs). ROTC courses may be substituted for not more than 3 hours of technical electives, subject to the approval of the student's advisor. Students who wish to combine the business and aerospace engineering sciences curricula are advised to consider obtaining the B.S. degree in aerospace and the M.S. degree in business rather than a combined B.S. degree. Business courses may not be substituted for technical electives in the aerospace curriculum.

Bioengineering/Premedical Option in Aerospace Engineering Sciences

The Department of Aerospace Engineering Sciences offers a premedical option which has been specifically designed for students who wish either to attend medical school or to enter graduate work in bioengineering after receiving the B.S. degree. Students wishing to enter the bioengineering/premedical option program will be allowed to substitute appropriate bioengineering courses for some of their normal course work during the senior year. Aero. 380, Bioengineering I, and chemistry through biochemistry provide a good introductory background for engineering students who are considering neuroscience, premedicine, or other bioengineering areas. Students electing this option should consult their advisor regularly to assure the adequacy of their curricula. This is of particular importance in the premedicine option where the curriculum must meet the requirements noted earlier under Undergraduate Degree Programs.

The Department's bioengineering activity at the graduate level is focused primarily in the neuroscience area, as represented by the courses Aero. 581, 582, 583, 584, and 585. Complementary courses in neurosciences are available within the campus-wide neuroscience program. Seniors and beginning graduate students are en-

couraged to enter the neuroscience program through the basic Aero. 581/582 sequence.

Senior and graduate students can also work with faculty in other bioengineering areas. These opportunities can be coordinated through the department with the college-wide bioengineering program.

Students must be sure that their curricula include 6 hours of design.

Curriculum for B.S., Aerospace Engineering Sciences

FRESHMAN YEAR

Fall Semester	*Semester Hours*
Aero. 130. Introduction to Science of Flight	3
Aero. 151. Freshman Laboratory	1
A.Math. 135. Calculus for Engineers I	4
Phys. 111. General Physics	4
Social humanistic elective (Note 1)	3
	15

Spring Semester	*Semester Hours*
Aero. 132. Introduction to Space Science	2
A.Math. 136. Calculus for Engineers II	4
Phys. 112. General Physics	4
Phys. 114. Experimental Physics	1
C.S. 115 Introduction to Scientific Programming	3
Social humanistic elective (Note 1)	3
	17

SOPHOMORE YEAR

Fall Semester	*Semester Hours*
A.Math 235. Calculus for Engineers III	4
Phys. 213. General Physics	3
Phys. 215. Experimental Physics	1
Aero. 203. Mechanics I	3
Chem. 103. General Chemistry	5
	16

Spring Semester	*Semester Hours*
A.Math. 236. Introduction to Linear Algebra and Differential Equations	3
Aero. 204. Mechanics II	3
Aero. 232. Thermodynamics and Heat Transfer	4
Aero. 222. Materials Science and Engineering	3
Social humanistic elective (Note 1)	3
	16

JUNIOR YEAR

Fall Semester	*Semester Hours*
Aero. 311. Fluid Dynamics I	3
Aero. 323. Structures I	3
Aero. 303. Aerospace Dynamics	3
Aero. 341. Systems Analysis I	3
E.C.E. 303. Electric Circuits I	3
E.C.E. 343. Electrical Laboratory I	1
	16

Spring Semester	*Semester Hours*
Aero. 312. Fluid Dynamics II	3
Aero. 352. Flight Mechanics	3
Aero. 342. Systems Analysis II	3
Aero. 324. Structures II	3
Technical electives (Notes 2 and 5)	3
	15

SENIOR YEAR

Fall Semester	*Semester Hours*
Aero. 413. Gas Dynamics and Propulsion	3
Aero. 417. Aerospace Laboratory I	2
Aero. 447. Computational Fluid Mechanics	3
Design course No. 1 (Note 3)	3
Technical electives (Notes 2 and 5)	3
Social humanistic electives (Note 1)	3
	17

Spring Semester	*Semester Hours*
Aero. 422. Aerospace Laboratory II	2
Design course No. 2 (Note 3)	3
Technical elective (Notes 2 and 5)	2
Social humanistic electives (Note 1)	6
Free electives (Notes 4 and 5)	3
	16

Curriculum Notes

All elective courses must conform to the following rules and must be approved in advance by the department's undergraduate advisor or freshman advisor.

1. *Social Humanistic Elective*—a course in one of the following categories:
   a. Literature (including foreign literature either in the original or translation) and philosophy.
   b. Economics, sociology, political science, history, psychology, and anthropology.
   c. Fine arts and music (critical and historical).

   A total of 18 credit hours is required with no more than 9 credit hours taken from any single category.

2. *Technical Elective*—a course in engineering or science (such as mathematics, physics, chemistry, biology, computer science) at a level of 300 or higher. A total of 8 credit hours of technical elective is required, of which a minimum of 3 credit hours must be in aerospace engineering sciences.

   Available options consisting of specially coordinated groups of technical elective courses are recommended for students who want to specialize in one of the following subfields of aerospace engineering sciences: aeronautics, computation, materials and structures, premedical/bioengineering, and space science.

3. *Design Courses*—a total of 6 credit hours of design is required with a minimum of 3 credit hours in aerospace engineering sciences. They must be taken from the following list of design courses: Aero. 456, Aircraft Design (generally offered in the fall semester); Aero 458, Spacecraft Design (when offered, generally in the spring semester); C.E. 351, Structural Design I (generally offered in both the fall and spring semesters). Other design courses will be added to this list as they become available. See departmental advisor for current list.

4. *Free Elective*—can be any college level course except those in physical education or performance skills such as drawing or playing a musical instrument.

5. A commission in R.O.T.C. earns 3 credit hours of technical electives and 3 credit hours of free electives toward graduation requirements in aerospace engineering sciences.

GRADUATE DEGREE PROGRAMS

Professional courses in the graduate area cover the fields of physics of fluids (fluid dynamics); propulsion and energy conversion; flight dynamics, control and guidance, space systems analysis; materials and structural mechanics; space environment; and bioengineering. In addition, the department has cooperative research programs with institutes in Boulder and the surrounding area.

Presently active areas of research include acoustics, aerospace vehicle design, bioengineering, computational fluid dynamics and data processing, control theory, cryogenics, environmental fluid dynamics, flight mechanics and astrodynamics, kinetic theory, magnetohydrodynamics, materials science and solid state

physics, physics of fluids, space sciences and astrophysics, turbulence and stochastic processes, and unsteady aerodynamics.

Requirements for Advanced Degrees

All graduate students applying for admission to Aerospace Engineering Sciences are required to present the results of the analytical, quantitative, and verbal sections of the Graduate Record Examination. Each student is encouraged to present also the results of one specialized section in any area of engineering, mathematics, physics, chemistry, or biology.

The department offers graduate programs leading to the Master of Engineering and the M.S. and Ph.D. degrees in aerospace engineering sciences. Degree plans often are formulated on the basis of the student's interest and needs. Portions of the program are included to assure the student's engineering and professional development.

A core of courses is required of all M.S. students as follows: Aero. 517/M.E. 532, Macroscopic Physics of Fluids; Aero. 547, Computational Fluid Mechanics; and M.E. 521 and 522, Methods of Engineering Analysis I and II (or their equivalents). Students may satisfy these requirements by transfer credit. Both the M.S. candidacy examination and the Ph.D. preliminary examination contain a written part based on the content of this core curriculum of four courses. This test is given once a semester or once a year, depending on the demand. The form of the remainder of the examinations, covering specific areas, is decided by the student's committee and can be written, oral, or both.

Further information on specific requirements can be obtained by writing to the Graduate Committee, Department of Aerospace Engineering Sciences, University of Colorado, Campus Box 429, Boulder, Colorado 80309.

APPLIED MATHEMATICS

Office in Engineering Center OT 2-38
Professor John H. Hodges, Chairman

The Department of Mathematics offers all courses in mathematics for the College of Engineering and Applied Science. The department also offers four options leading to the degree B.S. (A.Math.) in the College of Engineering and Applied Science. In Option I, the student takes a specified amount of course work in a specific engineering department. In Option II, the student takes course work in distributed engineering departments including a solid grounding in mechanics, electronics, and materials. Option III is a joint mathematics-computer science program. Option IV is a program designed for the mathematics major who is interested in statistics, operations research, and applied probability.

Pregraduate Courses. Students considering doing graduate work in mathematics are strongly urged to take Math. 314 and Math. 431-432. Without these courses students may have difficulty gaining admission to some graduate schools and, if admitted to graduate school, may expect a delay of an additional year in earning an advanced degree.

The undergraduate curriculum is designed to give training in mathematics and in engineering and science. The use of numerical methods and electronic computers is included. Technical electives indicated in the curriculum must be selected from the following fields: mathematics, engineering, physics, chemistry, computer science, biology, astro-geophysics, or geology.

In general, nontechnical electives should be broadening and have cultural value. Students interested in research are encouraged to take a foreign language as early as possible. German, French, and Russian are strongly recommended. (Only 6 hours of language courses below the 300 level or 6 hours of English composition may be counted toward the social-humanistic requirement.)

Students with high academic standing and Calculus I and II or their equivalents may be invited to enroll in the Honors sequence A.Math 237, 315. Admission is by controlled enrollment card. For further information, consult the Office of the Dean, College of Engineering and Applied Science.

BACHELOR'S DEGREE REQUIREMENTS

The B.S. degree in applied mathematics requires the completion of a minimum of 128 credit hours of course work with an average grade of *C* (2.00) or better. Students majoring in applied mathematics must complete the following minimum requirements:

1. At least 24 hours of mathematics beyond calculus, all with a grade of *C* or better.
2. At least 18 hours of mathematics courses numbered above 300, of which at least 6 hours must be numbered above 400, all with a grade of *C* or better.
3. Three semesters of calculus (Math. 130, 230, 240 are recommended but A.Math. 135, 136, and 235 may be taken), all with a grade of *C* or better.
4. Math. 313, all with a grade of *C* or better.
5. A minimum of 24 hours in addition to required engineering courses C.S. 120, Engr. 101, and Engr. 301 must be in courses taught in the departments of the College of Engineering and Applied Science. At least 6 hours of these 24 engineering hours must be at the 300 level or higher.
6. One of the four options below.
7. At least 18 hours of social-humanistic courses. Of these, 6 hours must be in literature, and 6 hours must be courses at the 300 level or higher. The student must also satisfy the requirements of the College of Engineering and Applied Science for the social-humanistic area. (See Undergraduate Degree Requirements.) At most, 6 additional hours of social-humanistic hours may be counted toward the required 128 hours.
8. Other electives to reach a total of 128 hours. These could include more technical electives, foreign language, English composition, speech, etc. These hours must include at least 6 hours in courses at the 300 level or higher.

OTHER PROGRAMS

Other degree programs are offered by the Department of Mathematics in the College of Arts and Sciences and in the Graduate School, including the M.S. and Ph.D. degrees in applied mathematics. For graduate course listings, see Mathematics.

Curriculum for B.S. (Applied Mathematics)

FRESHMAN YEAR

Fall Semester	*Semester Hours*
Math. 130. Analytic Geometry and Calculus I	5
E.Phys. 111. General Physics	4
Elective in Literature (Note 1)	3
C.S. 120. Introduction to Programming I	3
	15

Spring Semester	*Semester Hours*
Math. 230. Analytic Geometry and Calculus II	5
Engr. 101. Engineering Drawing I	2
Elective in Literature (Note 1)	3
E.Phys. 112. General Physics	4
E.Phys. 114. Experimental Physics	1
	15

SOPHOMORE YEAR

Fall Semester	*Semester Hours*
Math. 240. Analytical Geometry and Calculus III	4
E.Phys. 213. General Physics	3
E.Phys. 215. Experimental Physics	1
Electives (Note 2)	9
	17

Spring Semester	*Semester Hours*
Chem. 103. General Chemistry	5
Electives (Note 2)	12
	17

JUNIOR YEAR

Fall Semester	*Semester Hours*
Math. 313. Introduction to Linear Algebra	3
Electives (Note 2)	13
	16

Spring Semester	*Semester Hours*
Aero. 232. Thermodynamics and Heat Transfer	4
Electives (Note 2)	12
	16

SENIOR YEAR

Fall Semester	*Semester Hours*
Electives (Note 2)	16

Spring Semester	*Semester Hours*
Electives (Note 2)	16

Minimum total hours for degree 128

Requirements under each option are as follows:

OPTION I—ENGINEERING MINOR	*Semester Hours*
Specialty in a specific engineering department	24
Technical electives	12
Required social-humanistic electives	12

OPTION II—DISTRIBUTED ENGINEERING MINOR

Distributed engineering subjects in the College of Engineering 24

(A minimal program would consist of the following courses: Aero. 304, Aero. 311, C.E. 212, C.E. 311, E.E. 303, M.E. 301, or their equivalents.)

Technical electives	12
Required social-humanistic electives	12

OPTION III—COMPUTER SCIENCE

Specific courses required, all with grades of *C* or better.

C.S. 121	3
E.C.E. 257	3
E.C.E. 222	3
C.S. 225	3
C.S. 324	3
Additional hours of upper division C.S. courses or upper division E.C.E. courses which are cross-listed with C.S.	6
(Suggested 6 hrs. could be E.C.E. 453, E.E. 459)	
Technical electives	6
Noncomputer-oriented engineering courses	12
Required social-humanistic electives	12

Note: It is strongly recommended that students in Option III take the following mathematics courses: Math. 413, 443, 465, 466, and 481. Students should take Math. 413 immediately after Calculus III.

OPTION IV—STATISTICS AND OPERATIONS RESEARCH

Approved courses in statistics, operations research, and applied probability taught by departments in the College of Engineering	24

These hours must include I.E. 441, I.E. 442, I.E. 351

Technical electives	12
Required social-humanistic electives	12

Additional required courses offered by the Department of Mathematics are Math. 281, Math. 481, Math. 482.

Students electing this option should consult with an advisor no later than their fourth semester.

A. Math. Curriculum Notes

1. See the general engineering section for a list of English courses.
2. Electives include technical, social-humanistic, and electives in chosen option.

ARCHITECTURAL ENGINEERING

Office in Engineering Center OT 4-34
Associate Professor L. Duane Ball, Associate Chairman

BACHELOR'S DEGREE REQUIREMENTS

The architectural engineering curriculum is supervised and administered by the Department of Civil, Environmental, and Architectural Engineering of the College of Engineering and Applied Science. Students in this program are required to take some courses in the College of Design and Planning in addition to engineering courses.

The curriculum has been extensively revised. There is a broad core of requirements for all students. Students are expected to choose elective courses to add depth to one or more specialty areas in consultation with faculty advisors. There are numerous courses offered in structural analysis and design, an active program in construction engineering, and one in building energy engineering and illumination. Lists of recommended electives are made available to students to help

them select a coherent academic program which enhances one of these areas.

COMBINED DEGREE

Students interested in pursuing a B.S. degree in business in addition to the B.S. degree in architectural engineering should be prepared to spend at least three additional semesters. A faculty advisor should be consulted in the student's freshman year so that social sciences and humanities courses required of business students can be taken.

Academically qualified students may want to consider working toward the Master of Business Administration degree upon completion of the baccalaureate in engineering as an alternative to a B.S. in business.

Curriculum for B.S. (Arch.E.)

FRESHMAN YEAR

Fall Semester	*Semester Hours*
Arch.E. 130. Introduction to Architectural Engineering	3
A.Math. 135. Calculus for Engineers	4
C.S. 115. Introduction to Scientific Programming	3
E.Phys. 111. General Physics	4
Engr. 101. Engineering Drawing	2
	16

Spring Semester	*Semester Hours*
A.Math. 136. Calculus for Engineers II	4
Arch.E. 102. Descriptive Geometry	2
E.Phys. 112. General Physics	4
E.Phys. 114. Experimental Physics	1
Chem. 103. General Chemistry	5
	16

SOPHOMORE YEAR

Fall Semester	*Semester Hours*
C.E. 212. Analytical Mechanics I	3
C.E. 221. Plane Surveying	3
Arch.E. 201. Introduction to Solar Utilization	3
A.Math. 235. Calculus for Engineers III	4
Social-humanistic elective	3
	16

Spring Semester	*Semester Hours*
Arch.E. 202. Energy Fundamentals	3
C.E. 312. Mechanics of Materials	3
A.Math. 236. Introduction to Linear Algebra and Differential Equations	3
Basic science elective	4
Social-humanistic elective	3
	16

JUNIOR YEAR

Fall Semester	*Semester Hours*
C.E. 350. Structural Analysis	3
Arch.E. 301. Mechanical Systems for Buildings	3
Arch.E. 354. Illumination I	3
Arch. 470. Architectural History	3
Engineering science elective	3
	15

Spring Semester	*Semester Hours*
C.E. 351. Structural Design I	3
C.E. 314. Engineering Materials Laboratory	
or	
Arch.E. 303-2. Energy Laboratory	2
Arch. 471. Architectural History	3
E.C.E. 303. Electric Circuits	3
Technical elective	5
	16

SENIOR YEAR

Fall Semester	*Semester Hours*
C.E. 311. Analytical Mechanics II	3
Arch.E. 441. Construction Costs, Estimating, and Prices	3
Arch. 420. Architectural Appreciation and Design	
or	
Technical electives	6
Technical elective	2
Social-humanistic elective	3
	17

Spring Semester	*Semester Hours*
C.E. 499. Senior Seminar	1
Arch.E. 457. Building Electrical Systems	3
Technical electives	
or	
Arch. 420. Architectural Appreciation and Design	6
Technical elective	3
Social-humanistic elective	3
	16

Minimum hours for degree 128

Courses Available for Specialization

Upon consultation with their advisors, students are expected to select courses applicable to their areas of interest and specialization. The areas of specialization are construction engineering and management, building energy engineering, illumination, and structural engineering. In addition to the courses listed below, other courses, not listed, may be proposed by a student and approved by the advisor if they are found to be applicable.

Arch.E. 302-3. Energy Conservation Analysis
Arch.E. 401-3. Solar Design
Arch.E. 431-2. Design of Masonry Structures
Arch.E. 446-3. Construction Planning and Scheduling
Arch.E. 455-3. Illumination II
Arch.E. 458-3. Building Electrical Systems Design II
Arch.E. 456-3. Luminous Radiative Transfer II
C.E. 331-3. Theoretical Fluid Mechanics
C.E. 332-3. Applied Fluid Mechanics
C.E. 380-3. Geotechnical Engineering I
C.E. 381-3. Geotechnical Engineering II
C.E. 451-3. Matrix Structural Analysis
C.E. 454-3. Steel Design
C.E. 455-3. Reinforced Concrete Design
C.E. 456-2. Design of Timber Structures
C.E. 497-3. Engineering Economy
C.E. 498-3. Engineering Contracts
C.E. 511-3. Introduction to Structural Dynamics[1]
C.E. 512-3. Mechanics of Materials II[1]
C.E. 551-3. Introduction to Finite Element Analysis[1]
C.E. 552-3. Finite Element Analysis of Structures[1]
Econ. 201-4. Principles of Economics I
Econ. 202-4. Principles of Economics II
Acct. 201-3. Introduction to Financial Accounting

[1]For well-qualified undergraduates.

Acct. 202-3. Introduction to Managerial Accounting
E.C.E. 403-2. Elements of Electronics
E.C.E. 443-1. Elements of Electronics Laboratory
E.E. 576-3. Power Distribution Systems
M.E. 362-3. Heat Transfer
M.E. 421-3. Air Conditioning
M.E. 424-3. Refrigeration

GRADUATE STUDY

Graduate credit in architectural engineering is offered in the following courses:

C.E. 501-3. Energy Control Systems
C.E. 502-3. Building Energy Audits
C.E. 505-3. Advanced Solar Design
C.E. 506-3. Advanced Passive Solar Design
C.E. 507-3. Thermal Analysis of Buildings
C.E. 523-3. Construction Planning and Scheduling
C.E. 524-3. Engineering Contracts
C.E. 525-3. Construction Management
C.E. 526-3. Industrialized Building Techniques and Systems
C.E. 528-3. Construction Engineering I
C.E. 529-3. Construction Engineering II

CHEMICAL ENGINEERING

Office in Engineering Center OT 2-6
Professor Max S. Peters, Chairman

BACHELOR'S DEGREE REQUIREMENTS

The chemical engineering student must master the broad fields of organic and inorganic chemistry and be able to apply them on a large scale for a widely varied assortment of products. Among these are the whole range of petroleum products, plastics, detergents, synthetic and natural fibers, and many others. Production of these must be nonpolluting; the cleanup of pollution also requires the application of fundamental chemical engineering principles. Chemical engineers are actively engaged in meeting today's crises in oil and energy. Chemical engineers are currently redesigning chemical processes to conserve energy and are working on alternative sources of energy such as coal gasification, solar energy, and geothermal energy.

There is a natural affinity between chemical engineering and medicine, and the department emphasizes its special premedical and bioengineering program. Paralleling the technical courses are studies in literature, social sciences, and humanities.

Each student is requested to obtain close and careful counseling from the faculty. Students each year plan programs that will qualify them not only as chemical engineers but also for professional training in medical, law, or business schools or for graduate work in systems engineering or computing science. The department has several real-time process computers and an analog computer. Process control is stressed. *The department believes that since no two students are alike, no two programs should be alike either.* Students may carry out a portion of their studies in another country (see International Education). In particular, there is a junior year program of study in Monterrey, Mexico.

Options in the Chemical Engineering Curriculum

Curricular options have been established in fields of major importance and of particular interest. To follow one of these requires careful planning and course selection by student and advisor.

Bioengineering-Premedical Option. Since all biological systems are essentially intricate chemical machines, chemical engineering is a natural professional basis for either medical school or bioengineering research. The department has a strong undergraduate premedical program and graduate bioengineering research programs at both the M.S. and Ph.D. levels. The following courses comprise the central core of the bioengineering program: Ch.E. 370, Animal Engineering; Ch.E. 570, Biomedical Engineering; and Ch.E. 571, Molecular Bases of Behavior. In addition, bioengineering premedical students are required to complete two semesters of general biology.

The graduate research program in bioengineering is strongly oriented to specialization in the area of sensory physiology and biotechnology.

Environmental Engineering Option. Chemical engineers can make major contributions in the fields of pollution control, resource utilization, and environmental control. The environmental option is designed to emphasize biological and environmental sciences, the sociopolitical effects of engineering on the environment, and chemical engineering applications in environmental problems. The department has a strong interest in this field, including an active graduate program.

Computer Option. Modern machine computation continues to have a great impact on the practice of chemical engineering. The computer option allows the student to emphasize computer work, including the theory of computer operation, programming, and mathematical techniques for computer utilization. The department, the college, and the University have extensive, modern computing facilities.

Curriculum for B.S. (Ch.E.)

FRESHMAN YEAR

Fall Semester	*Semester Hours*
A.Math. 135. Calculus for Engineers I	4
Chem 103. General Chemistry (Note 1)	5
C.S. 120. Introduction to Programming I	3
Engl. 260. Introduction to World Literature (Note 2)	3
Ch.E. 130. Introduction to Chemical Engineering	2
	17

Spring Semester	*Semester Hours*
A.Math. 136. Calculus for Engineers II	4
Engr. 101. Engineering Drawing I	2
Chem. 106. General Chemistry (Note 1)	5
Ch.E. 201. Introduction to Chemical Engineering Calculations	3
Engl. 261. Introduction to World Literature (Note 2)	3
	17

SOPHOMORE YEAR

Fall Semester	*Semester Hours*
A.Math. 235. Calculus for Engineers III	4
Chem. 331/333. Organic Chemistry	4
Ch.E. 241. Chemical Engineering Materials and Industrial Chemicals	2

E.Phys. 111. General Physics	4
Social-humanistic elective	3
	17

Spring Semester — *Semester Hours*

A.Math. 236. Introduction to Linear Algebra and Differential Equations	3
Chem. 332/334. Organic Chemistry	4
Ch.E. 212. Chemical Engineering Material and Energy Balances	3
E.Phys. 112. General Physics	4
E.Phys. 114. Experimental Physics	1
	15

JUNIOR YEAR

Fall Semester — *Semester Hours*

Chem. 451. Physical Chemistry	3
Ch.E. 321. Chemical Engineering Principles I	4
E.C.E. 303. Electric Circuits I	3
E.C.E. 343. Electrical Laboratory I	1
Social-humanistic elective	3
Elective	3
	17

Spring Semester — *Semester Hours*

Chem. 452. or Chem. 453. Physical Chemistry	3
Chem. 454. Physical Chemistry Laboratory	2
Ch.E. 322. Chemical Engineering Principles II	4
Ch.E. 432. Chemical Engineering Thermodynamics	3
Elective	3
	15

SENIOR YEAR

Fall Semester — *Semester Hours*

Ch.E. 403. Chemical Engineering Laboratory (Note 3) or Technical elective	4
Ch.E. 433. Chemical Engineering Reaction Kinetics	3
Ch.E. 442. Organic and Polymeric Technology (Note 4)	3
Ch.E. 458. Chemical Engineering Process Dynamics	3
Social-humanistic elective	3
	16

Spring Semester — *Semester Hours*

Technical elective or Ch.E. 403. Chemical Engineering Laboratory (Note 3)	4
Ch.E. 452. Chemical Process Synthesis	4
Ch.E. 457. Instrumentation and Process Control (Note 4)	3
Social-humanistic elective	3
	14

Minimum total hours for degree 128

Ch.E. Curriculum Notes

1. The sequence of Chem. 107 and Chem. 108 is an acceptable substitute for Chem. 103 and Chem. 106. *See advisor* concerning the requirement of Chem. 103 and Chem. 106.
2. Alternate literature courses in English and foreign languages are acceptable. Students should consult advisors.
3. *Ch.E. 403 is required for graduation.*
4. Technical elective may be substituted but must meet engineering science and design requirements. See advisor.

GRADUATE DEGREE PROGRAMS

Major areas of current research interests in the Chemical Engineering Department are alternate energy, bioengineering, heterogeneous catalysis and kinetics, cryogenics, fluid dynamics, mass transfer, membrane and polymer science, phase equilibria, pollution control, process control and optimization, surface science and interfacial phenomena, systems modeling, transport in porous media, and thermodynamics.

Master of Science Degree

A candidate for the Master of Science degree in chemical engineering must fulfill the following departmental requirements:

1. Twenty-seven semester hours of graduate work including a satisfactory thesis. Maximum credit of 6 semester hours will be allowed for the completion of the master's thesis. Twelve hours at the 500 level or above (excluding 6 hours of thesis) must be completed. It is recommended that 6 to 9 semester hours be taken in a minor technical field approved by the Department of Chemical Engineering.
2. A final examination as required by the Graduate School on the thesis and/or course work must be passed.

It is expected that a qualified student can complete the master's degree in one and one-half calendar years. A graduate student with a bachelor's degree in a field related to chemical engineering can obtain the master's degree in chemical engineering. Programs will be arranged on an individual basis.

Three of the following core courses for the M.S. and Ph.D. degrees must be taken. Ch.E. 521 is required, and of the two additional courses at least one must be Ch.E. 522, Ch.E. 537, or Ch.E. 539.

Ch.E. 521. Transport Phenomena (required)
Ch.E. 522. Mass Transport
Ch.E. 537. Intermediate Chemical Engineering Thermodynamics
Ch.E. 539. Reaction Kinetics
Ch.E. 574. Analytical Methods in Chemical Engineering
Ch.E. 575. Numerical Methods in Chemical Engineering

A degree plan must be prepared at the beginning of the academic program in consultation with an advisory committee. The student is urged to maintain close contact with this advisory committee during the entire course of study.

The M.S. thesis committee must consist of three members, including two faculty members from the Department of Chemical Engineering.

Master of Engineering (M.E.) Degree Requirements

Admission. (The standards of admission to the M.S. program also apply to M.E. degree applicants.) A 3.0 overall undergraduate grade point average is required for regular admission; a 2.75 overall undergraduate grade point average is usually required for provisional acceptance.

M.E. Degree Advisor. All M.E. candidates should see the chemical engineering Master of Science degree advisor for counseling.

Requirements for Graduation. Nine hours of chemical engineering at the 500 level or above are required for those M.E. degree students enrolled in the Department of Chemical Engineering. Students will orally defend their written reports as specified in the M.E.

degree description. A comprehensive examination will be administered by the student's advisory committee on the report and course work. Television course credit will be given as approved by the committee.

Doctor of Philosophy Degree

Admission requirements for the Ph.D. include:

1. The applicant must have achieved an academic performance equivalent to a Master of Science degree from an accredited college or university, with a grade point average substantially above the minimum normally required for the degree.
2. The applicant must show the ability to perform independent research.
3. The applicant must indicate a field of specialization and be acceptable as a thesis advisee to a member of the chemical engineering graduate faculty.
4. The applicant must pass the Ph.D. preliminary examination administered by the Department of Chemical Engineering.

Admission to the doctoral program will be based on consideration of the above four criteria and decided by majority vote of the chemical engineering faculty.

A candidate for the Doctor of Philosophy degree must meet the requirements as described under Requirements for Advanced Degrees in the Graduate School section. A minimum of 30 semester hours of courses numbered 500 or above is required for the degree. Twelve hours should be taken outside the Department of Chemical Engineering.

The Ph.D. dissertation committee must consist of five members, including at least three from the Department of Chemical Engineering and at least one from outside the department. A regular faculty member of the department must be chosen to act as chairman of the committee.

Chemical engineering research facilities are extensive and modern. Many of the research laboratories are interfaced to the department's laboratory computer system which includes a central Eclipse S/130 minicomputer. This system is capable of multiprogramming and multitasking. Also, a number of stand-alone microcomputer systems are interfaced to experiments.

Studies in heterogeneous catalysis, kinetics, and surface science use the four ultrahigh vacuum systems located in the chemical engineering laboratories. These systems contain Auger spectrometers, an X-ray photoelectron spectrometer (ESCA), a secondary ion mass spectrometer, two low-energy electron diffraction systems, three mass spectrometers, high resolution electron energy loss spectrometry, and two transfer mechanisms that interface atmospheric pressure chambers to the ultrahigh vacuum systems. The extensive surface analysis facilities at the Solar Energy Research Institute have also been used. Heterogeneous catalysis experiments also use three gas chromatographs, a quadrupole mass spectrometer, a chemisorption apparatus, and several flow systems.

Process control studies make extensive use of the department's real-time computer systems and studies are carried out on a variety of experimental units. A twelve-foot-high fluidized bed with high speed radiation densitometer and pressure transducers is used. In addition, a distillation column, packed-bed catalytic reactor, and heat exchanger are used in process control studies.

There is a complete core flooding laboratory for work in enhanced oil recovery, leaching of oil shales, and modified in-situ oil shale studies. Spinning drop tensiometers, a dynamic Langmuir trough for adsorption/desorption of solutes, and a Wilhemy plate apparatus are used for surface phenomena studies. Oil shale leaching experiments simultaneously measure dynamic leaching and porous media properties. A porosimeter is used to determine pore size distributions. An electromechanical vibration system for particle dynamics studies is also available.

Membrane studies use a casting machine for fabrication of asymmetric membranes. Some studies on facilitated transport are also carried out at the national Bureau of Standards in Boulder. The Chemical Processing Division at the bureau is equipped with gas chromatographs, atomic absorption, flow systems, and microcomputers for liquid membrane research.

The bioengineering laboratory is equipped for biophysical measurements. The equipment includes a variety of optical instruments, a phase contrast and polarizing microscope, a microscope video camera, a Cary spectrophotometer, a plant growth chamber, autoclave, and a sterile room.

A system for electrocarbonization of coal is presently being constructed. A sensitive calorimeter for phase changes and heats of solution in solids is also under construction. Water pollution control equipment includes biological reactors and pressure vessels. Extrusion and injection molding machines, an intensive mixer, and a rheometer are available for polymer studies.

The numerous scanning and transmission electron microscopes in the Biology Department are used in membrane, porous media, and surface studies. The regional NMR facility is also available.

A Hughes Infrared Thermal-Imaging Video apparatus is available for combustion studies. A new 300,000X Scanning Electron Microscope with energy dispersive X-ray analysis capability has recently been purchased. A Berghof high pressure (150 bar) flow loop is available for characterizing the permselectivity properties of polymeric membranes.

CIVIL, ENVIRONMENTAL, AND ARCHITECTURAL ENGINEERING

Office in Engineering Center OT 4-34
Professor Professor Hon-Yim Ko, Chairman

BACHELOR'S DEGREE REQUIREMENTS

This curriculum requires the student to obtain a background in the humanities, a broad knowledge of the basic engineering sciences of chemistry, mathematics (including differential equations), physics, mechanics (including fluid mechanics and soil mechanics), electrical engineering, and thermodynamics. Social-humanistic hours may be devoted to literature, the so-

cial sciences, or to the humanities, with not more than half of the hours from any one of the three areas.

Advanced technical courses are elected in the senior year. Random selection is not allowed, the objective being to permit a graduate to enter the engineering profession with a firm groundwork in fundamental engineering science and adequate knowledge in specialized fields. Students should consult their advisors.

Students interested in pursuing a B.S. degree in business in addition to the B.S. (C.E.) degree should be prepared to spend at least 3 additional semesters. A faculty advisor should be consulted in the student's freshman year so that social sciences and humanities courses required of business students can be taken.

Academically qualified students may want to consider working toward the Master of Business Administration degree upon completion of the baccalaureate in engineering as an alternative to a B.S. in business.

A student interested in a premedical option should consult with an advisor and the department chairman at the earliest possible time in order to make proper plans for an acceptable program (see Premedical Option).

Curriculum for B.S. (C.E.)

FRESHMAN YEAR

Fall Semester	*Semester Hours*
A.Math 135. Calculus for Engineers I	4
E.Phys. 111. General Physics	4
C.E. 130. Introduction to Civil Engineering	3
Engr. 101. Engineering Drawing	2
Social-humanistic elective	3
	16

Spring Semester

A.Math 136. Calculus for Engineers II	4
E.Phys. 112. General Physics	4
E.Phys. 114. Experimental Physics	1
Chem. 103. General Chemistry	5
C.S. 115. Introduction to Scientific Programming	3
	17

SOPHOMORE YEAR

Fall Semester

A.Math. 235. Calculus for Engineers III	4
C.E. 212. Analytical Mechanics I	3
C.E. 221. Plane Surveying	3
Arch.E. 220. Energy Fundamentals	3
Social-humanistic elective	3
	16

Spring Semester

A.Math 236. Introduction to Linear Algebra and Differential Equations	3
C.E. 312. Mechanics of Materials	3
C.E. 331. Theoretical Fluid Mechanics	3
C.E. 389. Engineering Geology	3
Social-humanistic elective	3
	15

JUNIOR YEAR

Fall Semester

C.E. 314. Engineering Materials Laboratory (Note 1)	(2)
C.E. 332. Applied Fluid Mechanics	3
C.E. 344. Introduction to Environmental Engineering	3
C.E. 350. Structural Analysis	3
C.E. 380. Geotechnical Engineering	3
Social-humanistic elective	3
	(15) 17

Spring Semester

C.E. 315 or 318 Engineering Laboratory (Note 1)	(2)
C.E. 324. Introduction to Construction	3
C.E. 345. Water and Wastewater Treatment	3
C.E. 351. Structural Design I	3
C.E. 381. Geotechnical Engineering II	3
E.C.E. 303. Electrical Circuits	3
	15 (17)

SENIOR YEAR

Fall Semester

C.E. 391. Civil Engineering Systems	3
C.E. 311. Analytical Mechanics II	3
Technical electives (Note 2)	7
Social-humanistic elective	3
	16

Spring Semester

C.E. 360. Transportation Engineering	3
C.E. 499. Senior Seminar	1
Technical electives (Note 1)	9
Social-humanistic elective	3
	16

Minimum hours for degree 128

C.E. Curricula Notes

1. Either C.E. 314, 315, or 318 will fulfill lab requirement.
2. Not more than 6 hours of technical electives may be taken outside the department.

GRADUATE DEGREE PROGRAMS

A pamphlet on the requirements for graduate study in civil, environmental, and architectural engineering is available from the departmental office.

In competition for University and other fellowships, the Graduate Record Examination, consisting of the aptitude tests and advanced test in engineering, is used in the evaluation of candidates. Therefore, students who wish to be considered for fellowships are advised to take this examination prior to their arrival on campus. There is no other qualifying examination required by the department for the Master of Science degree.

The department offers the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with study emphasis in six major areas: building energy systems, construction engineering and management, environmental engineering, geotechnical engineering, structural engineering and structural mechanics, and water resources engineering. A major in transportation and planning is available through the Denver Campus.

Master of Science Degree

Requirements for this master's degree can be fulfilled in two ways. Under Plan I the candidate presents 24 semester hours of course work including thesis, and under Plan II, 30 credits of course work are required.

Master of Engineering Degree

Requirements for this professionally oriented degree are available from the Office of the Dean of Engineering.

Doctor of Philosophy Degree

This degree requires a minimum of 30 semester hours of graduate level (500 or above) work, the last 20 of which must be taken at this University. The doctoral dissertation likewise requires 30 semester hours. The applicant for this degree will normally have completed a master's degree in civil engineering or closely related field and must demonstrate the capability for both rigorous academic accomplishments and independent research.

RESEARCH INTERESTS AND FACILITIES

The department has a wide variety of research facilities including a 10g-ton centrifuge for geotechnical and structural model studies. A large 400 g-ton geotechnical centrifuge is in the design stages for use in model testing. Also available are numerous computing facilities, extensive structural mechanics and geotechnical capabilities, and hydraulics and water resources research laboratories including excellent facilities in water quality and environmental engineering. New programs in construction management and building energy are well supported.

Current research covers such topics as water and wastewater treatment, alpine hydrology, hydraulic research, land treatment, rapid infiltration, and activated sludge processes. Cost prediction in construction, construction management, energy conservation in buildings, solar applications, lighting systems, and wind engineering are included. Also, offshore structures, centrifugal modeling, excavations, tunnelling, and rock and soil mechanics are being studied. In structures, research includes focus on buckling, finite element techniques, reinforced concrete, earthquake behavior, masonry structures, and prestressed concrete.

COMPUTER SCIENCE

Office in Engineering Center, ECOT 7-7
Professor Leon J. Osterweil, Chairman

The Computer Science Department, in cooperation with other departments in the University, offers a wide range of opportunities for students interested in computing. The Computer Science Department itself offers a B.S. degree in computer science. This program is designed to prepare students for careers as computer specialists and for graduate study in computer science. An interdisciplinary B.A. program in applied computer science is offered for students interested primarily in the uses of computing in another field such as economics or psychology. Students interested in this program should contact the Office of the Dean of the College of Arts and Sciences (492-7885). Computer options are also offered by several departments, including electrical and computing engineering, business, and mathematics; students interested in these programs should contact the appropriate department.

The Computer Science Department also offers M.S. and Ph.D. degrees. See Graduate Requirements.

BACHELOR'S DEGREE REQUIREMENTS

Students electing to pursue the B.S. degree are required to master the central areas of computer science, including software design and construction, algorithm design and analysis, computer systems, programming languages and language processors, theoretical foundations, and numerical computation. A firm foundation for the scientific study of computing is laid in the freshman year, with detailed studies of the most important areas occupying the sophomore and junior years. Electrical engineering courses early in the curriculum provide essential knowledge of computer hardware. A two-semester sequence in the senior year involves students in all aspects of a major software development project, from requirements analysis to finished product. Students can round out their computer science backgrounds by selecting from a wide variety of electives in such areas as artificial intelligence, graphics, and data base systems. A student should consult his or her academic advisor before choosing electives.

It is also vital for the socially responsible computer professional to have a broad background in the liberal arts. Consequently, students are encouraged to pursue interests in non-technical as well as technical areas outside of computer science. Twenty-four hours of courses in the humanities and social sciences are required, including literature and composition. Competence in a foreign language at the second semester college level is required. The program also includes a broad sampling of mathematics and basic science courses.

A minimum of 128 hours is required for graduation. The requirements of the College of Engineering and Applied Science must be satisfied for graduation.

Curriculum for B.S. in Computer Science

FRESHMAN YEAR

Fall Semester	*Semester Hours*
C.S. 130. Introduction to Computing for Majors	4
C.S. 140. Discrete Methods for Computer Science	2
E.C.E. 130. Logic Circuits	3
A.Math. 135. Calculus for Engineers I	4
Science I (Note 1)	4
	17

Spring Semester	*Semester Hours*
C.S. 131. Fundamentals of Computer Science I (Note 7)	4
E.C.E. 133. Logic Laboratory	1
A.Math. 136. Calculus for Engineers II	4
Science II (Note 1)	4
Engl. 260. Introduction to World Literature	3
	16

SOPHOMORE YEAR

Fall Semester	*Semester Hours*
C.S. 232. Fundamentals of Computer Science II (Note 7)	4
E.C.E. 222. Microcomputer Architecture and Programming	3
A.Math. 235. Calculus for Engineers III	4
Engl. 261. Introduction to World Literature	3
Social-humanistic elective (Note 2)	3
	17

Spring Semester	*Semester Hours*
C.S. 255. Programming Languages (Note 7)	3
C.S. 275. Systems (Note 7)	3
Math. 313. Introduction to Linear Algebra	3
Science elective	3
English composition (Note 3)	3
	15

JUNIOR YEAR

Fall Semester	*Semester Hours*
C.S. 370. Hardware Systems (Note 7)	3
C.S. 365. Numerical Computation I (Note 7)	3
Math. 314. Modern Algebra or Math. 413. Discrete Mathematics I	3
Science elective	3
Social-humanistic elective	3
	15

Spring Semester	*Semester Hours*
C.S. 343. Computer Science Theory I (Note 7)	3
C.S. 355. Language Processors (Note 7)	4
Science elective	3
Social-humanistic elective	3
Elective	3
	16

SENIOR YEAR

Fall Semester	*Semester Hours*
C.S. 430. Software Development I (Note 7)	4
C.S. elective (Notes 4, 5)	3
I.E. 351. Engineering Statistics (Note 6)	3
Social-humanistic elective	3
Elective	3
	16

Spring Semester	*Semester Hours*
C.S. 431. Software Development II (Note 7)	4
Social-humanistic elective	3
Electives	9
	16

C.S. Curriculum Notes

1. The courses listed as Science I and Science II must be a two-semester introductory sequence in a laboratory science.
2. Students must demonstrate a proficiency in a foreign language equivalent to two college-level semesters.
3. This must be a course emphasizing expository writing by the student. Engl. 315 (Report Writing) is recommended.
4. This course may be any upper division undergraduate course with the exception of Computers and Society or Computer Facilities Management.
5. Students who intend to pursue graduate degrees are strongly encouraged to take C.S. 443 (Computer Science Theory II) and Math. 451 (Introduction to Mathematical Logic).
6. Math. 587 (Statistical Methods in Research) is an acceptable substitute for I.E. 351.
7. These courses were under development at press time and had not been through the approval process. Descriptions of these courses are therefore not printed in this catalog. An updated list of courses which have been approved, along with catalog descriptions, may be obtained from the Computer Science Department.

GRADUATE DEGREE PROGRAMS

General Admission Requirements

The Computer Science Department offers the following areas of study: automata theory, programming languages, operating systems, information systems, and numerical analysis. Graduate students should consider a major in computer science if they are primarily interested in the general aspects of computational processes, both theoretical and practical, e.g., theory of algorithms, methods by which algorithms are implemented on a computer, and information structures. A student who is primarily interested in the results of a computer process and its relation to a particular area of application should major in another field and consider a minor in computer science.

Applicants will be favorably considered for graduate study in computer science if they hold at least a bachelor's degree or its equivalent from an institution comparable to the University of Colorado. They should have considerable programming experience and sufficient mathematical maturity to understand pure mathematics courses.

The applicant should satisfy the following requirements for mathematics courses: at least three semesters of university-level calculus and at least two one-semester courses of a mathematical nature beyond calculus, for example, advanced calculus, differential equations, linear algebra, probability, statistics, combinatorial analysis, etc. These courses need not be in a mathematics department; however, they should require mathematical maturity expected of an upper level mathematics undergraduate.

In computer science, the applicant should offer the equivalent of the following University of Colorado courses (the contents of which are outlined later in the catalog): C.S. 130, 140, 131, 232, 255, 453, and 465.

Applicants should have a grade point average of at least 3.00 (on a scale of 4.00). Applicants having the listed qualifications will, if accepted, be classified as regular degree students. Applicants with an average below 3.00 and above 2.75 and/or lacking certain of the prerequisites, as indicated, will be considered on an individual basis. Students accepted in this category will be classified as provisional degree students.

All applicants who wish to be considered for financial aid should have their applications in by February 15 preceding the academic year in which they plan to enroll. Financial aid opportunities exist through research assitant and teaching assistant positions.

All Ph.D. applicants and any applicants who wish to apply for financial aid must submit scores from the Verbal, Quantitative, and Advanced sections of the Graduate Record Examination. Applicants with a grade point average near or below 3.00 should also submit G.R.E. scores, as they weigh heavily in deciding borderline cases.

The Ph.D. applicant must satisfy the same entrace requirements as those noted above for the M.S. degree. In addition, strong academic and problem-solving abilities should have been demonstrated.

Ph.D. applications should be submitted by January 15 preceding the academic year in which the applicant wishes to enroll. M.S. applications should be submitted by April 1 preceding the fall semester and by October 1 preceding the spring semester in which the applicant wishes to enroll.

Master's Degree

Admission requirements for this program are given above under general admission requirements. Plan I or Plan II may be followed. The requirements for Plan I (thesis) are as stated under the general requirements of the Graduate School in the Graduate School section. Students in Plan I and Plan II must pass a written comprehensive examination. Students in Plan I are examined orally on their theses. Under Plan II (no thesis) a student must take C.S. 701 (3 hours), do independent reading from a list supplied by the department, and be examined orally on this material. Under Plan I or Plan II a student may take 6 hours in a minor field. Students are expected to work out an acceptable program of course work with their advisors. Specific courses depend on the student's background and field of specialization.

Doctor's Degree

Admission requirements for this program are given above under general admission requirements. Students in this program must pass a preliminary examination to be eligible for admission to Ph.D. candidacy. This examination consists of participation in a special seminar involving the solution of a variety of problems in computer science and a written examination covering elementary topics in computer science. The language requirement is as stated under the general requirements of the Graduate School. A minimum of 30 semester hours in courses numbered 500 or above is required for the degree, but the number of hours in formal courses will ordinarily be greater than this. Specific courses depend on the student's background and field of specialization. Following the formal course work, a student must pass a comprehensive examination aimed primarily at determining whether the student is adequately prepared to begin doctoral thesis work. Finally, the student is expected with a minimum of 30 semester hours to prepare a doctoral thesis based on original research in the field of computer science. After the thesis has been completed, an oral final examination on the thesis and related topics will be conducted. The examination will be conducted by a committee of at least five graduate faculty members.

Further details on either the M.S. or Ph.D. degree programs are available in the departmental office.

DEPARTMENT COMPUTING FACILITY

The Computer Science Department and the Electrical and Computer Engineering Department have a network (Ethernet) of computers dedicated to research. There are three Vax Computers (two 11/780's and one 11/750), three Sun Workstations, a Pyramid P90x Mini-Computer, and an Iris Graphics Workstation on the network. These machines, together with associated peripherals, sophisticated output devices, and terminals, provide ready access for graduate students and faculty. A limited number of undergraduates also use the systems for independent study projects.

ELECTRICAL AND COMPUTER ENGINEERING

Office in Engineering Center OT 2-32
Professor David C. Chang, Chairman

BACHELOR'S DEGREE REQUIREMENTS

The Department of Electrical and Computer Engineering offers students a wide range of elective choices, including the following specialty areas:

Electromagnetic field propagation associated with radio and related areas
Signal processing, communications, and communications systems
Electrical devices, from rotating machines to lasers
Power equipment and systems
Solid-state devices, solid-state materials, integrated circuit fabrication techniques
Modeling of systems related to electrical engineering
Bioelectronics research for selected undergraduate students

In just four years it is impossible to study all the areas in detail. Qualified students may specialize further by pursuing a graduate program or by taking continuing education courses after completing the B.S. degree requirements. A graduating senior with high scholarship can finish a master's degree in electrical engineering in about one additional full year of work at any of the nation's major universities.

Principles of computing, physics, chemistry, mathematics, logic, electric circuits, and electronics augmented with laboratory experience form the core of the first two years of study. The third year includes additional work in electronic circuits, solid-state devices, electromagnetic and transmission theory, electrical machines and transformers, heat, and mechanics. During this year, those students desiring to specialize in computer engineering may elect the computer engineering degree program. This program requires additional courses in software and hardware and has a special emphasis on computer languages and the mathematics in courses necessary for this field. In the summer between the junior and senior years, many students will have an opportunity to put their knowledge to work with jobs in industry or on research projects being conducted at the University. In the senior year they may elect courses from a wide variety of subject areas to fit their particular interests. Practical experience in well-equipped laboratories augments the theoretical approach throughout the program.

Students are encouraged to develop interests outside their electrical engineering specialties through the requirement of nontechnical subjects, usually in the College of Arts and Sciences, to develop a well-rounded background for a professional role in society. They are urged to participate in college and University activities as well as meetings of their technical societies.

Students entering in the fall of 1983 or after will be required to complete a minimum of 128 hours for graduation. Those who entered earlier will be required to complete a minimum of 132 hours.

Qualified transfer students can usually join the program without appreciable loss of time or credit. For example, a student who has completed the required mathematics and physics of the freshman and sopho-

more years and who has a total of about 68 credit hours acceptable to the department can usually complete the program in about four semesters.

Standard Curriculum for B.S. (E.E.) in Electrical and Computer Engineering

The regular ECE curriculum provides a broad background enhanced by a wide range of elective subjects in the senior year. Part of the requirement may be fulfilled through courses in other branches of engineering approved by the student's advisor. Although many students avail themselves of this broadly based program, those who have specific interests in computer technology, business or a career in medicine may wish to elect one of the programs listed below.

Computer Engineering Degree Program for B.S. (E.E. and C.S.)

This program is elected by petition during the junior year and covers both hardware and software aspects of computer system design. It is directed toward students whose major interests are in the computer itself and in a broad range of applications. The program leads to a B.S. (E.E. and C.S.) and can be extended for one year to obtain an M.S. in either computer science or electrical engineering.

The details of the program are listed below. Additional information may be obtained from the departmental office. This curriculum is considerably more specific than the general E.C.E. program and includes courses in scientific application of computers, logic structure of computers, and assembly language programming. Operating experience on departmental computers is an important adjunct to this program.

For other computer-related programs, see the Computer Science listings.

Premedical and Bioengineering Programs in Electrical and Computer Engineering

Students interested in medical careers can complete their premedical requirements in the E.C.E. Department by adding three chemistry and two biology courses to their programs. All but two of these courses may be used as technical electives in the E.C.E. program, resulting in a probable minimum requirement of 136 credit hours. Pre-med E.C.E. students are advised to begin the chemistry sequence in the freshman year so that all premedicine courses can be completed in time for the MCAT tests in the junior year. To do this, some of the sophomore E.C.E. requirements may have to be deferred to the junior year. Further information and examples of course programs that fulfill both E.C.E. and pre-med requirements can be obtained from the departmental advisor.

The undergraduate E.C.E. course of study in bioengineering also incorporates course work in biology and chemistry, but it is tailored to fit the standard 128-credit-hour E.C.E. curriculum and does not require a rearrangement of the required E.C.E. course sequence. It is primarily a technical elective emphasis area which includes bioengineering courses in E.C.E. and other engineering and biological science departments.

The bioengineering emphasis area is provided for students interested in the application of engineering techniques to biomedical problems rather than as an entrance to a medical career. Students who initially pursue the premedical course of study can easily change to bioengineering, but the reverse will be more difficult.

Combined Business Degree Program

A five-year combined program in electrical engineering and business leading to the degrees B.S.(E.E.) and B.S.(Bus.) is available to those interested in this area. Students electing this program should enroll for Econ. 201 and 202 as two of their social-humanistic electives. The program does not begin until the fourth year. Election should be made during the junior year.

Curriculum for B.S.(E.E.) and B.S.(E.E. and C.S.)

FRESHMAN YEAR

Fall Semester	*Semester Hours*
A.Math. 135. Calculus for Engineers I	4
E.C.E. 130. Logic Circuits	3
C.S. 120. Introduction to Programming I (Note 3)	3
Social-humanistic elective (Note 2)	6
	16

Spring Semester	
E.C.E 133. Logic Laboratory	1
A.Math. 136. Calculus for Engineers II	4
E.Phys. 111. General Physics	4
C.S. 123. Introduction to Programming for Engineering Students.	4
Social-humanistic elective (Note 2)	3
E.C.E. 134. Technical Writing (Note 1)	1
	17

SOPHOMORE YEAR

Fall Semester	
A.Math. 235. Calculus for Engineers III (Note 4)	4
E.Phys. 114. Experimental Physics	1
E.Phys. 212. General Physics	3
E.C.E. 215. Circuits/Electronics I	4
E.C.E. 255. Circuits/Electronics Laboratory I	1
E.C.E. 222. Microcomputer Architecture and Programming	3
	16

Spring Semester	
A.Math. 236. Introduction to Linear Algebra and Differential Equations (Note 4)	3
E.Phys. 213. General Physics	3
E.C.E. 216. Circuits/Electronics II	4
E.C.E. 256. Circuits/Electronics Laboratory II	1
E.C.E. 223. Microcomputer Laboratory	1
E.C.E. 381. Introduction to Probability	3
	15

JUNIOR YEAR

Fall Semester	
E.C.E. 323. Circuits/Electronics III	3
E.C.E. 353. Circuits/Electronics Lab III	1
Ch.E. 210. Chemical and Physical Properties of Materials	4
Social-humanistic electives (Note 2)	2
E.C.E. electives (Note 6)	6/7
	16/17

Spring Semester

Basic sciences (Note 5)	3
Technical electives (Note 8)	7
E.C.E. electives (Note 6)	7/6
	17/16

SENIOR YEAR

Fall Semester

Social-humanistic electives (Note 2)	3
Technical electives (Note 8)	13
	16

Spring Semester

Technical electives (Note 8)	9
Social-humanistic electives (Note 2)	6
	15

Curriculum for B.S. (E.E. and C.S.) Option*

JUNIOR YEAR

Fall Semester	*Semester Hours*
A.Math. 235. Calculus for Engineers III (Note 4)	4
E.Phys. 114. Experimental Physics	1
E.Phys. 212. General Physics	3
E.Phys. 215. Circuits/Electronics I with Laboratory	5
E.C.E. 222. Microcomputer Architecture and Programming	3
	16

Spring Semester

A.Math. 236. Introduction to Linear Algebra and Differential Equations (Note 4)	3
E.Phys. 213. General Physics	3
E.C.E. 216. Circuits/Electronics II with Laboratory	5
E.C.E. 223. Microcomputer Laboratory	1
E.C.E. 381. Introduction to Probability	3
	15

JUNIOR YEAR

Fall Semester

E.C.E. 323. Circuits/Electronics III with Laboratory	4
Ch.E. 210. Chemical and Physical Properties of Materials	4
Social-humanistic electives (Note 2)	2
E.C.E. electives (Note 6)	6/7
	16/17

Spring Semester

Basic sciences (Note 5)	3
Technical electives (Note 8)	7
E.C.E. electives (Note 6)	7/6
	17/16

SENIOR YEAR

Fall Semester

Social-humanstic electives (Note 2)	3
Technical electives (Note 8)	13
	16

Spring Semester

Technical electives (Note 8)	9
Social-humanistic electives (Note 2)	6
	15

Curriculum for B.S. (E.E. and C.S.) Option[1]

JUNIOR YEAR

Fall Semester	*Semester Hours*
E.C.E. 323. Circuits/Electronics III With Laboratory	4
E.C.E. 470. Switching and Finite Automata	3
Social-humanistic electives (Note 2)	3
E.C.E. electives (Note 7)	6/7
	16/17

Spring Semester

Chem. 103. General Chemistry	5
C.S. 225. Data Structures and Algorithms	3
E.C.E./C.S. 459. Computer Organization	3
E.C.E. electives (¢Note 7)	3
Social-humanistic electives	3
	17

SENIOR YEAR

Fall Semester

E.C.E. 466. Computer Systems Laboratory	1
Technical electives	12
C.S. 324. Programming Languages	3
	16

Spring Semester

Technical electives	8/9
Social-humanistic electives (Note 2)	6
	14/15

Minimum total hours for degree 128

E.C.E. and E.C.E./C.S. Curricula Notes

1. E.C.E. 134. Technical Writing. This is a required course for freshmen in electrical engineering that must be taken concurrently with E.C.E. 130.

2. Students are strongly encouraged to distribute the social-humanistic courses of their curricula as uniformly as possible throughout the entire program and should take no more than half of these electives from any one of the three categories listed below:

a. Literature (including foreign literature either in the original language or in translation) and philosophy.
b. Anthropology, economics, history, political science, psychology, and sociology.
c. Fine arts and music (critical or historical).

*A maximum of 3 hours of credit will be allowed for such courses as public speaking, elementary foreign languages, accounting, and contracts.

3. C.S. 120 (Introduction to Programming I) and C.S. 123 (Introduction to Programming II for Engineering Students). These courses are taught in Pascal and may be repetition of material covered in other courses. If this seems to be the case, the student should request a waiver of the course in question from the student's advisor before or during the first week of the semester in which the student is registered for the course.

4. Students who have been admitted to the the Mathematics Honors Program will substitute A.Math 237 and Math 315 for A.Math 235 and A. Math 236, respectively.

5. The basic science course should be selected from E.C.E. 302, (Statistical Thermodynamics), Engr. 301 (Thermodynamics), Phys. 321 (Analytical Mechanics), C.E. 313 (Applied Mechanics).

6. E.C.E. electives for the E.E. degree include a minimum of four of the following five courses: E.C.E. 232 (Semiconductor Devices), E.C.E. 314 (Electromagnetic Fields I), E.C.E. 317 (Energy Conversion I, with laboratory), E.C.E. 331 (Linear Systems), E.C.E. 470 (Switching and Finite Automata).

7. E.C.E. electives for the E.E./C.S. program include a minimum of three of the following four courses: E.C.E. 232 (Semiconductor

[1]Election will be made during the first semester of the junior year.

Devices), E.C.E. 314 (Electromagnetic Fields I), E.C.E. 317 (Energy Conversion I with laboratory), E.C.E. 331 (Linear Systems).

8. The senior year technical electives provide for breadth in the program and usually include courses in electrical engineering, mathematics, and physics at the 300, 400 or 500 levels. A minimum grade point average of 2.85 is required for enrollment in any 500-level course, and courses above this level are open to qualified graduate students only. The approval of the student's undergraduate advisor is required for all technical electives.

Electrical engineering technical electives are designated in the following nine subject areas: Bioengineering (B), Communications (C), Computer Systems (CS), Digital (D), Electronics (E), Fields (F), Materials (M), Power (P), and Systems (S). To insure a minimum breadth of studies, each senior's program must include at least 9 semester hours of electrical engineering theory courses distributed in three different areas and minimum of three electrical engineering laboratory courses in three different areas. Students enrolled in the computer science option must elect one theory course and one laboratory from the Digital (D) or Computer Systems (CS) areas. E.C.E. 466 may be used to meet the distribution requirement for a laboratory course.

Only one independent study course (E.C.E. 940) may be applied toward the laboratory distribution requirement. Courses at the 400 and 500 level without a letter designation may not be used to satisfy the distribution requirement.

Technical electives beyond those used to satisfy the electrical engineering distribution requirements may include upper division courses in other engineering disciplines, mathematics, physics, and science. Courses in other colleges require prior written approval of the student's advisor and should be related to the student's overall program.

GRADUATE DEGREE PROGRAMS

Electrical engineering graduate programs leading to M.S. and Ph.D. degrees cover the areas of biomedical engineering, materials and quantum electronics, information systems, energy conversion and systems, control theory, circuits and electronics, fields and propagation, VLSI/design automation, digital signal processing and computers. Close cooperation with the National Bureau of Standards and other organizations in the Boulder area enhances the graduate effort, and both teaching and research capabilities are strengthened by the addition of adjoint faculty members from these institutions.

Requirements for Advanced Degrees

An undergraduate grade point average of 3.0 or above is required for entrance into the graduate program. Information and application forms may be obtained by writing to the Director of Graduate Admissions, Department of Electrical and Computer Engineering, Campus Box 425, Boulder, Colorado, 80309. Qualified students in their senior year and within 18 hours of graduation may be admitted into the graduate program and apply graduate-level credits above the 128-semester-hour B.S. requirement toward an advanced degree. Students formally accepted into the graduate program will be assigned to program advisors.

Master's students are expected to include two semesters of graduate seminar (without credit) in their programs and to present theses under Plan I unless specifically exempted by the department.

All students accepted into the Ph.D. program must take the Ph.D. Preliminary Examination at the next administration. They are required to pass the examination in the areas of mathematics and their specialty from the following list:

Circuits (active, passive, models)
Communication theory
Computers
Control systems
Electrical and magnetic fields
Energy conversion
Physical and semiconductor electronics

The Doctor of Philosophy is the highest degree awarded by the Electrical and Computer Engineering Department. The usual requirements for admission include excellence in intellectual achievement, successful completion of an M.S. program (with thesis), and demonstration of research ability.

In addition to the regularly listed graduate level courses in this catalog, many special ones are offered in a variety of subject areas such as the following:

Signal processing for remote probing
Computer memory and storage
Nonlinear optics
Crystal physics
Foundations of plasma physics
Interaction of light and sound
Lightning transients
Conduction in metals at low temperatures
Pulse response of transmission lines
Error correcting codes
Problems in pattern recognition
Decision theory
Semiconductor diode lasers
Computerized design of networks

The department is involved in an interdisciplinary study leading to the M.S. degree in Telecommunications, details of which are included under Telecommunications in this bulletin.

ENGINEERING PHYSICS

Office in Duane Building E-032
Professor Neil Ashby, Chairman

BACHELOR'S DEGREE REQUIREMENTS

The engineering physics curriculum gives students a thorough foundation in the physical principles underlying most of engineering. The large number of engineering electives which may be incorporated in the curriculum make it possible for the student to prepare for professional work or graduate school in a wide variety of fields. Because the program is particularly flexible, students should be aware that proper preparation for their professional fields will require careful selection of their engineering electives. Students are urged to prepare, in consultation with a departmental advisor, a coherent plan of courses to meet their professional objectives.

During the freshman and sophomore years, the student must attain a thorough training in mathematics and a grounding in fundamental methods and principles of physical sciences.

During the junior and senior years the work in physics is extended to provide a comprehensive knowledge of the various branches of physics such as nuclear physics, atomic physics, electronics, thermodynamics, mechanics, electricity, and magnetism. Individual initiative and resourcefulness are stressed.

For purposes of federal Civil Service requirements this degree is an engineering degree from an accredited college of engineering. Students who plan to become registered professional engineers should check the requirements for registration in their state before choosing their engineering electives.

It is recommended that students preparing for graduate school also prepare for its foreign language requirement as part of their undergraduate curriculum.

In order to earn a bachelor's degree in engineering physics from the Department of Physics, a student must, in addition to any other requirements, successfully complete 30 semester hours of courses on the Boulder Campus, including 12 semester hours in upper division physics courses.

Applied Physics Option

It is also possible to earn the degree Bachelor of Science (Engineering Physics) with an applied physics option. This option differs from the regular engineering physics degree primarily in that fewer advanced theoretical physics courses are required and in their place a selection of applied science courses is required. This option should not be selected by students intending to pursue graduate study in physics, but it is appropriate for students intending to pursue graduate work or employment in related fields such as geophysics, environmental science, oceanography, nuclear engineering, medicine, and law. Students intending to pursue this option should consult an advisor by the beginning of their junior year regarding the electives which they wish to propose. The 24 hours of electives in pure or applied natural science must be approved by the engineering physics advising committee. The committee will consider the proposed courses relative to the student's stated educational and/or professional objectives. *At least 30 semester hours of credit* must be earned *after* the student's proposed program is approved. Because of recent changes in the graduation requirements in engineering physics, it is felt that the objectives of the Applied Physics Option can be achieved within the framework of the regular engineering physics degree. Accordingly, no new applications for the Applied Physics Option will be accepted after September 1, 1986.

Curriculum for B.S. (E.Phys.) (Note 1)

FRESHMAN YEAR

Fall Semester	*Semester Hours*
A.Math. 135. Calculus for Engineers I	4
Engr. 101. Engineering Drawing I	2
Social-humanistic electives (Note 2)	6
E.Phys. 111. General Physics	4
	16

Spring Semester

A.Math. 136. Calculus for Engineers II	4
Social-humanistic electives (Note 2)	3
E.Phys. 112. General Physics	4
E.Phys. 114. Experimental Physics (Note 3)	1
C.S. 120. Introduction to Programming I	3
	15

SOPHOMORE YEAR

Fall Semester

A.Math. 235. Calculus for Engineers III	4
Elective (Note 4)	3
E.Phys. 213. General Physics (Note 3)	3
E.Phys. 215. Experimental Physics	1
Chem. 103. General Chemistry (Note 5)	5
	16

Spring Semester

A.Math. 236. Introduction to Linear Algebra and Differential Equations	3
Chem. 106. General Chemistry (Note 5)	5
Social-humanistic elective (Note 2)	3
E.Phys. 214. Methods of Theoretical Physics (Note 3)	3
Elective (Note 4)	3
	17

JUNIOR YEAR

Fall Semester

Upper division mathematics elective	3
E.Phys. 317. Junior Laboratory	2
E.Phys. 321. Analytical Mechanics	3
E.Phys. 331. Principles of Electricity and Magnetism I	3
Social-Humanistic elective (Note 2)	3
Elective (Note 4)	2
	16

Spring Semester

E.Phys. 318. Junior Laboratory	2
E.Phys. 322. Analytical Mechanics and Quantum Mechanics	3
E.Phys. 332. Principles of Electricity and Magnetism II	3
E.Phys. 341. Thermodynamics and Statistical Mechanics	3
Elective (Note 4)	5
	16

SENIOR YEAR

Fall Semester

E.C.E. 403. Elements of Electronics	2
E.C.E. 443. Elements of Electronics Laboratory	1
E.Phys. 491. Atomic and Nuclear Physics	3
E.Phys. 495. Senior Laboratory	2
Electives (Note 4)	5
Social-humanistic elective (Note 2)	3
	16

Spring Semester

E.Phys. 492. Atomic and Nuclear Physics	3
E.Phys. 496. Senior Laboratory (Note 6)	2
Electives (Note 4)	11
	16

Curriculum for B.S. (E.Phys.)—Applied Physics Option

The first five semesters are identical to those of the regular engineering physics curriculum.

JUNIOR YEAR

Spring Semester	*Semester Hours*
E.Phys. 322. Classical Mechanics and Quantum Mechanics	3
E.Phys. 332. Principles of Electricity and Magnetism	3
Upper Division Thermodynamics elective	3
Electives (Note 7)	7
	16

SENIOR YEAR

Fall Semester

E.C.E. 403. Elements of Electronics	2
E.C.E. 443. Elements of Electronics Laboratory	1
Electives (Note 7)	13
	16

Spring Semester

Social-humanistic elective (Note 2)	3
Electives (Note 7)	13
	16

Minimum total hours for degree 128

E.Phys. Curricula Notes

1. *The minimum total number of hours* for the degree is 128. Approved ROTC courses may be substituted for a maximum of 6 hours of electives.
2. A total of 18 semester hours of social-humanistic electives is required from the following three areas, with not more than 9 hours from any one area: (a) literature (English or foreign language) and philosophy; (b) anthropology, history, economics, political science, psychology, and sociology; (c) fine arts and music (critical or historical courses only).
3. E.Phys. 116 and E.Phys. 217 (General Physics-Honors) can replace E.Phys. 112, 213, and 214 for students selected by the department. (If E.Phys. 116 is elected, E.Phys. 217 must be completed also.)
4. Required and elective engineering courses excluding mathematics, physics, and computer science must total 22 semester hours.
5. Chem. 107-108 may replace Chem. 103-106.
6. *Or* Phys. 455, or 3-hour physics elective.
7. The elective courses are divided into three exclusive groups. (1) physics electives—there must be 5 hours from among E.Phys. 318, 341, 446, 451, 455, 461, 462, 491, 492, 495, 496, 500, 501, 503, 504, and 585; (2) applied natural science electives (24 semester hours, minimum)—these two groups must include 4 hours of upper division laboratory courses and sufficient engineering courses so that the total of engineering courses (excluding mathematics and physics) is at least 22 semester hours; (3) other courses.

MECHANICAL ENGINEERING

Office in Engineering Center OT 4-6

BACHELOR'S DEGREE REQUIREMENTS

The mechanical engineering curriculum begins with a strong emphasis on mathematics, physics, and chemistry. It continues with a concentration in engineering sciences such as solid and fluid mechanics; thermodynamics, heat and mass transport; materials; and systems analysis and control. It concludes with laboratory and design courses which demonstrate the ways in which scientific knowledge is applied in the design and development of useful devices and processes.

The mechanical engineering program may be roughly subdivided into two-year groupings. In the first two years, the program emphasizes the fundamentals of those engineering sciences that are essential for an understanding of most branches of professional engineering. Because broad and varied demands are imposed on the mechanical engineer, the department provides two plans—A and B—for the curriculum leading to the degree Bachelor of Science in mechanical engineering. The plans are designed to accommodate the professional objectives of the individual student.

Plan A specifies a typical mechanical engineering curriculum and is intended for students who wish to obtain a broad, general education in mechanical engineering without an emphasis on any of the specific professional aspects.

Plan B is designed for students who know what they intend to do upon graduation. It allows the student to pursue any course plan that meets a valid professional objective and has been approved by the undergraduate advisor. Under Plan B, the specific requirements of the program are determined after a detailed conference with the advisor. In the course of this conference, the professional objectives of the individual student are studied in detail, and a specific plan (with a minimum of 128 credit hours) is designed to meet these objectives. With liberal use of courses throughout the University, the following may be considered typical among the professional concentrations which can be achieved:

Thermodynamics	Industrial engineering
Heat transfer	Design
Fluid mechanics	Dynamics and controls
Solid mechanics	Materials science
Electromechanical systems	Premedicine

Curriculum for B.S. (M.E.)

FRESHMAN YEAR

Fall Semester — *Semester Hours*

Literature	3
A.Math. 135. Calculus for Engineers I	4
C.S. 120. Introduction to Programming I	3
M.E. 130. Introduction to Mechanical Engineering	2
Chem. 103. General Chemistry	5
	17

Spring Semester

Literature	3
E.Phys. 111. General Physics	4
A.Math. 136. Calculus for Engineers II	4
Engr. 101. Engineering Drawing I	2
M.E. 131. Manufacturing Processes	3
	16

SOPHOMORE YEAR

Fall Semester

M.E. 281. Mechanics I	3
M.E. 203. Introduction to Computer-Aided Design	3
E.Phys. 112. General Physics	4
E.Phys. 114. Experimental Physics	1
A.Math. 235. Calculus for Engineers III	4
	15

Spring Semester

M.E. 282. Mechanics II	3
E.Phys. 213. General Physics	3
E.Phys. 215. Experimental Physics	1
A.Math. 236. Introduction to Linear Algebra and Differential Equations	3
M.E. 212. Engineering Thermodynamics I	3
Social-humanistic elective	3
	16

JUNIOR YEAR

Fall Semester

E.C.E. 303. Electric Circuits	3
M.E. 314. Measurements I	2
M.E. 371. Systems Analysis I	3
M.E. 313. Engineering Thermodynamics II	3
M.E. 383. Mechanics III	3
Social-humanistic elective	3
	17

Spring Semester

M.E. 301. Introduction to Materials Science I	3
M.E. 316. Measurements II	2
M.E. 372. Systems Analysis II	3
M.E. 384. Mechanics IV	3
M.E. 385. Mechanics V	3
Social-humanistic elective	3
	17

SENIOR YEAR

Fall Semester

M.E. 362. Heat Transfer	3
M.E. 401. Mechanical Behavior of Materials II	3
M.E. 414. Mechanical Engineering Design I	3
I.E. 397. Engineering Economy	3
Technical Elective	3
	15

Spring Semester

M.E. 416. Mechanical Engineering Design II	3
M.E. 442. Mechanical Engineering Laboratory	3
Technical electives	6
Social-humanistic elective	3
	15

Minimum total hours for degree 128

M.E. Curricula Notes

1. If applicable, 3 hours of ROTC will count toward the 128 required hours.
2. First year foreign language will not count towards the 128 required hours.

GRADUATE DEGREE PROGRAMS

Graduate Study in Mechanical Engineering

The department offers graduate programs leading to the M.S. and Ph.D. degrees in mechanical engineering to students whose goal is teaching, research, or advanced development in the broad disciplines of solid mechanics, fluid mechanics, heat transfer, thermodynamics, mechanical and thermal design, and engineering economy and management. These areas of study provide the technical background necessary to deal with a wide variety of contemporary mechanical engineering problems. Typical examples include combustion-generated pollution, fire safety, explosions, use of geothermal energy sources, efficient energy management of thermal systems, static and dynamic behavior of high strength composites, on-line ultrasonic inspection, mechanical properties of polymers, selected topics in bioengineering, and sensing systems for robots.

At the M.S. degree level students following Plan I (with thesis) are required to take 9 hours of core courses which include engineering analysis and a selection from thermodynamics, mechanics, design, and mechanisms. Students following Plan II (all formal course work) are required to take 15 hours of core courses in thermodynamics, continuum mechanics, dynamics, and engineering mathematics. The remainder of the program is developed by the student in consultation with the advisor.

For admission to Ph.D. candidacy the student must pass a comprehensive examination to demonstrate a general competence in mechanical engineering at an advanced level. In addition, second-year college-level reading proficiency must be demonstrated in scientific French, German, Russian, or other foreign language approved by the department upon petition by the student.

Graduate Study in Mechanics

Graduate programs leading to the M.S. and Ph.D. degrees in mechanics that emphasize the mechanical sciences of solids and fluids and thermal science are available through the Department of Mechanical Engineering. For students working in mechanics, a strong cognate program in mathematics is imperative. Specific degree plans emphasize courses of both a fundamental character and a research level treatment.

Requirements for the M.S. and Ph.D. degrees in mechanics are similar to those in mechanical engineering, with the additional requirement that students following Plan II (all formal course work) at the M.S. level must take 6 hours in advanced calculus, ordinary and differential equations, complex variables, boundary value problems, or their equivalent.

INDUSTRIAL ENGINEERING OPTION IN MECHANICAL ENGINEERING

Office in Engineering Center OT 4-7
Mechanical Engineering Department

BACHELOR'S DEGREE REQUIREMENTS

Industrial engineering concerns itself primarily with problems which involve effectiveness and efficiency in the use of money, materials, time, energy, and human effort. The ever-increasing demands on each of these resources, coupled with diminishing supplies (particularly of energy and materials), means that more must be done with fewer resources. A substantial increase in industrial productivity has become one of the top priorities in the U.S. economy.

Industrial engineering employs the principles and methods of engineering analysis and design, together with the knowledge and skills of the physical and social sciences. Complex problems in manufacturing, health systems, transportation, and similar operational areas require an integrated systems approach, utilizing mathematics, statistics, simulation, computer science, and operations research techniques to maximize the productive utilization of all resources.

Earlier industrial engineers were frequently called efficiency experts. More recent identification has in-

cluded the terms systems engineers and operations researchers. The current need is for what might be called a productivity engineer. Productivity may be defined as the process of providing in the most efficient manner any end result that the public demands. All industrial nations compete for increasingly scarce resources for manufacturing as well as for markets for their products. High rates of productivity are necessary to minimize manufacturing costs and maximize a country's competitive position. Significantly, the rates of productivity growth in the United States since World War II have been the lowest of those among the eleven major industrial nations.

In a very real sense, the industrial engineer has the basic responsibilities of providing leadership in generating alternative courses of action to reduce costs and increase productivity through both technological changes and improvement in human performance and of providing leadership in evaluating technically and economically such alternatives and in the implementation of the desired alternatives.

Such responsibilities have technical, social, economic, and political components, and there is an increasing need to assess the impacts of various courses of action upon the individual and society.

Curriculum for I.E. Option B.S. (M.E.)

Freshman year and sophomore year are the same as for the B.S. (M.E.)

JUNIOR YEAR

Fall Semester	*Semester Hours*
Social-humanistic elective	3
I.E. 351. Engineering Statistics	3
M.E. 301. Introduction to Materials Science I	3
M.E. 313. Engineering Thermodynamics II	3
M.E. 314. Measurements I	2
M.E. 383. Mechanics III	3
	17

Spring Semester

I.E. 331. Industrial Cost Analysis	3
I.E. 397. Engineering Economics	3
E.E. 343. Electrical Laboratory I	1
M.E. 384. Mechanics IV	3
E.E. 303. Circuits I	3
I.E. 303. Computers in Industrial Engineering	3
	16

SENIOR YEAR

Fall Semester

I.E 465. Human Factors	3
M.E. 414. Mechanical Engineering Design I	3
E.E. 403. Elements of Electronics	2
E.C.E. 443. Elements of Electronics Laboratory	1
Social-humanistic elective	6
	15

Spring Semester

I.E. 431. Production Automation Systems	3
I.E. 441. Introduction to Operations Research	3
I.E. 451. Engineering Management	3
I.E. 460. Senior Project	4
I.E. Technical Elective	3
	16

Minimum total hours for degree 128

M.E. Curricula Notes

1. If applicable three hours of ROTC will count towards the 128 hours.

2. First year foreign languages will not count towards the 128 required hours.

One person, who must be a member of the graduate faculty, shall come from the University at large. More than one dissenting vote from the Dissertation Committee will disqualify the candidate in the final examination.

Arrangements for the final examination must be made in the Office of Graduate Studies at least two weeks in advance. The examination must be scheduled no later than two weeks before the date on which the degree is to be conferred. The student must be registered at the time he attempts the final examination.

Time Limit. All work for the degree must be completed within seven years after the student is admitted to the Graduate School for the D.B.A. program. If a student fails to complete all requirements for the degree within four years of the date on which the preliminary comprehensive examination was passed, a second examination similar in content to the first will be required before the candidate may take the final comprehensive examination. If this second examination is failed, it may be attempted once more after a period of time determined by the examining board.

Foreign Language. There is no foreign language requirement for the Doctor of Business Administration degree.

Graduate School

INFORMATION ABOUT THE SCHOOL

Bruce R. Ekstrand, Dean of the Graduate School, Boulder
Lawrence Meskin, Acting Dean of the Graduate School, Health Sciences Center
Linda Dixon, Acting Dean of the Graduate School, Denver
Joan Fairchild, Acting Dean of the Graduate School, Colorado Springs

History

Graduate work at the University of Colorado began on a small scale in 1892. Following some years of development, the present Graduate School was organized in 1909 with a separate faculty. The Graduate School is administered by a dean, who also serves as the Vice President for Academic Affairs, in conjunction with the Executive Committee appointed by the president of the University and governed by the rules of the Graduate School. In addition, there is a dean of the Graduate School in residence on each of the four campuses of the University.

Degrees Offered

The Graduate School of the University of Colorado offers instruction leading to the following advanced degrees:

Doctor of Philosophy (Ph.D.)
Doctor of Business Administration (D.B.A.)
Doctor of Education (Ed.D.)
Doctor of Musical Arts (D.Mus.A.)
Specialist in Education (Ed.S.)
Master of Arts (M.A.)
Master of Science (M.S.)
Master of Basic Science (M.B.S.)
Master of Engineering (M.E.)
Master of Fine Arts (M.F.A.)
Master of Humanities (Denver)
Master of Music (M.Mus.)
Master of Music Education (M.Mus.Ed.)
Master of Social Science (Denver)

The Ph.D. can be earned in the following fields:

Aerospace engineering sciences
Anatomy[1]
Anthropology
Biology
Applied mathematics
Astrophysical, planetary and atmospheric sciences
Astrophysics
Biochemistry[1]
Biometrics[1]
Biophysics and genetics[1]
Chemical engineering
Chemical physics
Chemistry
Civil engineering
Classics
Communication disorders and speech science
Comparative literature
Computer science
Economics
Education
Electrical engineering
English
French
Geography
Geology
Geophysics
History
Linguistics
Mathematical physics
Mathematics
Mechanical engineering
Mechanics
Microbiology and immunology[1]
Music education
Musicology
Nursing[1]
Pathology[1]
Pharmacology[1]
Pharmaceutical sciences
Philosophy
Physics
Physiology[1]
Political science
Psychology
Sociology
Spanish
Theatre

The M.A. can be earned in the following fields:

Anthropology
Art education
Art history
Biology
Classics
Communication disorders and speech science
Communication and theatre[2]
Comparative literature
Dance
Economics
Education
English language
English literature
French
General psychology[3]
Geography
German
History
Journalism
Linguistics
Mathematics
Philosophy
Political science
Psychology
Religious studies
Russian
Sociology
Spanish
Theatre

The M.S. can be earned in the following fields:

Aerospace engineering sciences
Anatomy[1]
Anesthesiology[1]
Applied mathematics
Applied physics
Astrophysical, planetary and atmospheric sciences
Biochemistry[1]
Biometrics[1]
Biophysics and genetics[1]
Business: accounting
Business: finance
Business: management and organization
Business: management science
Business: marketing
Chemical engineering
Chemistry
Child health associate[1]
Civil engineering
Computer science
Electrical engineering
Environmental science[2]
Geography
Geology
Health administration[2]

[1]Departments offering degrees in these fields are located at the Health Sciences Center in Denver.
[2]Offered only at the University of Colorado, Denver.
[3]Offered only at the University of Colorado, Colorado Springs.

Mechanical engineering	Physical education
Mechanics	Physical therapy[1]
Medicine[1]	Physics
Microbiology and immunology[1]	Physiology[1]
Nursing	Preventive medicine[1]
Pathology[1]	Psychiatry[1]
Pediatrics[1]	Radiology[1]
Pharmaceutical sciences	Social science[1]
Pharmacology[1]	Telecommunications

Research Support at the University of Colorado

The University of Colorado takes an active part in research in a wide variety of fields.

Combined research and related instructional programs sponsored within the University represent annual expenditures amounting to over $80 million. Of this total, the expenditures on the Boulder, Denver, and Colorado Springs campuses are now approximately $40 million per year. The sponsored research, clinical, and instructional program of the Health Sciences Center in Denver totals more than $40 million annually. The principal sources of these funds for research and training contracts and grants are various agencies of the federal government. The University of Colorado's research activity is also supported by appropriations from the state of Colorado, private foundations, and private donors.

The Institute of Arctic and Alpine Research (INSTAAR) is an interdisciplinary research institute of the Graduate School of the University of Colorado which emphasizes the environmental sciences (biology, geography, and geology), especially as they pertain to high latitudes and high altitudes and to cold environments. INSTAAR faculty are appointed jointly in the institute and in the relevant academic departments, usually in the College of Arts and Sciences. Courses taught include Arctic and Alpine Environments, Data Processing in the Earth Sciences, Advanced Geomorphology, History of Biological Communities, Advanced Palynology, Quaternary Stratigraphy, Techniques in Quaternary Micropaleontology, Mountain Geomorphology, Morphology and Genesis of Soils, Techniques in Geoecology, Quantitative Plant Ecology, Mountain Climatology, and Independent Study. Not all courses are offered every year.

INSTAAR'S main headquarters are on the East Campus of the University. The facility includes a lecture room; a reading room; well-equipped geomorphology, sedimentology, palynology, plant and animal ecology, and amino-acid-dating laboratories; staff, faculty, and graduate student offices; and the editorial office of *Arctic and Alpine Research,* a quarterly journal published by the institute.

The Mountain Research Station operated by INSTAAR is located at 2,925 m (9,600 feet) in the Front Range of the Colorado Rocky Mountains, 40 km (25 miles) west of Boulder. The Mountain Research Station is a complex of buildings including summer and winter living quarters; washhouse; dining room; meeting room; Alpine Laboratory with offices, laboratories and library; and a warehouse. Weather-observing stations have been operated since 1952 at four elevations between 2,200 m and 3,743 m. Solar radiation and near-surface ground-temperature measurements, together with the standard climatic parameters, form a data bank vital to many branches of field research. Each year several summer field courses are held at the Mountain Research Station.

The Institute for Behavioral Genetics is an organized research unit whose mission is to conduct and promote research on the genetic bases of individual differences in behavior and to conduct research training in this interdisciplinary area. This rapidly developing field brings to bear the perspectives of biochemical genetics, cytogenetics, developmental genetics, evolutionary genetics, molecular genetics, pharmacogenetics, and quantitative genetics upon behavioral research. Facilities are available for research on a variety of organisms, including humans and laboratory mice. Institute faculty currently are applying the concepts and tools of behavioral genetics to such diverse areas as alcoholism, cognitive development, drug addiction, learning disabilities, neurological diseases, personality, and psychopathology.

The Institute of Behavioral Science is an interdisciplinary research organization serving faculty and graduate students in the behavioral sciences. Its principal functions are to conduct and sponsor research programs involving two or more of the behavioral sciences and related fields; to provide research facilities, equipment, and administrative services for participating faculty; to facilitate graduate research training; and to disseminate information about its activities and findings to scientific groups and institutions.

The institute conducts four research programs which constitute its principal administrative units: Research Program on Problem Behavior, Research Program on Population Processes, Research Program on Environment and Behavior, and Research Program on Political and Economic Change. Included in IBS is the Social Science Data Analysis Center which provides general user assistance in social science research and statistical computing.

The Institute of Cognitive Science (ICS) was established to promote interdisciplinary research in the fields of psychology, education, linguistics, computer science, and other cognitive sciences. Its major current research programs are concerned with cognitive factors in linguistic comprehension, decision making, memory, problem solving, speech perception, mental skills, and artificial intelligence. These programs encompass the study of individual differences, development changes, and industrial and educational applications.

The Cooperative Institute for Research in Environmental Sciences (CIRES) is jointly sponsored by the University of Colorado and the National Oceanic and Atmospheric Administration with support from other public and private sources. CIRES consists of more than 200 faculty, students, and staff from several scientific disciplines. Graduate students in CIRES conduct multidisciplinary studies of atmospheric and environmental chemistry, atmospheric and climate dynamics, environmental biochemistry and geochemistry, solid

[1]Departments offering degrees in these fields are located at the Health Sciences Center in Denver.

earth geophysics, and other subjects. Current research programs in which graduate students are involved include measurement of constituents and reactions in the atmosphere, acid deposition, kinetics of reactions in the stratosphere and troposphere, gas and liquid chromatography, instrumentation and detectors, mass spectrometry, analytical chemistry, microcomputer interfaced instrumentation, surface science, separation science, metal complex chemistry, aerosol chemistry, laser chemistry, leaching of toxic wastes from mining, contemporary and paleo-climatology, air-sea interactions, ocean dynamics, ice nucleation, cryosphere studies, ice sheet modeling, earthquake prediction and earthquake physics, plate tectonics, seismic wave propagation, nuclear test discrimination, rock deformation and fracture, numerical hydrodynamics, dynamics of the atmospheric boundary layer, strains and tilts associated with earthtides and secular deformation, geodesy, geophysical inverse studies, and normal modes of vibrations of the earth.

Research performed includes theoretical studies, laboratory experimentation, and field investigations. Field studies are conducted along the Front Range and in the mountains of Colorado, in the Aleutian Islands, Hawaii, and elsewhere. Results of this fundamental research bear on such practical societal problems as the destruction of the earth's ozone shield by pollutants, acid rain and snow, the degradation of air and water quality, energy developments such as synfuels from oil shale, toxic waste treatment and disposal, weather and climate modification, frost damage, earthquake prediction, and enhancement of fossil fuel and geothermal energy production.

The work of the approximately 60 graduate students presently conducting studies in CIRES is supported by grants, contracts, and gifts from NOAA, NSF, USGS, DOE, AFOSR, CMA, ARO, NASA, EPA, and private companies. The departments presently represented in CIRES are astrophysical, planetary, and atmospheric science; chemistry; chemical engineering; geography; geological sciences; electrical engineering; mechanical engineering; and physics. The institute serves as a center for multidisciplinary collaboration of research workers from Boulder and institutions throughout the world. A visiting fellowship program enables scientists working in these fields to spend time at CIRES. A new Central Analytical Laboratory providing sophisticated analysis services, e.g., high resolution gas chromatography coupled with tandem high resolution mass spectrometry, to researchers throughout the University, has been established by CIRES.

The Joint Institute for Laboratory Astrophysics (JILA) was established in 1962 by an agreement between the University and the National Bureau of Standards. Located in the Duane Physics complex on the Boulder Campus, the institute provides facilities for advanced research and graduate training in a number of areas, in particular of atomic and molecular physics and astrophysics. These areas include both theoretical and experimental studies of atomic interactions, spectroscopy and line broadening, chemical physics, laser physics and laser spectroscopy, precision measurements, new geophysical measurement techniques, stellar atmospheres and radiative transfer, stellar interiors, solar physics, binary X-ray sources, and the interstellar medium and galactic astronomy. Senior scientific staff are associated with the Quantum Physics and the Time and Frequency divisions of the National Bureau of Standards, and with the University departments of Physics; Chemistry; and Astrophysical, Planetary, and Atmospheric Sciences. A brochure giving more detailed information is available on request from the institute.

The Laboratory for Atmospheric and Space Physics (LASP) is an established center for research in terrestrial and planetary atmospheres, solar physics, and space astronomy. A leader in ultraviolet spectroscopy, LASP is located on the Boulder Campus and involves students and faculty from the Departments of Astrophysical, Planetary, and Atmospheric Sciences and Physics in many experimental and theoretical research programs. Currently, it is operating the Solar Mesosphere Explorer satellite from an innovative control center in Boulder. The satellite was launched in October 1981; its payload of ultraviolet, visible, and infrared instruments was developed and built at LASP. The mission is studying the effects of minor gaseous species and variations in the sun's UV radiation on the earth's ozone layer. In addition to the satellite operations, LASP performs the scientific analysis and interpretation of the data. The laboratory will soon begin construction of a solar-monitoring instrument for NASA's forthcoming Upper Atmosphere Research Satellite. LASP has experiments on two current NASA spacecraft: on the Voyager mission a photopolarimeter is studying the atmospheres of Jupiter, Saturn, and Uranus; and the Pioneer Venus mission carries a programmable ultraviolet spectrometer which is examining the Venusian atmosphere and the planet's cloud tops. An ultraviolet spectrometer experiment is currently being developed at LASP for the Galileo mission to Jupiter in 1986. LASP has developed a unique data handling system for use with these space experiments as well as with earlier experiments such as the Mariner 9 Mars orbiter and the Orbiting Solar Observatory-8.

LASP is studying the application of its spacecraft operations and data management concepts to several NASA missions, including the Space Station. Laboratory experiments, such as a major program to develop sensitive, new photoelectric array detectors for ground-based and space astronomical observations, are also pursued on a continuing basis. LASP astrophysicists are involved in analyzing and interpreting data from other scientific satellites such as the High Energy Astrophysical Observatory, the International Ultraviolet Explorer, and Copernicus. They are also involved in developing state-of-the-art ultraviolet and x-ray instruments. Active sounding rocket programs complement the research in planetary atmospheres, solar astrophysics, and astronomy.

The Center for Applied Humanities attempts to demystify the humanities—and scholarship in general—by making the results of specialized research available and attractive to a wide audience of general readers. This is accomplished in three ways. First, all members of the center must be able to write clearly and gracefully. Second, all members of the center are published

scholars whose past work demonstrates their ability to make difficult concepts accessible to any group of intelligent readers without misrepresenting those concepts. Third, all members undertake research projects of potentially broad application and of potential interest to the general public. The center is especially interested in bringing the methods of humanistic inquiry to bear on topics in law, the arts, medicine, politics, and public literacy.

The Center for Economic Analysis formulates and conducts research projects in economics and related fields in order to further knowledge about the nature and behavior of economic variables, to develop and refine research methodology, and to provide decision makers in both the public and private sectors with data and techniques to improve the quality of their decision making. The center conducts research under contract and grant arrangements with governmental and private agencies. Economics graduate students participate as research assistants to gain professional research experience and to supplement their formal education.

The Center for Educational Leadership Services in the School of Education provides assistance to the schools and educational agencies of Colorado and facilitation of faculty research work. Evaluation services, school surveys, assistance in curriculum revision, in-service education programs, educational planning, and a variety of consultant services are available through the center, which focuses the resources of the University on educational problems in the state.

The Center for Labor Education and Research (CLEAR) conducts labor education programs and research in various aspects of labor relations. Noncredit courses are offered for members of organized labor as the University's service to the labor community of Colorado. Graduate students may avail themselves of conferences with staff members and use of available library facilities. CLEAR staff members also teach credit courses in other schools and colleges as related to those fields.

The Center for Public Policy Research strives to integrate knowledge and practice. The research program applies the resources of various disciplines to specific problems in policy areas such as energy and natural resources, poverty, and growth. It also draws on practical experience in contributing to the development of the policy sciences. For these purposes, researchers maintain working relationships with public officials at all levels of government. The center is the editorial home of *Policy Sciences*, an international journal devoted to the improvement of policy, and supervises the public policy curriculum leading to an M. A. in political science.

The Engineering Research Center coordinates the research activities of the College of Engineering and Applied Science and ensures that these achieve educational as well as scientific value. Currently there are more than 100 research projects in progress, most of them funded from governmental agencies or industry. Many other projects replace conventional demonstration laboratory work for graduate students. Typical projects which have been ongoing for some time include extensive work with semiconductors, the development of new semiconductor materials and the fabrication of large-scale integrated circuits; the computer-aided design of very large scale integrated circuits (VLSI); laser research; bioengineering studies in various areas including the effects of microwaves on living tissue and sensory devices; and areas of energy-related research including coal gasification, power transmission, conservation, and CAD/CAM. There are elaborate new integrated circuits laboratories with class 1,000 clean rooms. Faculty and graduate students of the college have made important contributions to the fields of computer technology and programming, smog control, bioengineering, cryogenics, high speed rotating electrical machinery, solid state devices, electromagnetic propagation, analog and digital signal processing, microprocessors, tertiary oil recovery, water resources, materials science, fluid dynamics, and various aspects of aerospace engineering sciences.

Research in computer science ranges from automata theory and artificial intelligence to computer-aided programming, optimization, the analysis of algorithms, and numerical mathematics.

The International Economic Studies Center engages in cooperative instructional and research programs with foreign universities with a view to expanding the opportunities of students and faculty members interested in international developmental problems.

The Business Research Division, the research arm of the College of Business and Administration, was originally chartered as the Bureau of Business Research in 1915.

The research effort of the division falls into three general categories: state service, contract research, and faculty research. State service, the principal activity, focuses on assisting the Colorado business community by providing information and special studies on the state's economy and special business problems. Contract research is conducted for federal, state, and local agencies, as well as for private business firms and associations. Research includes regional and local economic base studies and studies on manufacturing, tourism, and other state industries.

The Business Research Division serves as a Census Summary Tape Processing Center in cooperation with the Colorado Division of Planning. The Business Research Division also maintains the Colorado Business/Economic Data Bank which contains state information on Colorado economic activities.

Publications of the division include the *Colorado Business Review,* the *Directory of Colorado Manufacturers,* the *Journal of Travel Research, Colorado County and City Retail Sales, Colorado Ski and Winter Recreation Statistics,* and numerous special interest publications.

The Economics Institute has over 25 years of experience in training and orientation for foreign students entering graduate programs in economics, agricultural economics, and management-related fields at universities throughout the world that use English as the language of instruction. The institute engages in research, publications, and service activities. Course offerings include English, mathematics, statistics, economic theory, accounting, finance, management and or-

ganization, management science and information systems, research and teaching methods, as well as a number of seminars and other special courses focused around the institute's lecture series. The program is organized in quarter and half-quarter (five-week) terms. Participants may be admitted to up to a year of work at the institute, depending on beginning proficiency in English. The institute also provides a variety of short-term training opportunities for foreign professionals as well as a University Placement Assistance Service. University of Colorado credit is available for several institute course offerings, and its courses are open to local students by special arrangement. The institute is sponsored by the American Economic Association in cooperation with the American Agricultural Economic Association, the Institute of International Education, and the University of Colorado.

Laboratories and Special Equipment

Laboratories, special classrooms, and specialized equipment are essential to graduate training and research. Some of the facilities at the University of Colorado are described in the following paragraphs.

Aerospace engineering sciences laboratories have the following facilities for instruction and research: three low-turbulence wind tunnels and several hotwire anemometer sets for turbulence, acoustic, and unsteady aerodynamic research; a laboratory for the study of the hydrodynamics of superfluid helium and geophysical fluid dynamical modeling; bioengineering laboratories for studies in cardiac physiology, neurophysiology, and neurochemistry; laser doppler anemometers for unsteady aerodynamics and aeroacoustics research; and apparatus for studying plasma turbulence.

The Astrophysical, Planetary, and Atmospheric Sciences Department emphasizes studies of the sun, atmospheres of the earth and other planets, theoretical and observational astrophysics, astronomy, geophysical and astrophysical fluid dynamics, aeronomy, space physics, hydrodynamics, plasma physics (including controlled thermonuclear fusion), radiative transfer, atmospheric circulations, and the earth's magnetic field.

The department operates the Sommers-Bausch Observatory, laboratories in experimental fluid dynamics and plasma physics, and makes extensive use of the Fiske Planetarium on the campus. Also used are observational facilities of the Sacramento Peak Observatory at Sunspot, New Mexico; the Kitt Peak National Observatory, Tucson, Arizona; the National Radio Astronomy Observatory, Green Bank, West Virginia, the Very Large Array (VLA) in New Mexico, and many NASA astronomical and planetary satellites. A considerable part of the teaching and research is in collaboration with the National Center for Atmospheric Research (including the High Altitude Observatory), the Laboratory for Atmospheric and Space Physics, National Bureau of Standards, Joint Institute for Laboratory Astrophysics, National Oceanic and Atmospheric Administration (e.g., Space Environment Laboratory, Aeronomy Laboratory), Cooperative Institute for Research in Environmental Sciences, and Institute for Telecommunication Sciences in Boulder.

Chemical engineering research facilities are extensive and modern. Many of the research laboratories are interfaced to the department's laboratory computer system, which includes a central Eclipse S/130 minicomputer. This system is capable of multiprogramming and multitasking. Also, a number of stand-alone microcomputer systems are interfaced to experiments.

Studies in heterogeneous catalysis, kinetics, and surface science use the four ultrahigh vacuum systems located in the chemical engineering laboratories. These systems contain Auger spectrometers, an X-ray photoelectron spectrometer (ESCA), a secondary ion mass spectrometer, two low-energy electron diffraction systems, three mass spectrometers, high resolution electron energy loss spectrometry, and two transfer mechanisms that interface atmospheric pressure chambers to the ultrahigh vacuum systems. The extensive surface analysis facilities at the Solar Energy Research Institute have also been used. Heterogeneous catalysis experiments also use three gas chromatographs, a quadrupole mass spectrometer, a chemisorption apparatus, and several flow systems.

Process control studies make extensive use of the department's real-time computer systems and studies are carried out on a variety of experimental units. A 12-foot-high fluidized bed with high speed radiation densitometer and pressure transducers is used. In addition, a distillation column, packed-bed catalytic reactor, and heat exchanger are used in process control studies.

There is a complete core flooding laboratory for work in enhanced oil recovery, leaching of oil shales, and modified in-situ oil shale studies. Spinning drop tensiometers, a dynamic Langmuir trough for adsorption/desorption of solutes, and a Wilhemy plate apparatus are used for surface phenomena studies. Oil shale leaching experiments simultaneously measure dynamic leaching and porous media properties. A porosimeter is used to determine pore size distributions. An electromechanical vibration system for particle dynamics studies is also available.

Membrane studies use a casting machine for fabrication of asymmetric membranes. Some studies on facilitated transport are also carried out at the National Bureau of Standards in Boulder. The Center for Chemical Engineering at the bureau is equipped with gas chromatographs, gas absorption, flow systems, and microcomputers for liquid membrane research.

The bioengineering laboratory is equipped for biophysical measurements. The equipment includes a variety of optical instruments, a phase contrast and polarizing microscope, a microscope video camera, a Cary spectrophotometer, a plant growth chamber, autoclave, and a sterile room.

A system for electrocarbonization of coal is presently being constructed. A sensitive calorimeter for phase changes and heats of solution in solids is also under construction. Water pollution control equipment includes biological reactors and pressure vessels. Extrusion and injection molding machines, an intensive mixer, and a rheometer are available for polymer studies.

The numerous scanning and transmission electron microscopes in the Biology Department are used in membrane, porous media, and surface studies. The regional NMR facility is also available.

A Hughes Infrared Thermal-Imaging Video apparatus is available for combustion studies. A new 300,000X Scanning Electron Microscope with energy dispersive X-ray analysis capability has recently been purchased. A Berghof high pressure (150 bar) flow loop is available for characterizing the permselectivity properties of polymeric membranes.

The Computer Science Department and Electrical and Computer Engineering Department have a network (Ethernet) of computers dedicated to research. There are three Vax Computers (two 11/780s and one 11/750), three Sun Workstations, a Pyramid P90x Mini-Computer, and an Iris Graphics Workstation on the network. These machines together with associated peripherals, sophisticated output devices, and terminals provide ready access for graduate students and faculty. A limited number of undergraduates also use the system for independent study projects.

The Department of Civil, Environmental, and Architectural Engineering research interests and facilities include extensive structural mechanics and geotechnical capabilities, hydraulics and water resources research laboratories with excellent facilities in water quality, environmental engineering, construction management, and building energy. The laboratories also include a 10 g-ton centrifuge for geotechnical and structural model studies, and numerous computing facilities.

Current research covers such topics as water and wastewater treatment, alpine hydrology, hydraulic research, land treatment, rapid infiltration, and activiated sludge processes. Cost prediction in construction, construction management, energy conservation in buildings, solar applications, lighting systems, and wind engineering are included. Also, offshore structures, centrifugal modeling, excavations, tunnelling, mine waste planning, and rock and soil mechanics are being studied. In structures, research includes focus on buckling, finite element techniques, reinforced concrete, earthquake behavior, masonry structures, and prestressed concrete.

The Electrical and Computer Engineering Department special equipment and facilities include a class 1,000 clean room facility for epitaxial growth and fabrication of microwave and optical devices; high-vacuum and vacuum deposition equipment for thin-films research; an integrated circuits laboratory; ion implantation equipment; crystal growing facilities; a modern systems laboratory; undergraduate laboratories in circuits, electronics, and energy conversion; a holography laboratory; numerous special purpose computers; mini and microprocessors and a computer laboratory; a roof-mounted antenna range; an anechoic chamber for studying propagation effects at microwave frequencies; a high-voltage laboratory for impulse tests to 1,000,000 volts; a special microscope for laser manipulation of microorganisms *in vivo*; a bio-microwave laboratory, and a growing array of other bioengineering research apparatus.

Mechanical engineering laboratories provide for experimental studies of thermal and mechanical systems. Typical areas of study include heat transfer, fluid and solid mechanics, mechanical behavior of materials, combustion, and prosthetic device performance.

The Combustion Laboratory contains instrumentation for gas analysis and gas dynamics measurements in chemically reacting flows. Included are systems for gas chromatography, laser-induced fluorescence spectroscopy, and laser doppler anemometry. The laboratory is also equipped for computer control of the instrumentation and automatic data reduction including graphics capabilities.

The Materials Laboratory contains instrumentation for the measurement of physical and mechanical properties relating to phase transition characterization, fatigue behavior, and viscoelasticity. Facilities include a Perkin Elmer differential scanning calorimeter, a Fatigue Dynamics strain-controlled fatigue tester with environmental chamber, and a Polymer Laboratories dynamic mechanical thermal analyzer. A Perkin Elmer thermal analysis data station (TADS) and Hewlett-Packard 9816S and 9826 laboratory computers provide capability for instrument control, data acquisition, and analysis.

The Fluid Mechanics Laboratory also utilizes modern instrumentation techniques. Some examples are hot-film and hot-wire anemometry and LDV for velocity measurement, conductivity probes for density measurement, high sensitivity piezometric gages for shock wave detection, capacitance-controlled oscillators for detection of small amplitude capillary waves, laser timing circuitry for Stokes drag measurements, Reticon optical arrays for monitoring instability waves in liquid jets, and laser-induced fluorescence for visualization studies.

Other specialized equipment includes Instron testing machines, a diffued light polariscope, a digital storage/dual beam oscilloscope, metallographs, and shaker tables.

Electrical and mechanical equipment is available for work in servo-mechanisms, modeling presses, and fabrication equipment for plastics technology; modular analog computer units; high-speed photographic equipment; a precision microscope for grain examination land film reading; time-sharing computer terminals; a servo-analyzer; an 8-track instrumentation tape recorder; and special equipment for bioengineering studies of skeletal systems and prosthetic devices.

The Nuclear Physics Laboratory, of the Department of Physics, conducts experimental and theoretical research in nuclear physics. The investigations center on problems of nuclear structure and nuclear reaction mechanisms, as well as applications of nuclear science to a number of other fields. In particular, problems of environmental and medical science have also been investigated. The laboratory is equipped with a modern cyclotron capable of accelerating protons to 27 MeV and helium three ions to 45 MeV. Also available are several computers and instrumentation for precision spectroscopy of charged particles, neutrons, and gamma rays. A magnetic spectrometer system, which permits very high resolution analysis of charged particle reac-

tion products, and a time-of-flight system for precision neutron studies are two somewhat unique features of the laboratory equipment. Graduate students and faculty of the laboratory participate also in medium energy experiments carried out at the Los Alamos Meson Physics Facility, at Tri-Universities Meson Physics Facility (TRIUMF) in Vancouver, B.C., and at the Indiana University Cyclotron Facility. Research assistantship support is available for graduate student research in both theoretical nuclear physics and medium energy physics.

The High Altitude Observatory is an internationally recognized center for the study of solar, interplanetary, and magnetospheric physics with emphasis on the interrelationships between these areas. Established in 1940, HAO now has its central laboratory and administrative offices in the National Center for Atmospheric Research (NCAR) building in south Boulder.

HAO is a part of NCAR, which is sponsored by the National Science Foundation. HAO's extensive research facilities are available to and are used by graduate students pursuing advanced studies in the Departments of Astrophysical, Planetary, and Atmospheric Sciences and Physics.

The Sommers-Bausch Observatory on the Boulder Campus is equipped with 18- and 24-inch Cassegrain telescopes with ancillary equipment for photographic, spectrographic, and photometric stellar observations. The facilities at Sommers-Bausch are used by the Department of Astrophysical, Planetary, and Atmospheric Sciences for undergraduate and graduate teaching and research. Open houses, for both students and the public, are generally held on Friday nights by reservation.

Facilities for Graduate Study on the Colorado Springs Campus

The University of Colorado at Colorado Springs is located in northeast Colorado Springs. The campus offers programs in the College of Business and Administration and the Graduate School of Business Administration, the School of Education, the College of Engineering and Applied Science, the College of Letters, Arts and Sciences, and the Graduate School of Public Affairs, as well as the Graduate School.

The library offers seating for over 500 users in a variety of configurations ranging from lounge areas to group study rooms. Also included is a microcomputer laboratory/classroom housing over 20 microcomputers, and 10 micros with hookups to the main frame. The holdings of the library total more than 175,000 volumes with a subscription list of over 1,200 titles. Photoreproduction and audiovisual services are available. There is a fully configured VAX 11/780 superminicomputer and a PDP 11/70 minicomputer providing instructional and research support. Most major application packages are available on these systems. In addition, access to the Boulder Cyber 720 is available.

The following programs at the master's level are available for completion through the Graduate School:

History (M.A.)
Computer science (M.S.)
Basic science (M.B.S.)
Political science (M.A.)
Psychology (M.A.)
Electrical engineering (M.S.)
Education (M.A.)
Special education (M.A.)
Applied mathematics (M.S.)
Sociology (M.A.)

A Master of Public Administration (M.P.A.) degree is offered through the Graduate School of Public Affairs, and the Master of Business Administration (M.B.A.) degree is offered through the Graduate School of Business Administration.

Further details may be obtained by contacting the individual departments on the Colorado Springs Campus.

Facilities for Graduate Study and Research on the Denver Campus

The University of Colorado at Denver is located at 1100 14th Street (14th and Arapahoe) in downtown Denver. The campus offers programs in the following schools and colleges:

College of Business and Administration and Graduate School of Business Administration
College of Design and Planning
School of Education
College of Engineering and Applied Science
College of Liberal Arts and Sciences
College of Music
Graduate School
Graduate School of Public Affairs

UCD is a partner in the Auraria Higher Education Center with the primary role of providing graduate, professional, and upper division education. The Auraria Library has over 560,000 volumes of books, microforms, and bound periodicals, in addition to over 1,700 current periodical and newspaper subscriptions. In addition, UCD students can draw on the holdings of the libraries of the other campuses. Good photoreproduction and media center services are also available.

The Denver Campus is making research contributions in many areas, with special emphasis upon programs with an urban direction. The Institute for Urban and Public Policy Research, the Center for Urban Transportation Studies, and the Center for Community Development and Design are examples of organizations that provide a multidisciplinary approach to the problems of the city.

The following graduate programs are available for completion through the Graduate School on the Denver Campus:

The Master of Arts (M.A.) in:

Anthropology
Biology
Communication and theatre
Economics
English
Geography
History
Mathematics
Computer science option
Political science
Psychology
Sociology

The Master of Education (M.Ed.) and the Master of Arts (M.A.) in:

Early childhood education
Educational psychology
Elementary education
Foundations, education
Guidance and counseling
Initial Certification Program (certification only or certification and M.A. in elementary or secondary education)
Library media
Reading
Secondary Education
Special education

The Master of Science (M.S.) in:

Accounting	Environmental science
Applied mathematics	Finance
Chemistry	Health administration
Civil engineering	Management and organization
Computer science[1]	Management science
Electrical engineering	Marketing
	Mechanical engineering

The Master of Basic Science (M.B.S.)
The Master of Engineering (M.E.)
The Master of Humanities (M.H.)
The Master of Social Science (M.S.S.)

Further details may be obtained by contacting the resident dean of the Graduate School, University of Colorado at Denver, 1100 14th Street, Denver, Colorado 80202, or by consulting the bulletin for the University of Colorado at Denver.

Students should contact the College of Business and Administration, the College of Design and Planning, and the Graduate School of Public Affairs for graduate work within their respective programs.

Facilities for Graduate Study and Research at the Health Sciences Center in Denver

The University's Health Sciences Center is located at 4200 East Ninth Avenue, Denver, on its own 32-acre campus. It includes the School of Medicine, the School of Nursing, the School of Dentistry, the Graduate School Division of the Health Sciences Center, and the clinical teaching facilities of the University Hospitals, John F. Kennedy Child Development Center, Children's Psychiatric Day Care Center, Diagnostic Service for Rheumatic and Congenital Heart Diseases, Newborn and Premature Center, and Children's Diagnostic Center for the evaluation of emotionally disturbed children.

Also on the Health Sciences Center Campus are the Florence R. Sabin Building for Research in Cellular Biology, the Denison Memorial Library, the Humphreys Postgraduate Center, and the Bonfils Tumor Clinic. Additional facilities on the Medical Campus include the Webb-Waring Lung Institute, Belle Bonfils Memorial Blood Bank, the Eleanor Roosevelt Institute for Cancer Research, and the Barbara Davis Children's Diabetes Center.

The Denison Memorial Library has a collection of over 179,128 bound volumes and a subscription list of 2,200 medical and scientific journals, American and foreign. There are photoreproduction facilities and 120 private study carrels.

The Health Sciences Center is making research contributions in such fields as ultrastructure of cells, molecular genetics, mechanisms of enzyme action, protein synthesis, physical chemistry of macromolecules, neurophysiology, viral structure and function, cell growth and differentiation, and immuno-chemical mechanisms, as well as in such areas of clinical investigation as transplantation of vital human organs, mental illness and retardation, allergies, viral and bacterial infections, heart disease, muscular dystrophy, cancer, emphysema, arthritis and rheumatism, and radiation effects.

The following graduate programs are available for completion through the Graduate School on the Health Sciences Center campus.

The Master of Science (M.S.) in:

Biometrics	Nursing
Biophysics and genetics (genetic counseling)	Physical therapy
Child health associate	Preventive medicine
	Radiology (medical physics)

The Doctor of Philosophy (Ph.D.) in:

Anatomy	Microbiology and immunology
Biochemistry	Nursing
Biometrics	Pathology
Biophysics and genetics	Pharmacology
Interdepartmental—human genetics	Physiology

Graduate Student Advisory Council (GSAC)

The Graduate Student Advisory Council (GSAC) represents virtually all graduate students on the Boulder campus of the University of Colorado. It is composed of graduate student representatives elected from 41 graduate disciplines that span most of the schools and colleges of the University. GSAC seeks to serve graduate students by participating in the University of Colorado Student Union (UCSU), acting as an effective liason between graduate students, the Graduate School, and individual departments, and by sponsoring special projects and workshops of specific concern to graduate students. To these ends GSAC advises and makes recommendations to the University administration through the dean of the Graduate School, the Executive Committee of the Graduate School, the Western Interstate Commission for Higher Education, and the graduate faculty concerning the quality of graduate education. GSAC is also concerned with the equitable treatment of graduate students with respect to appointments, support, and University services, as well as other matters which may affect the welfare and education of graduate students. Representatives from GSAC are voting members of the Executive Committee of the Graduate School and the Executive Council of UCSU. GSAC representatives serve on the University Program Review Panel (PRP) and on all Boulder Faculty Assembly Committees which include Budget, Academic Planning (CAPPS), Special Events, Financial Aid, Libraries, Discipline, and Minority Affairs.

Graduate Student Committee on Privilege (GSCP)

Grievances that concern graduate students and cannot be redressed through appropriate administrative channels should be directed to the GSCP, either through the Graduate Student Advisory Council (UMC 183E, 492-5068) or through the dean of the Graduate School (492-7401). The GSAP, a graduate student com-

[1] Offered as an option through mathematics and electrical engineering.

mittee, considers grievances involving graduate student rights and privileges, expedites grievance proceedings, and protects the grievant from any overt or covert discrimination or intimidation that may result from filing a complaint. The committee has been endorsed by the dean of the Graduate School, the Executive Committee of the Graduate School, and the graduate faculty.

FINANCIAL AID FOR GRADUATE STUDY

Financial Aid

Graduate students wishing to apply for long-term loans through the National Direct Student Loan Program and for part-time jobs through the College Work-Study Program should submit an Application for Financial Aid to the Office of Financial Aid by March 1.

Scholarships and Fellowships

The University of Colorado administers various forms of financial assistance for graduate students: fellowships, fellowships for protected-class individuals, traineeships, scholarships, research and teaching assistantships, and a number of awards from outside agencies.

The Graduate School offers three types of assistance: Colorado Doctoral Fellowships, Colorado Graduate Grants, and Chancellor's Doctoral Fellowships.

Colorado Doctoral Fellowships are awarded to entering and continuing regular degree doctoral students. These are awarded to entering students on the basis of academic promise, to continuing students on criteria of academic success. In order for fellowships to be renewed, students holding them must reapply each year to their departments. Special fellowships, traineeships, and scholarships are also available for study in certain departments. For those entering students intending to apply for fellowships, it is recommended that they take the Graduate Record Examination.

The Chancellor's Doctoral Fellowship Program was instituted in the academic year 1984-85 to recruit the most outstanding potential students for doctoral level study at the University of Colorado. The student receives a stipend of $12,000 and a full waiver of all tuition fees. To be considered for this award, a student must be an entering doctoral student and be nominated to the Graduate School by the department the student will attend.

Applications for fellowships and scholarships are due in the department before the announced departmental deadline.

The Colorado Graduate Grant Program is a program open to graduate students who are residents of the state of Colorado. The competition for these funds is based on need. Applications are available from the Office of Financial Aid.

For further details consult the University of Colorado brochure, *Fellowships, Scholarships, and Assistantships for Graduate Students, 1984-85.*

GRADUATE PART-TIME INSTRUCTORS AND TEACHING ASSISTANTS

Many departments employ graduate students as graduate part-time instructors (GPTI) or as teaching assistants. GPTIs are full-time, regular degree graduate students who have a master's degree or the equivalent. Teaching assistants are also full-time regular degree graduate students, but it is not necessary for them to have any previous experience. Students are compensated on the basis of the percentage of time that is worked. Tuition credits are also based on the student's percentage of time. Nonresident students employed as assistants are eligible for the nonresident tuition differential waiver for their first-year appointments only. Exceptions extending beyond the first year must be approved in advance by the respective dean.

RESEARCH ASSISTANTS

Research activities provide opportunities for graduate students to secure part-time work as research assistants in many departments. Students are compensated and receive tuition waivers based on the percentage of time of their appointment. General fund research assistantships are subject to the one-year rule on eligibility for waiver of the nonresident tuition differential. Research assistants must be full-time regularly enrolled graduate students.

ADMISSION REQUIREMENTS

General Requirements

A student who is granted admission must reflect in a moral and ethical sense a personal background acceptable to the University. The University reserves the right to deny admission to applicants whose total credentials reflect an inability to assume those obligations of performance and behavior deemed essential by the University and relevant to any of its lawful missions, processes, and functions as an educational institution.

Admission to the Graduate School is not admission to candidacy for an advanced degree. A student who wishes to become a candidate for a degree must make special application at the time and in the manner prescribed by the requirements for the degree sought. Students may be admitted to the Graduate School in either of the two categories described below.

Regular Degree Students

Qualified students are recommended for admission to regular degree status by the appropriate department. In addition to departmental approval, an applicant for admission as a regular degree student must:

1. Hold a baccalaureate degree from a college or university of recognized standing, or have done work equivalent to that required for such a degree and equivalent to the degree given at this University.
2. Show promise of ability to pursue advanced study and research, as judged by the student's previous scholastic record.
3. Have had adequate preparation to enter graduate study in the field chosen.

4. Have at least a 2.75 (2.0 = *C*) undergraduate grade point average (for engineering, 3.0).

5. Meet additional requirements for admission as established by major departments.

Pass-Fail Grades. In order to permit a meaningful evaluation of an applicant's scholastic record, not more than 10 percent of those credit hours that are relevant to the intended field of graduate study shall have been earned with pass-fail grades, nor more than 20 percent overall. Applicants whose academic record contains a larger percentage of pass-fail credits must submit suitable additional evidence that they possess the required scholastic ability. An applicant who does not submit satisfactory additional evidence can be admitted only as a provisional student.

Provisional Degree Students

Students who do not meet the requirements for admission as regular degree students may be recommended for provisional degree status by the major department. With the concurrence of the dean of the Graduate School these students are admitted to a probationary term of either one or two semesters of full-time study or its equivalent for part-time students. At the end of the specified probationary period, provisional degree students must be either admitted to regular degree status or dismissed from the graduate program to which they were provisionally admitted.

Credit earned by persons in provisional degree status may count toward a degree at this University.

Provisional degree students are required to maintain a 3.0 grade point average or higher, according to the terms of their provisional admission, each semester or summer session on all work taken, whether or not it is to be applied toward the advanced degree sought. Students who fail to maintain such a standard of performance will be subject to suspension from the Graduate School.

Seniors at the University of Colorado

A University of Colorado senior who has satisfied the undergraduate residence requirement and does not need more than 6 semester hours of advanced subjects and 12 credit points to meet the requirements for a bachelor's degree may be admitted to the Graduate School.

A University of Colorado senior enrolled in the College of Engineering and Applied Science who needs not more than 18 semester hours or 36 credit points to meet the requirements for a bachelor's degree may be admitted to the Graduate School, but is not eligible for financial aid, scholarships, or fellowships as a graduate student until the equivalent of the minimum requirements for the bachelor's degree have been satisfied.

Graduate Record Examinations

The Graduate Record Examinations (GRE) are requested of applicants for fellowships and scholarships and applicants for admission as provisional degree students. At the option of any department, the Graduate Record Examination may be required of applicants for assistantships or of any student before the student's status is determined. For the Health Sciences Center, see individual departments. A satisfactory score on the GRE is required on the Health Sciences Center Campus for graduate students in the basic sciences.

Students who are applying for the fall of 1985 should take the GRE no later than the December testing date so that their scores will be available to the graduate awards selection committee.

The Office of Research and Testing administers the GRE and other graduate and professional qualifying examinations, but does not set admissions requirements. Since these requirements vary, the specific department should be consulted before taking any graduate test.

Packets containing application/registration materials, instructions, test dates and deadlines, and fee information may be obtained just inside the west (main) entrance to Willard Administrative Center. Special problems or requests must be handled by Educational Testing Service, Box 995, Princeton, New Jersey 08541; telephone (609) 921-9000.

GRE fee waiver information is available through the Office of Financial Aid.

Other Graduate Qualifying Examinations

Students entering professional schools and special programs may obtain application/registration materials for law school (LSAT), business school (GMAT), medical school (MCAT), dental school (DAT), National Teacher Examinations (NTE), and Miller Analogies Test (MAT) just inside the west (main) entrance to Willard Administrative Center.

Readmission of Former and Suspended Students

Students who were previously admitted to a graduate degree program but who did not complete that degree and who have not been continuously registered at the University must:

1. Clarify their status with the department to determine their eligibility to return and pursue the same degree.

2. After receiving departmental approval, as indicated above, submit a Former Student Application to the Office of Admissions before quotas are filled or deadlines passed for the term in which they expect to return to the University.

In some instances, students who have left the degree program to which they were formerly admitted must submit a new Graduate Application form and be reconsidered for admission by the department concerned.

Former students who wish to change from undergraduate to graduate status or from one major to another must complete the appropriate forms at the time they apply for readmission.

Students transferring from one campus to another must apply and be accepted to the new campus.

A student admitted to the Graduate School for the master's program must reapply for admission for the doctoral program.

A suspended student is eligible to apply for readmission after one year. Approval or rejection of this

application rests jointly with the student's major department and the dean. In case of lack of agreement between the department and the dean or in case of appeal by the student, the final decision will be made by the Executive Committee.

Faculty Members

No member of the faculty above the rank of instructor may receive an advanced degree from this University.

Boulder Campus

All requests from U.S. citizens and permanent U.S. residents for admission to the Graduate School should be sent to the chairman of the department in which the applicant wishes to study. Prospective foreign students must contact the Office of Admissions, University of Colorado, Regent Administrative Center, Campus Box B-65, Boulder, Colorado 80309.

Colorado Springs Campus

Graduate students who expect to study on the Colorado Springs Campus should apply for admission by contacting the graduate representative for the particular program. Specific admission requirements for programs on the Colorado Springs Campus may be found by consulting the bulletin of the University of Colorado at Colorado Springs.

Denver Campus

Graduate students who expect to study on the Denver Campus should apply for admission by contacting the graduate representative for the particular program. Specific admission requirements for programs on the Denver Campus may be found by consulting the bulletin of the University of Colorado at Denver. Further information may be obtained from the Office of the Resident Dean, Graduate School, University of Colorado at Denver, 1100 14th Street, Denver, Colorado 80202, (303) 629-2663.

Graduate School at the Health Sciences Center

Requests and inquiries regarding admission to all graduate programs at the Health Sciences Center should be addressed to the graduate program in which the applicant wishes to study, University of Colorado Health Sciences Center, 4200 East 9th Ave., Denver, Colorado 80262.

Aside from the general admission requirements for the Graduate School, the minimal departmental admission requirements for most doctoral degree programs are as follows: one year each of biology, general physics, differential and integral calculus, and one semester of physical chemistry.

In the event that an applicant is deficient in any of these subjects, but is otherwise scholastically acceptable for admission for the Ph.D. degree, it is recommended that these deficiencies be eliminated as early as possible in the student's residency by taking the appropriate courses on the Boulder Campus, Denver Campus, or through the University Division of Continuing Education.

APPLICATION PROCEDURES

An applicant for admission must present complete application materials which include:

1. Part I and Part II of the graduate application.
2. Two official transcripts of *all* academic work completed to date.
3. A $20 nonrefundable application fee (check or money order). No application will be processed unless this fee is paid. Foreign application fee is $50.
4. Four reports from references (not required from M.B.A. applicants).
5. Test scores and other materials as required by specific departments.

All credentials presented for admission become the property of the University of Colorado.

When a prospective degree student applies for admission, the chairman of each department or a committee named for the purpose shall decide whether an applicant shall be recommended for admission. That recommendation is further reviewed and the student is informed of the decision by the Office of Admissions. Applicants not recommended for admission will be informed of the decision by the department. Persons who do not wish to work toward an advanced degree should see the section entitled Special Students.

A completed application must be in the office of the major department at least 120 days prior to the term for which the admission is sought or earlier as may be required by the major department.

Foreign students coming from abroad should have completed applications on file in the Office of Admissions prior to May 1 for the fall semester and October 1 for the spring semester; those foreign students currently studying in the United States should follow deadlines set for United States citizens.

Applicants should be aware of the limitation on total enrollment in effect at the University of Colorado, Boulder. Acceptable applicants may find that their application cannot be processed for a specific term if the enrollment goal has been reached.

Graduate Notification and Confirmation

After the Office of Admissions has received the department recommendation and all required credentials, the applicant will be notified regarding eligibility for admission. If eligible, the applicant will receive a Statement of Eligibility as well as a confirmation form which must be returned with the confirmation deposit before the enrollment goals are reached or the deadline passed. The 1984 confirmation amounts were $300 for a nonresident student and $100 for a resident of Colorado. If the confirmation is accepted, the student will be sent information regarding registration. Should the enrollment goals be reached, the confirmation deposit will be returned. Applicants not accepted for admission will be notified by the appropriate graduate department.

REGISTRATION

Every student entering this Graduate School for the first time must have a Statement of Eligibility Form. Former students must have a Statement of Eligibility Form when changing departments or when working toward another graduate degree. This form is mailed from the Office of Admissions after review and processing of the approved application have been completed.

Late Registration

Late registration will be held only if enrollment goals have not been reached. Therefore, there is no guarantee there will be a late registration. Graduate students who fail to complete registration and pay fees during the regular registration days may be charged a late registration fee if a late registration is held. Students registering as Candidate for Degree or for thesis must register during the regular registration period or be subject to the late registration fee if a late registration is held.

Limitation of Registration

FULL LOAD

A graduate student will be considered to be carrying a full load during a regular semester for purposes of determining residence credit if the student is registered for not fewer than 5 semester hours in work numbered 500 or above, at least 8 semester hours in a combination of undergraduate/graduate/professional course work acceptable for graduate credit, or any number of thesis hours.

A maximum of two-thirds of a semester of residence credit may be earned during the summer if a student registers for 3 semester hours of work in courses numbered 500 or above, 5 semester hours of other graduate work, or any number of thesis hours.

MAXIMUM LOAD

No graduate student may receive graduate credit toward a degree for more than 15 hours in a regular semester.

The maximum number of graduate credits that may be applied toward a degree during a summer session is 6 hours per 5-week term and 10 hours per 10-week summer session.

UNIVERSITY EMPLOYEES

Full-time employees of the University may not undertake more than 6 credit hours per semester. Part-time employees, including assistants, may take such work as is approved by the major department.

Changes in Registration

A student who wishes to drop a course or take it for no credit should follow the drop/add standard procedure found in the current *Schedule of Courses.* Note that after the 10th week of classes a graduate student may not drop, add, or change a course to noncredit without presenting a letter to the dean of the Graduate School, 308 Regent Administrative Center, stating the exceptional circumstances which justify the change. This letter, endorsed by the instructor of the course, must accompany the properly signed and completed drop/add form.

Withdrawal

A graduate student who desires to withdraw from the University should go to Room 125, Regent Administrative Center, for a withdrawal interview. A student who discontinues attendance in a course without official withdrawal will be marked as having failed the course.

REQUIREMENTS FOR ADVANCED DEGREES

Quality of Graduate Work

Although the work for advanced degrees is specified partly in terms of credit hours, *an advanced degree will not be conferred merely for the completion of a specified period of residence and the passing of a given number of courses.* A student should not expect to gain from formal courses all the training, knowledge, and grasp of ideas necessary to meet the requirements for an advanced degree.

A student is required to maintain at least a *B* average in *all* work attempted while enrolled in the Graduate School.

For the Ph.D., a course mark below *B* is unsatisfactory and will not be counted toward fulfilling the minimum requirements for the degree.

A student who fails to do satisfactory work will be subject to suspension from the Graduate School by the dean with the approval of the major department. Appeal may be made to the Executive Committee of the Graduate School, whose decision shall be final.

GRADING SYSTEM

Students should refer to the uniform grading system described in the General Information section of this catalog and note the following:

1. Work receiving the lowest passing grade, *D*, may not be counted toward a degree, nor may it be accepted for the removal of deficiencies. Marks below *B* are not accepted for the Ph.D.
2. Should a student enter the armed forces before completing a course and an *IW* is reported, this grade may be carried on the records for the duration of the student's service provided arrangements have been made in advance with the dean of the Graduate School.
3. An *in progress* grade given for thesis or M.Ed. report will be valid until the thesis or report has been completed.

REPEATING A COURSE

A graduate student who receives a grade of *C, D,* or *F* in a course may repeat that course once, upon written recommendation to the dean by the chairman of the student's advisory committee and major department,

provided the course has not previously been applied toward a degree.

In calculating a student's grade point average for Graduate School purposes, the grade for a repeated course will substitute for the old grade. Grades earned in courses taken as an undergraduate or as a special student, as well as grades earned in first- and second-year foreign language courses, will not be used in calculating the Graduate School grade point average. However, all grades received will appear on the student's transcript.

CHANGE OF DEPARTMENT OR MAJOR

A graduate student wishing to change department or major must submit a new Part I and Part II of the graduate applicaiton to the new department or school and request the former department to forward recommendations and credentials.

USE OF ENGLISH

A student who is noticeably deficient in the use and spelling of the English language may not obtain an advanced degree from the University of Colorado. The satisfaction of this requirement depends not so much upon the ability to pass formal tests, although these may be demanded, as it does upon the habitual use of good English in all oral and written work. Ability to use the language with precision and distinction should be cultivated as an attainment of major importance.

Each department will judge the qualifications of its advanced students in the use of English. Reports, examinations, and speech will be considered in estimating the candidate's proficiency.

Master of Arts and Master of Science

A student regularly admitted to the Graduate School and later accepted as a candidate for the degree Master of Arts or Master of Science will be recommended for the degree only after the following requirements have been met.

In general, only graduates of an approved institution who have a thorough preparation for their proposed fields of study and who do graduate work of high quality are able to attain the degree with the minimum amount of work specified below. All studies offered toward the minimum requirement for the degree must be of graduate rank. Courses taken during the fall semester of 1975 and thereafter will have graduate rank only if they are taught by members of the graduate school faculty and are in one of the two following categories: (1) courses within the major department at the 500 level or above; (2) courses outside the major department at any level, provided they are approved for graduate rank for a specific degree plan by the faculty of the degree-granting program and the dean of the Graduate School. Necessary additional work required to make up deficiencies or prerequisites may be partly or entirely undergraduate courses.

The requirements stated below are minimum requirements; additional conditions set by the department will be found in the announcements of separate departments. Any department may make further regulations consistent with the general rules.

Students planning to graduate should obtain current deadline dates in the office of the Graduate School. It is the graduate student's and the department's responsibility to see that all requirements and deadlines are met (i.e., changing of *IW* grades, notifying the Graduate School of final examinations, etc.).

Departments or program committees may have additional deadlines which must be met by graduate students in that department or program. It is the student's responsibility to ascertain such requirements and to meet them as designated by the department or program chairperson.

MINIMUM REQUIREMENT

The minimum requirement of graduate work for the degree Master of Arts or Master of Science may be fulfilled by following either Plan I or Plan II below.

Plan I: By presenting 24 semester hours of graduate work, including a thesis. At least 12 semester hours of this work must be at the 500 level or above.

Plan II: By presenting 30 semester hours of graduate work, without a thesis. At least 16 semester hours of work must be at the 500 level or above. Courses below the 500 level may be used only if they are in departments other than the student's major department.

Plan II does not represent a free option for the student. A candidate for the master's degree may be allowed to select Plan II only on the recommendation of the department concerned.

MASTER'S THESIS

A graduate student who writes a thesis under Plan I must register for 4, 5, or 6 semester thesis hours (700). The student may register for 6 hours during one semester or spread the total out over a number of semesters. The student may not register for zero thesis hours. After the student has registered for the total number of thesis hours, he or she should, if registration is required for a final examination, register as Master's Degree Candidate (999).

The final grade will be withheld until the thesis is completed; if the thesis is not finished at the end of the term in which the student is registered, an *in progress* (IP) will be reported.

LANGUAGE REQUIREMENTS

Candidates must have such knowledge of ancient and modern languages as each department requires. See special departmental requirements.

CREDIT BY TRANSFER

Work already applied toward a master's degree received from another institution cannot be accepted for transfer toward the master's degree at the University of Colorado; extension work completed at another institution cannot be transferred; and correspondence work, except to make up deficiencies, is not recognized.

All work accepted by transfer must come within the five-year time limit or be validated by *special* examination.

Credit will not be transferred until the student has established, in the Graduate School of this University, a satisfactory record of at least one semester in residence; such transfer will not reduce the residence requirement at this University, but it may reduce the amount of work to be done in formal courses.

Excess undergraduate credits from another institution may not be transferred to the Graduate School. Seniors in this University may, however, transfer a limited amount of advanced resident work (up to 8 semester hours) provided such work:

1. Is completed with distinction in the senior year at this University.
2. Comes within the five-year time limit.
3. Has not been applied toward another degree.
4. Is recommended for transfer by the department concerned and is approved by the dean of the Graduate School.

The maximum amount of work that may be transferred to this University, dependent upon the master's degree sought, is noted below:

Degree	*Semester Hours*
M.A. or M.S.	8
M.Bus.Ed.	8
M.Ed.	8
M.Mus.	8
M.Mus.Ed.	8
M.F.A. (Studio)	16

Requests for transfer of credit to be applied toward an advanced degree must be made on the form specified for this purpose and submitted to the Graduate School by the beginning of the semester prior to that in which the student will graduate. This form is to be completed by the student, endorsed by his advisor, the department chairperson or the designated representative, and the dean of the college if applicable, and sent to the Graduate School. An official transcript of credit must accompany the request. (Information required: course title, number, credit hours, when and where taken, grade received, and certification that student was enrolled in graduate school at the time.) To be eligible for courses to be considered for transfer, a student must have an overall *B* average in all courses taken at the University of Colorado in the Graduate School.

TRANSFER OF SPECIAL STUDENT CREDIT HOURS

A department may recommend to the graduate dean the acceptance of as many as 8 hours of credit toward the requirements for a master's degree for courses taken either as a student at another recognized graduate school, as a special student at this University, or both. In addition, the department may recommend to the graduate dean the acceptance of credit for courses taken as a special student at this University during the term *for which* the student applied for admission to the Graduate School provided such admission date was delayed through no fault of the student's. A grade of *B* or better must be obtained in any course work transferred in this manner.

CONTINUING EDUCATION COURSE WORK

Students may use the resources of the Division of Continuing Education in the pursuit of graduate study only if they obtain proper academic approval from the major department and the graduate dean in advance.

RESIDENCE

In general the residence requirements can be met only by residence at this University for at least two semesters or at least three summer sessions. For full residence a student must be registered within the time designated at the beginning of a semester and must carry the equivalent of at least 5 semester hours of work in courses numbered 500 or above, or at least a combination of 8 semester hours of other course work acceptable for graduate credit. See Limitation of Registration, Full Load for requirements for full residence credit during the summer. Students who are noticeably deficient in their general training or in the specific preparation required by the department cannot expect to obtain a degree in the minimum time specified.

Assistants and other employees of the University may fulfill the residence requirements of one year in two semesters, provided their duties do not require more than half time. Full-time employees may not satisfy the residence requirement of one year in fewer than four semesters.

CANDIDACY

A student who wishes to become a candidate for a master's degree must file an application in the dean's office not later than 10 weeks prior to the completion of the comprehensive-final examination.

This application must be made on forms obtainable at the dean's office and in appropriate departments and must be signed by the major department, certifying that the student's work is satisfactory and that the program outlined in the application meets the requirements set for the student.

THESIS REQUIREMENTS

A thesis, which may be of a research, expository, critical, or creative type, is required of every master's degree candidate under Plan I. Every thesis presented in partial fulfillment of the requirements for an advanced degree must:

1. Deal with a definite topic related to the major field.
2. Be based upon independent study and investigation.
3. Represent the equivalent of from 4 to 6 semester hours of work.
4. Receive the approval of the major department at least 30 days (in some departments, 90 days) before the commencement at which the degree is to be conferred.
5. Be essentially complete at the time the comprehensive-final examination is given.

6. Comply in mechanical features with specifications of the Graduate School.

Two weeks prior to the date on which the degree is to be conferred, two formally approved, typewritten copies of the thesis, complete with abstracts, must be filed in the Graduate School.

The thesis must be signed by two professors in the student's major field. All approved theses are kept on file in the library. The thesis binding fee must be paid when the thesis is deposited in the Graduate School.

COMPREHENSIVE-FINAL EXAMINATIONS

Each candidate for a master's degree is required to take a comprehensive-final examination *after* the other requirements for the degree have been completed. This examination may be given near the end of the last semester of residence while the candidate is still taking required courses for the degree, provided satisfactory progress is being made in those courses.

The following rules applying to the comprehensive-final examination must be observed:

1. A student must be registered when the examination is taken.
2. Notice of the examination must be filed by the major department in the dean's office at least one week prior to the examination.
3. The examination is to be given by a committee of three graduate faculty members appointed by the department concerned with approval of the dean of the Graduate School.
4. The examination, which may be oral or written, or both, must cover the thesis, which should be essentially complete at the time, as well as other work done in the University in formal courses and seminars in the major field.
5. The examination must include all work presented for the degree. The examination on transferred work will be given by representatives of the corresponding fields of study in this University.
6. A student who fails the comprehensive-final examination may not attempt the examination again until at least three months have elapsed and until such work as may be prescribed by the examining committee has been completed. The student may retake the examination only once.

SUPPLEMENTAL EXAMINATIONS

Supplemental examinations should be simply an extension of the original examination and given immediately. If the student fails the supplemental examination, three months must elapse before he or she may attempt the comprehensive examination again.

TIME LIMIT

All work, including the comprehensive-final examination, should be completed within five years or six successive summers. Work done earlier will not be accepted for the degree unless validated by a *special* examination. A candidate for the master's degree is expected to complete the work with reasonable continuity.

Students whose residence in this University is interrupted by military service may apply to the dean of the Graduate School for an extension of time.

Doctor of Philosophy

The Doctor of Philosophy degree is the highest academic degree conferred by the University. To state the requirements for the degree in terms of credit hours would be misleading, since the degree is not conferred merely upon the satisfactory completion of a course of study, however faithfully pursued. Students who receive this degree must demonstrate that they are proficient in some broad subject of learning and that they can critically evaluate work in this field; furthermore, they must have shown the ability to work independently in their chosen field and must have made an original contribution of significance to the advancement of knowledge. The technical requirements stated below are minimal requirements for all candidates for the degree; additional conditions set by the departments will be found in the announcements of separate departments. Any department may make additional regulations consistent with these general rules.

Studies leading to the Doctor of Philosophy degree must be chosen so as to contribute to special competence and a high order of scholarship in a broad field of knowledge. A field of study chosen by the student may be in one department or it may include two or more closely related departments. The criterion as to what constitutes an acceptable field of study shall be that the student's work must contribute to an organized program of study and research without regard to the organization of academic departments within the University.

Students planning to graduate should obtain current deadline dates in the office of the Graduate School. It is the graduate student's and the department's responsibility to see that all requirements and deadlines are met (i.e., changing of *IW* grades, notifying the Graduate School of final examinations, etc.).

Departments or program committees may have additional deadlines which must be met by graduate students in that department or program. It is the student's responsibility to ascertain such requirements and to meet them as designated by the department or program chairman.

MINIMUM COURSE REQUIREMENT

A minimum of 30 semester hours of courses numbered 500 or above is required for the degree, but the number of hours of formal courses will ordinarily exceed this minimum. At least 20 of the required hours must be in graduate courses taken at this University. Unless otherwise specified by departmental requirements, all 500-level or above courses taken for the master's degree at the University of Colorado may be applied toward the doctor's degree at the University. Students who have been admitted to the Graduate School with deficiencies may expect to receive little or no residence credit until the deficiencies have been removed.

THESIS CREDIT HOUR REQUIREMENT

To complete the requirements for the Ph.D. and other doctoral degrees, except the Doctor of Musical Arts degree, a student must register for a total of at least 30 hours of doctoral thesis credit, with not more than 10 of these credit hours in any one semester. Not more than 10 thesis hours may be taken preceding the semester of taking comprehensive examinations. In addition, up to 10 hours may be taken in the semester in which the student passes comprehensives. Thesis credit does not apply toward the minimum 30 hours of required course work specified above, and will not be included in calculation of the student's grade point average. Only the grades of *A, B, C,* and *IP* shall be used.

Course work and work on the thesis may proceed concurrently throughout the doctoral program. However, at no time shall a doctoral student register for more than 15 hours of 500-level and above courses. Normally a student must have earned at least three and not more than six semesters of residency before admission to candidacy.

CONTINUOUS REGISTRATION REQUIREMENT

Following successful completion of comprehensive examinations, students must register continuously. Students will register for and be charged for 10 hours of credit for each full-time term term of doctoral work. For each term of part-time enrollment, students will be charged for 7 hours of credit, except that students not making use of campus facilities may peititon the Graduate School for 3-credit-hour status. Continuous registration during the academic year will be required until completion of the thesis defense. It is expected that the student and advisor will consult each semester as to the number of hours for which the student will register, consistent with the classifications identified above.

QUALITY OF WORK

Students are expected to complete with distinction all work in the formal courses in which they enroll. A course mark below *B* is unsatisfactory and will not be counted toward fulfilling the minimum requirements for the degree. Upon recommendation by the advisory committee and the executive officer of the department and with the approval of the dean, a student may be required to withdraw at any time for failure to maintain satisfactory progress toward the degree.

ADVISORY COMMITTEE

As soon as the field of specialization has been chosen, the candidate will request the faculty member with whom the candidate wishes to work to act as chairperson of the advisory committee. The chairperson, with the advice and approval of the executive officer of the department, may select two or more others to serve on the committee, so that the several fields related to the student's special interest will be represented. A purpose of the advisory committee (beyond guiding the student throughout his graduate study) is to ensure against too narrow specialization. The student shall obtain the signature of the chairperson of the committee (thereby signifying the chairperson's willingness to act) on the Application for Admission to Candidacy Form. Any change in the membership of the Advisory Committee is to be reported to the Graduate School.

RESIDENCE

The student must be properly registered to earn residence credit. The minimal residence requirement shall be six semesters of scholarly work beyond the attainment of an acceptable bachelor's degree. Mere attendance shall not constitute residence as the word is here used. Residence must be earned for course work completed with distinction, for participation in seminars, or for scholarly research performed here or elsewhere under the auspices of the University of Colorado.

As a guiding policy in determining residence credit for employed students, those who are employed in three-fourths to full-time work which does not contribute directly to their program toward a degree may not earn more than one-half residence credit in any semester. Students who are employed more than one-fourth time and less than three-fourths time in work that does not contribute directly to the degree may earn not more than three-fourths residence credit. Those who have one-fourth time employment or less may earn full residence credit. (All these provisions are subject to the definition of residence credit given in the preceding paragraph.) In case the interpretation of residence credit for any student needs to be clarified, a decision will be made by the chairperson of the student's advisory committee, the executive officer of the student's major department, and the dean of the Graduate School.

Two semesters of residence credit may be allowed for a master's degree from another institution of approved standing, but at least four semesters of residence credit, two of which must be consecutive in one academic year, must be earned for work (course and/or dissertation) taken at this University.

PRELIMINARY EXAMINATION

Each department will satisfy itself (by examination or other means) that students who signify intent to undertake study for the Ph.D. degree are qualified to do so. The means by which each department makes this evaluation shall be specified in departmental requirements. Students who are thus evaluated will be notified immediately of the results. The results of this preliminary evaluation shall be reported to the Office of the Graduate School on the Application for Candidacy Form filed by the student at least two weeks before the comprehensive examination is attempted.

LANGUAGE REQUIREMENT

Students are required to meet the following language requirements:

Communication Requirement

1. All graduate students for whom English is the native language are required to demonstrate at least

second-year college proficiency in a foreign language of their choice. This requirement may be satisfied in the following ways:

a. The student's undergraduate transcript may be presented, showing completion with a grade of *C* or better of at least 3 semester hours of a fourth-semester undergraduate college course in a foreign language. The transcript must accompany the student's Application for Admission to Candidacy when it is submitted to the Graduate School.
b. The student may take the Graduate School Foreign Language Test (GSFLT) at the Testing Office before or after admission to the Graduate School. Students should check with the Graduate School for the passing score required for each language.
c. If the student wishes to demonstrate competence in a language for which the GSFLT is not available, a test designed and administered by the appropriate language department at the University of Colorado may be taken, with the passing criterion to be set comparable to the above GSFLT criterion.
d. The student may register at the University for any fourth-semester course in a foreign language and pass it with a grade of *C* or better. (Registration in such courses is contingent upon the language department's approval.)

A student who elects b, c, or d above must complete the requirements before the Ph.D. comprehensive examination may be scheduled.

2. Students whose native language is not English will, by passing their courses and completing their graduate work at the University, demonstrate sufficient ability in English to meet the communication requirement.

Special Languages

When special languages are needed as tools to read foreign literature in a particular field, the individual academic departments may require further training in foreign languages for all their Ph.D. graduate students. The choice and number of languages as well as the required levels of skill and the methods of testing these skills are determined by the individual departments.

CREDIT BY TRANSFER

Resident graduate work of high quality earned in another institution of approved standing will not be accepted for transfer to apply toward the doctorate until the student has established in this Graduate School a satisfactory record in residence, but such credit must be transferred before the student makes application for admission to candidacy for the degree. Such transfer will not reduce the minimum residence requirement at this University, but it may reduce the amount of work to be done in formal courses.

The maximum amount of work which may be transferred to this University, dependent upon the doctoral degree sought, is noted below:

Degree	*Semester Hours*
Ed.D	16
Ph.D.	10
D.B.A.	10
D.M.A.	10

APPLICATION FOR ADMISSION TO CANDIDACY

A student must make formal application for admission to candidacy for the Ph.D. degree on forms supplied by the Graduate School office at least two weeks before the comprehensive examination is attempted.

A student shall have earned at least three semesters of residence, shall have passed the language requirements, and shall have passed the comprehensive examination before admission to candidacy for the degree.

COMPREHENSIVE EXAMINATION

Before admission to candidacy for the Ph.D. degree, the student must pass a comprehensive examination in the field of concentration and related fields. This examination may be oral, written, or both, and will test the student's mastery of a broad field of knowledge, not merely the formal course work completed. The oral part is open to members of the faculty. *The student must be registered at the time the comprehensive examination is attempted.*

The examination shall be conducted by an examining board appointed by the chairperson of the department concerned and approved by the dean. The board shall consist of the advisory committee and additional members as necessary to a minimum of five. A successful candidate must receive the affirmative votes of a majority of the members of the examination board. In case of failure, the examination may be attempted once more after a period of time determined by the examining board.

THESIS REQUIREMENTS

A thesis based upon original investigation and showing mature scholarship and critical judgment as well as familiarity with tools and methods of research must be written upon some subject approved by the student's major department. To be acceptable, this dissertation should be a worthwhile contribution to knowledge in the student's special field. It must be finished and submitted in typewritten form at least 30 days (in some departments, 90 days) before the day of the final examination and must be formally approved and made available for inspection by the examining committee before the final examination may be taken.

In mechanical features all dissertations must comply with the specifications of the Graduate School.

It is the student's responsibility to notify the Graduate School of the *exact* title of the dissertation at least six weeks prior to the commencement at which the student will graduate. This title will be printed in the commencement program.

One formally approved, typewritten copy of the thesis, including abstract, plus one additional copy of the

title page and abstract must be filed in the Graduate School office at least *18 days* before the date on which the degree is to be conferred.

The abstract, not to exceed 350 words, will be published in *Dissertation Abstracts International.* The determination of what constitutes an adequate abstract shall rest with the major department.

All theses must be signed by no fewer than two members of the major department staff who are regularly engaged in graduate instruction.

All approved theses are kept on file in the library.

When the thesis is deposited in the Graduate School, the candidate must pay the thesis-binding fee and sign an agreement with *University Microfilms International* to allow for publication in *Dissertation Abstracts International* and to grant *University Microfilms International* the right to reproduce and sell (a) copies of the manuscript in microform and/or (b) copies of the manuscript made from microform. The author retains all rights to publish and/or sell the dissertation by any means at any time except by reproduction from negative microform.

FINAL EXAMINATION

After the thesis has been accepted, a final examination of the thesis and related topics will be conducted. This examination will be wholly or partly oral, the oral part being open to anyone. The examination will be conducted by a committee appointed by the dean, which will consist of at least five persons, one of whom must be from outside the student's department. More than one dissenting vote will disqualify the candidate in the final examination.

Arrangements for the final examination must be made in the dean's office at least two weeks in advance. The examination must be scheduled not later than 18 days before the date on which the degree is to be conferred. A student must be registered at the time of the final examination.

TIME LIMIT

If a student fails to complete all requirements for the degree within four years of the date on which the comprehensive examination was passed, a second examination similar in extent to the first will be required before the candidate may take the final examination. If the second comprehensive examination is failed, it may be attempted once more after not fewer than eight months of further work.

Interdepartmental Programs

See departmental listings in the college and school sections of this catalog for descriptions of graduate programs.

The following are descriptions of interdepartmental programs, medical division programs, and the graduate nursing program.

BEHAVIORAL GENETICS

The Institute for Behavioral Genetics (IBG) offers a training program in behavioral genetics but is not a degree-granting unit of the University. The goal of the program is to train scientists capable of working both within their academic disciplines and in the broad interdiscipline of behavioral genetics. The program features a core set of courses and continuous research apprentice training with one or more IBG faculty members and furnishes valuable opportunities for interaction among scholars with widely varying academic backgrounds. A student wishing to specialize in behavioral genetics must be regularly enrolled as a graduate student in an academic department of the University and must satisfy all requirements of that department.

The training program has two levels. The goal of Level I is to establish minimal competency in behavioral genetics. The requirements include successful performance in Psy. 510 (Behavioral Genetics), Psy. 511 (Concepts in Behavioral Genetics), and two semesters of Psy. 610 (Seminar in Behavioral Genetics). Level II includes the following additional requirements: competence in general genetics (e.g., EPOB 320), quantitative genetics (Psy. 512), and molecular genetics (e.g., MCDB 384 or 489, or Chem. 481-482); one graduate level statistics course; and at least two semesters of research in behavioral genetics (Psy. 601).

Students at either level must have an IBG faculty member as an advisor to guide their course work and research training. Trainees aspiring to Level II competency also must have an advisory committee consisting of faculty members from both IBG and the student's academic department. In addition to guiding the student's course work and research training, the advisory committee will evaluate the student's progress and may impose additional requirements.

Further information about this interdisciplinary training program can be obtained from the institute.

CHEMICAL PHYSICS

The purpose of the interdepartmental doctoral program in chemical physics is to prepare students for research in such interdisciplinary fields as atomic and molecular radiative processes, nuclear and electron magnetic resonance spectroscopy, laser chemistry and physics, x-ray crystallography, molecular quantum mechanics, statistical mechanics, quantum chemistry, kinetics, and chemistry and physics of the surface and condensed state.

Students wishing to pursue graduate work leading to the Ph.D. degree in chemical physics should apply for admission to, and will be formally associated with, either the Department of Chemistry or the Department of Physics, in accordance with their undergraduate backgrounds.

Entering students will take the qualifying examination in the area of their undergraduate major, but the comprehensive examination will test their knowledge in the relevant aspects of both chemistry and physics. Certain requirements associated with the regular Ph.D. programs in the participating departments will be re-

placed by some in the complementary field; each student's program of course work and research will be individually planned according to the student's special needs.

Some of the courses that will be used in planning most programs in chemical physics are listed below. For descriptions of their contents, refer to the listings of the participating departments.

	Semester Hours
Chem. 501 and 506. Advanced Inorganic Chemistry	6
Chem. 531 and 532. Advanced Organic Chemistry	6
Chem. 550. Chemical Dynamics	3
Chem. 553. Statistical Mechanics	3
Chem. 556. Physical Chemistry of Macromolecules	3
Chem. 558. Quantum Chemistry	3
Chem. 559. Advanced Molecular Spectroscopy	3
Chem. 652. Advanced Topics in Physical Chemistry	3
Chem. 653. Nuclear and Electron Magnetic Resonance Spectroscopy	3
Chem. 800 or Phys. 800. Doctor's Thesis	16-24
Phys. 621. Theoretical Mechanics	3
Phys. 625 and 626. Introduction to Quantum Mechanics	6
Phys. 631 and 632. Electromagnetic Theory	6
Phys. 644. Statistical Mechanics	3
Phys. 653. Chemical Physics	3
Phys. 656. Atomic and Molecular Spectra	3

The program is administered by an interdepartmental committee. For further information, contact either the chairman, Department of Chemistry, or the secretary, Department of Physics.

GEOPHYSICS

This is an interdisciplinary and interdepartmental program leading to the Ph.D. degree. It is designed to encourage students with a wide variety of undergraduate backgrounds to pursue graduate studies in solid earth geophysics. The program is flexible enough to allow a student to specialize in one of the many aspects of geophysics, while providing a general background in geophysics and an in-depth training in the relevant parts of the parent disciplines.

Students wishing to enter the program should apply for admission and will be formally associated with one of the following departments: geological sciences; astrophysical, planetary, and atmospheric sciences; physics; aerospace engineering sciences; civil and environmental engineering; electrical engineering; or mechanical engineering. The choice will depend upon the student's primary area of interest. A committee on geophysics assists in the choice of department and the planning of individual academic programs. The preliminary examination for the Ph.D. is administered by the student's department, while the comprehensive examination and thesis are conducted by an interdepartmental committee.

Exceptional research opportunities are available through the Cooperative Institute for Research in Environmental Sciences (CIRES). Financial support is available either through teaching assistantships in the student's department or as research assistantships on research programs. These are awarded on a competitive basis to students applying to the program. For further information, contact Professor Carl Kisslinger, CIRES, Campus Box 449, or the Department of Geological Sciences.

MASTER OF BASIC SCIENCE PROGRAM

The program is an interdisciplinary one leading to the Master of Basic Science degree. It provides an opportunity for present and prospective mathematics and science professionals and others to extend and/or broaden their training in computer science, mathematics, museology, and the natural sciences at advanced undergraduate and graduate levels. These professionals would include public school teachers, industrial scientists, engineers, business persons, and others.

The student may elect the mathematics, museology, or science option as described below. Wide latitude is possible in the details of a degree plan so that each student may follow a course of study most pertinent to his or her interest. Each degree plan must be approved by the M.B.S. Executive Committee.

The Master of Basic Science degree is supervised by an administrative committee appointed by the dean of the Graduate School with representation from the following departments: anthropology; astrogeophysics; environmental, population, and organismic biology; chemistry; computer science; geological sciences; mathematics; molecular, cellular, and developmental biology; museum; and physics. The Colorado Springs and Denver campuses are also represented. The deans of the College of Arts and Sciences and the Graduate School are ex officio members.

Application should be made to the Master of Basic Science Program, Campus Box B-26, University of Colorado, Boulder, Colorado 80309.

REQUIREMENTS FOR ADMISSION

1. General regulations for admission to the Graduate School apply (see Admission Requirements).
2. A student must present at least 40 semester hours in the natural sciences and mathematics, preferably including one year of calculus. Students may be admitted to the program with a deficiency in calculus, but must remedy the deficiency within two years after admission by completing one year of calculus (or other courses in mathematical subjects on approval by the executive committee) with a grade of *C* or better.

REQUIREMENTS FOR THE MASTER OF BASIC SCIENCE DEGREE

1. General regulations of the Graduate School governing the award of the master's degree apply (see Master of Arts and Master of Science) except as modified below.
2. For the nonthesis option, 30 semester hours of basic science courses numbered 300 and above, taught by members of the graduate faculty, and selected from two or more departments. For the thesis option, 24 hours of basic science courses numbered 300 and above, taught by members of the graduate faculty, and selected from two or more departments. Of the required hours

for either option, 12 hours or more must be from courses numbered 500 and above. Thesis credit does not count toward these 12 hours. Courses fulfilling program requirements may be selected only from among the departments listed below. See mathematics, museology, and science options below.

- Anthropology (museology option only)
- Astrophysical, planetary, and atmospheric sciences
- Chemistry
- Computer science
- Environmental, population, and organismic biology
- Geology
- Mathematics
- Molecular, cellular, and developmental biology
- Museum (museology option only)
- Physics

All courses applied toward the degree must be taken over a period of five years or six successive summers. Courses may be taken at each or at all three University of Colorado campuses. A maximum of 8 hours of graduate-level course credit of *B* or better grade transferred from other institutions may be applied toward the M.B.S. degree, provided that such credit has been approved by both the M.B.S. Executive Committee and the appropriate University of Colorado department. Students already in the program must obtain approval prior to enrolling in courses they may wish to transfer.

3. For the nonthesis option, completion of a paper describing a research project or other specialized study on a topic approved by the Executive Committee. For the thesis option, completion of a thesis which must meet the general requirements of the Graduate School for M.A. or M.S. theses and must be approved by the Executive Committee. Approval of the topic, for either option, is given on the basis of a written explanation or precis submitted no later than the end of the semester in which the student completes 21 hours of course credit or the completion of the third year after entering the program, whichever is earlier. The final paper must be approved by the student's committee.

4. Minimum grade point average: courses on the 300 and 400 level will be accepted toward the degree only with grades of *A* or *B*; 500- and 600-level courses will be accepted toward the degree with grades of *A, B,* or *C*. The student must have a *B* average in all courses taken subsequent to admission to the program, including courses not actually offered for the degree.

MATHEMATICS OPTION

1. A reasonable degree of competence is required in the fields of analysis, algebra, and geometry. A minimum of 15 semester hours of upper division courses (300-level or above) in mathematics must be offered for the degree, including at least 3 hours of analysis, 6 hours of algebra, and 3 hours of geometry.

2. One upper division sequence of at least 6 semester hours in any of the physical and biological sciences named above. With permission, two independent one-semester courses in the same area may be substituted for the one-year sequence.

3. Upper division electives in science, mathematics, or computer science, to complete an approved 30-hour degree plan. Of these 30, 12 hours or more must be from courses numbered 500 and above. The 30 hours may also include 3 semester hours of courses or seminars in secondary school mathematics teaching, history of mathematics or science, or philosophy of mathematics or science.

MUSEOLOGY OPTION

1. At least 8 but not more than 12 semester hours of courses offered by the museum. Alternatives are the sequence Musm. 401-402-403, or Musm. 401 and a selection of additional courses in museum. Students are required to take 3 semester hours in small business management and are permitted to take an additional 3 semester hours in the College of Business and Administration. The total museum-business semester hours may not exceed 15.

2. An upper division sequence (300-level or above) of at least 6 semester hours in one of the departments (other than museum) represented in the program.

3. Upper division electives in science, mathematics, or computer science to complete an approved 30-semester-hour degree plan. Of these 30, 12 hours or more must be from courses numbered 500 and above.

SCIENCE OPTION

Within the science option there are two choices: the nonthesis option or the thesis option.

1. In either option the student must take an upperdivision sequence (300-level or above) of at least 6 semester hours in each of two of the physical and biological sciences named above. With permission, two independent one-semester courses in the same area may be substituted for one of the one-year sequences.

2. For the nonthesis option, upper division electives in science, mathematics, or computer science to complete an approved 30-semester-hour degree plan. For the thesis option, upper division electives in science, mathematics, or computer science to complete an approved 24-semester-hour degree plan. Of the required hours for either option, 12 hours or more must be from courses numbered 500 and above, not to include thesis credit. The required hours may also include 3 semester hours of upper division courses or seminars in secondary school teaching, history of science, or philosophy of science.

3. Thesis Option. The student who plans to present a thesis for the M.B.S. degree must report this to the Executive Committee of the M.B.S. program not later than the second semester. The student's choice of a thesis advisor must be approved by Executive Committee at this time.

MASTER OF ENGINEERING PROGRAM

The Master of Engineering degree program is administered by the Graduate School through the departments of engineering. The requirements for admission and for quality and quantity of academic work are the same as for the Master of Science awarded in the College of Engineering and Applied Science.

The principal difference between the Master of Engineering degree and the Master of Science is that the

Master of Engineering is intended to meet the needs of those practicing engineers who are working full time outside the University and who wish to carry on an integrated program of studies in an exceptionally broad interdisciplinary field in engineering and allied subjects related to the individual student's professional work. Examples of broad interdisciplinary fields include engineering and the social sciences, engineering and the biological sciences, engineering and law, and engineering and business administration. A successful program to meet these needs requires greater flexibility in operation than is normally possible or intended under the existing Master of Science degree program.

The program makes use of the Audiovisual Continuing Education program and of the Center for Advanced Training in Engineering and Computer Science (CATECS).

The degree is not intended as a means to permit a random, unguided selection of courses. Each prospective student is required to present a well-defined objective in order to be admitted to the program. An academic program is developed to meet this objective in consultation with faculty advisors.

REQUIREMENTS

The requirements for the degree are 30 credit hours plus a written report on a creative investigation, which may be related to the student's professional work. The report will be of the same general quality as that required for the thesis for the Master of Science degree and must be defended orally, but does not in itself carry credit, nor require registration as specified by the rules under Master's Thesis or Report. It may be based upon work done for credit under independent study. At least 15 credit hours must be in engineering at the 500 level or above. As many as 15 credit hours may be taken outside of engineering. Credit in courses below the 400 level will not apply toward degree requirements.

Requirements relating to the following items are the same as those for the Master of Science degree as awarded in the College of Engineering and Applied Science: admission to Graduate School, application procedures, registration, quality of graduate work, status, credit by transfer, and admission to candidacy. Applicants may petition for credit for up to an additional 4 hours of transfer credit. The time limit to complete this program is six years.

The admission of each student to graduate study, approval of the degree program, admission to candidacy for the degree, and approval of the awarding of a degree are to originate through a specific department of the College of Engineering and Applied Science in the same manner as for the established Master of Science program. An advisory committee, consisting of not fewer than three faculty members, will be appointed for each student by the major department promptly upon the student's beginning work toward the degree. At that time a plan of study shall be completed and a copy placed on record with the office of the associate dean of engineering for graduate and research programs and associate dean of the Graduate School. Changes in the plan must have the concurrence of the committee and must be reported to the dean.

The members of each advisory committee shall be chosen from the various interdisciplinary academic areas represented in the student's program and will be from more than one department. The advisory committee guides the student. It is responsible for approving the individual's degree program and admission to candidacy; it approves the student's written report and the awarding of the degree.

The student should see also the requirements of the departments involved.

MATHEMATICAL PHYSICS

In recent years the increasingly mathematical character of many branches of physics has opened up numerous opportunities for fruitful interplay of the ideas of mathematics with those of physics. At the same time increasing specialization in both fields has, if anything, reduced the possibility of communication between the two disciplines, so that students of mathematics have less time to study physics and vice versa. This contrasts strongly with the period up to the first quarter of this century, when there was close contact between the two fields, many great mathematicians were deeply involved in physics problems, and a number of important mathematical ideas had their origin in the study of nature itself.

It is against this background that the Departments of Mathematics and Physics offer an interdisciplinary doctoral program in mathematical physics, with the following general objectives:

1. To attract students to and prepare them for research in modern mathematical physics and the relevant mathematics.
2. To promote collaboration and cooperation between the Departments of Mathematics and of Physics.
3. To institute courses pertinent to mathematical physics not already offered in either department.
4. To develop a strong center of mathematical physics at this university.

Initially the number of students involved in the program will be small, and it should be possible for the Steering Committee to follow their progress individually and closely. It therefore seems unnecessary and undesirable to spell out in complete detail a rigid set of requirements and regulations. The design of the program is outlined below.

1. *Administration of the Program.* The mathematical physics program is guided by a Steering Committee composed of members of the Departments of Mathematics and Physics. This Steering Committee adminsters the program within the rules of the Graduate School.

2. *Admission Requirements.* The requirements for entrance into the program are acceptance as a degree student either in the Department of Mathematics or in the Department of Physics and a good undergraduate background in both physics and mathematics, obtained by either a double major in undergraduate study or a major in one of the fields combined with suitable subsequent study of undergraduate courses in the other.

Acceptance into the program is decided by the Steering Committee on the basis of the foregoing requirements and the student's general promise. Satisfaction of the second requirement is evaluated in each case individually, partly on the basis of the student's transcript and partly on the basis of a written examination on undergraduate work in the second field. For a student enrolled in the Department of Mathematics, that examination is the Physics Department's Preliminary Examination given to entering physics graduate students at the beginning of each fall term. For a student enrolled in the Physics Department, it is a similar examination on undergraduate mathematics administered by the Steering Committee or by a faculty member designated by the committee. The examination is partly diagnostic; as result of it, the Steering Committee or the student's advisor may recommend further study of certain subjects.

3. *Advisory Committee.* Each student in the program, as soon as his field of specialization has been chosen, requests the staff member with whom he wishes to work to act as chairman of his advisory committee. The chairman, with the advice and approval of the Steering Committee, selects one member of the graduate faculty from the Department of Mathematics and one from the Department of Physics to serve on the student's advisory committee. A purpose of the advisory committee (beyond guiding the student throughout his graduate study) is to insure against too narrow a specialization.

4. *Course Requirements.* To prepare for the Ph.D. in mathematical physics, each student must take appropriate course work in the Department of Mathematics and the Department of Physics. His program of study must be approved by his advisory committee and should be designed in part to prepare him for the second-year examination (see 5 below) in the department in which he is matriculated. In addition, the candidate is expected to pass at least two distinct graduate-level core courses in the second field (see table below) and at least two semesters of the advanced mathematical physics courses (Math. 653, 654, 655, 656 = Phys. 603, 604, 605, 606).

CORE COURSES IN THE SECOND FIELD

Mathematics Courses for Physics Students

Math. 501, 502. Topology
Math. 513. Algebra
Math. 523, 524. Differential Geometry
Math. 531, 532. Real Analysis
Math. 635, 636. Functional Analysis

Physics Courses for Mathematics Students

Phys. 621. Mechanics
Phys. 625, 626, 627, 628. Quantum Mechanics
Phys. 631, 632. Electromagnetism
Phys. 644, 645. Statistical Mechanics
Phys. 685. Theory of Relativity

These are in addition to subjects like ordinary and partial differential equations, linear algebra, and complex variables required of all physics students and covered, for example, in mathematical physics.

5. *Examination Requirements.* Each student in the mathematical physics program must pass the second-year examination in the department in which the student is matriculated (i.e., the physics comprehensive or the mathematics preliminary examination) according to the rules of that department. The second-year examination constitutes the *Comprehensive Examination* required by the Graduate School.

6. *Transferring Into and out of the Program.* Transfer into the program is possible at any time, subject to the entrance requirements mentioned above, and also transfer out of it, because a student in the program retains status as a regular degree student in the department of his primary field. Formal acceptance into the program is usually deferred until the student has passed the second-year examination but any student who is interested in the program and has an appropriate background is urged to apply for the program as soon as possible.

7. *Master's Degree.* Master's degrees in mathematical physics are not given. If for any reason a student becomes a master's degree candidate, he will be transferred out of the mathematical physics program into a regular department major.

8. *Research Requirements.* Each successful participant in the program is required to submit and to defend a thesis describing original research performed by himself. The student may carry out his research under the direction of any graduate faculty member in the Department of Mathematics or the Department of Physics.

9. *Language Requirement.* Each student in the program must fulfill the language requirement of the department in which he has matriculated.

TELECOMMUNICATIONS

The telecommunications program is interdisciplinary, involving the Departments of Communication, Journalism, Electrical Engineering, Mechanical Engineering, Economics, Political Science, and Computer Science, and the College of Business, leading to a Master of Science degree in telecommunications. The object of this 12- to 18-month program is to provide graduate professional education for persons interested in the management of telecommunication systems. Such positions require knowledge about the technical aspects of communication theory, about governmental regulations relating to telecommunications, and about the sociological and economic aspects of the operation and growth of telecommunications systems.

It is expected that participants in the program will include both midcareer professional persons and beginning graduate students.

Inquiries should be directed to Chairman, Graduate Committee on Telecommunications, Campus Box 425, Engineering Center OT 2-32, University of Colorado, Boulder 80309.

Although this was basically a 12-month program, it is expected that most current students will be able to enroll for 18 months, with consequent benefit from the extended curriculum.

A suitable academic program is planned for each individual. Some of the course offerings are listed below.

Fall Semester	*Semester Hours*
E.E. 531. Telecommunications Systems	3
EE. 534. Introduction to Telecommunications System Theory[1]	3
E.E. 581. Introduction to the Systems Approach	3
I.E. 950. Engineering Economy	3
Comm. 524. Organizational Communications	3
Econ. 576. Economics of Public Service	3
P.Sc. 580. The Political System and Telecommunications	3
I.S. 645. Information Systems and Management	3
E.E. 597. Seminar	1
Jour. 565. Mass Communication Legal Issues	3

Spring Semester	
E.E. 526. Propagation Effects on Satellite and Deep-Space Telecommunications	3
E.E. 537. Telecommunications Laboratory[1]	2
E.E. 582. Introduction to Information Systems	3
E.E. 584. Satellite Communications	3
E.E. 591. Data Communications	3
E.E. 592. Telephone Systems	3
Comm. 560. Radio-TV Station Organization and Operation	3
Jour. 592. Economic and Political Aspects of Mass Communications	3
E.E. 597. Seminar	1

Summer Session	
E.E. 591. Cable TV	3
E.E. 592. Contemporary Issues in Telecommunication Policy	3
Telecommunications project or thesis	6

A minimum of 32 hours is needed to graduate, but students are encouraged to take at least 40 hours where possible.

Electives will normally be taken at the 500 level. For students without a previous technical background, and as a review for students with a technical background, E.E. 534 (Introduction to Telecommunications System Theory) is recommended.

E.E. 537 (Telecommunications Laboratory) is designed for students lacking a prior experience with electrical equipment. E.E. 534 is normally a prerequisite. Students entering the program are expected to be competent at least at the high school level in mathematics and elementary physics and are advised to review such material if necessary prior to commencing course work.

E.E. 597 (Seminar) is required for two semesters and is scheduled on a weekly basis. It carries 1 hour of credit per semester, and exposes the student to a range of topics by speakers representing many different sides of the telecommunication industry.

Students with no prior experience in computer programming will need to take an elementary computer course as part of their curriculum.

The student will register for a total of 6 hours of credit for a project or thesis. The courses registered for will be decided upon by each individual with the help of the student's advisor.

Graduate School at the Health Science Center

ANATOMY

Students wishing to pursue graduate work in anatomy leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees, and Graduate School at the Health Sciences Center Admission Requirements.

Prerequisites. A student wishing to major in anatomy should have completed the following:

1. Equivalent of an undergraduate major in the field of zoology or biology, including general zoology, comparative anatomy, genetics, and embryology.
2. Courses in chemistry (inorganic, organic, and physical), college physics, integral calculus.
3. Reading knowledge of at least one foreign language.

The Graduate Record Examination is required.

Anat. 501A-11. Human Anatomy. *Winter.* Designed to help the student achieve a reasonable, competent knowledge and understanding of the structure and function of the human body through lectures, discussions, cadaver dissection, and investigation of clinincal correlates. Willson.

Anat. 501B-9. Human Anatomy. *Winter.* Course provides, in less time than is normally required, a comprehensive study of the structure and function of the human body. Thorough dissection of one major cadaver area and study of other regions through presentations of dissections of other students in the class. Whitlock, Temple.

Anat. 502-5. Microanatomy of Cells and Tissues. *Fall.* Lectures describe the way in which cells and tissues execute specific physiological functions. Laboratory sessions permit firsthand light microscopic observations of the cellular architecture of mammalian and human tissues. The constant interrelationship extant between structure and function is strongly emphasized. Roper, Moran, Hahn.

Anat. 602-1. Departmental Seminar. *Fall, Winter, Spring.* Weekly scientific reports on various original research projects are presented by faculty, students and guest scientists. Finger.

Anat. 603-2. Experimental Vertebrate Neuroanatomy. *Spring.* Organization of the vertebrate central nervous system with special emphasis on experimental neuronantomy. Discussions will include aspects of histology, embryology, and structure of the CNS of experimental animals, as well as uses and limitations of contemporary neuroanatomical techniques. Prer., concurrent or previous enrollment in IDPT 513 or equivalent. Finger.

Anat. 650-credit to be arranged. Research in Anatomy. *All quarters.* Programs of investigation in fields of anatomy including neuroanatomy, cell biology, developmental biology, endocrinology, fine structure, and chemistry. Lasher and staff.

Anat. 700-credit to be arranged. Master's Thesis. *All quarters.*

Anat. 800-credit to be arranged. Doctor's Thesis. *All quarters.*

IDPT 509-3. Human Embryology and Development. *Winter.* The first third of this course integrates concepts of cell growth and differentiation, and of genetic and environmental interaction, with a descriptive survey of early human embryology. The remainder of the course covers normal and abnormal development of specific organ systems, and outlines functional (both physical and, where possible, psychological) development of the whole organism through adolescence. Lasher and Manchester.

IDPT 513-6. Neurobiology. *Spring.* Provides a basic understanding of the various sensory, motor, and associative pathways of the human central nervous system, through lectures, examination of sectioned or

[1] May not be necessary for recent engineering graduates or others with the relevant experience.

dissected material, and clinical illustrations. Nolte, Finger, Martin, Wickelgren and Betz.

IDPT 666-2. The Anatomy and Methods of Imaging the Thorax. *Summer.* The course provides training in the cross-sectional anatomy of the human thorax as seen in transverse, coronal and sagittal planes, and presents information on the mehtods employed clinically to image the anatomy. Prer., Human Gross Anatomy. Whitlock and Hendee.

BIOCHEMISTRY, BIOPHYSICS, AND GENETICS

The graduate program gives advanced training to candidates for the Ph.D. degreee in general biochemistry, biophysics, and genetics; theoretical biophysics; cell biology; human genetics; and for the master's degree in human and applied genetics.

There are also special interdepartmental programs in human and molecular genetics as well as in cellular and molecular biology. These programs combine this department's facilities and faculty with those of other basic science and clinical departments to provide unusually diverse training opportunities.

Students considering graduate studies in the department should read carefully the sections of this catalog concerning Requirements for Advanced Degrees and Graduate School Admission Requirements.

MASTER'S PROGRAM

Students wishing to specialize in human and applied genetics may apply for admission to a program leading to a master's degree in genetics. Requirements for admission include a baccalaureate degree or its equivalent, a minimum undergraduate grade point average of 2.75, and satisfactory scores on the Graduate Record Examination. Background necessary for the program includes courses in biology, physical chemistry, general physics, differential and integral calculus, organic chemistry, and genetics. In a few cases students may be admitted provisionally while completing course deficiencies.

In general, the program of course work will include instruction in basic sciences fundamental to human genetics, laboratory techniques applicable to human genetics, clinical genetics and genetic counseling, and mathematical genetics. The student will also do research for a thesis.

DOCTORAL PROGRAM

The department welcomes applications from students who have strong background at the college level in biology and chemistry, preferably students who have majored in both or who have honors degrees in one or the other of these fields. Requests for admission should be sent to:

Committee on Admissions
Department of Biochemistry, Biophysics, and Genetics
University of Colorado School of Medicine
4200 E. 9th Avenue, B-126
Denver, Colorado 80262

Students should make certain that the Committee on Admissions is provided with transcripts relating to their college degrees, with letters of recommendation from their colleges and with the results of the Graduate Record Examination (GRE).

In general, preference will be given to students who meet the following standards:

1. A combined score in excess of 1900 in the Verbal, Quantitative, and Analytical sections of the GRE. Students are encouraged to take the Advanced section of this examination, although this is not a requirement.
2. Completion in college of two semesters, or equivalent, in organic chemistry; one semester, or equivalent, of organic chemistry laboratory; one year of biology; and one year of general physics.
3. Completion in college of a course in physical chemistry that deals in some detail with thermodynamics and the properties of solutions.
4. Completion of college-level mathematics through calculus.
5. Completion in college of four semesters, or equivalent, in a foreign language.

Students who do not fully meet the requirements in 3 and 5 may be admitted on a probationary basis, but will be required to make up these deficiencies.

For descriptions of research programs in the department, students should request from the department a descriptive brochure covering these programs.

BBGN 500-9.5. Principles of Biochemistry. *Fall.* Protein structure and relationship of structure to biological function. Fundamentals of free energy, bioenergetics, and catalysis. Pathways, mechanisms, and regulation of carbohydrate, lipid, and amino acid metabolism. Biological oxidation and energy transductions. Theory of enzyme kinetics. The structure, function, and metabolism of peptide and steroid hormones. The metabolism of purine and pyrimidine nucleotides and the structure synthesis and function of the nucleic acids. The mechanism and regulation of the extracellular environment, pH, and gas exchange. Connective tissue biochemistry. Vitamins and their actions. Nutritional requirements and energetics in the human. Hirs and staff.

BBGN 502-3. Medical Biophysics and Genetics. *Fall.* Human genetics and its biological basis. Two hrs. lect., one hr. demo. and disc. Freshman medical students and graduate students. Seeds and staff.

BBGN 600-5. General Biochemistry. *Fall, Winter, Spring.* Five lect. hrs. and one hr. disc. per wk. This is a three-quarter course, with 5 hours of credit each quarter. The course stresses the relations between molecular structure and function in biological systems. It is designed for students whose aim is a career in research and teaching in biochemistry and allied disciplines, particularly biophysics and genetics. The major areas of biochemistry and molecular biology will be covered and should provide the foundation for more comprehensive treatment of specialized subjects which a student may wish to pursue further in advanced courses or in the laboratory. Prer., organic chemistry, calculus. Hirs and staff.

BBGN 601-2. Topics in Medical Genetics. *Fall, Winter, Spring.* This is a three-quarter course, with 2 hours of credit each quarter. *Fall:* Survey of principles of genetics and introduction to counseling skills. *Winter:* Biomedical foundation for understanding genetic disorders. *Spring:* Clinical and laboratory methods in diagnosis and treatment of genetic disorders. Morse.

BBGN 602-2. Tutorial in Human Genetics. *Fall, Winter, Spring.* In-depth laboratory and clinical pursuits of a specific problem in human genetics. Some specific problems of interest are in the field of immunogenetics, lipid and lipoproteins and abnormalities in atherosclerosis, and the genetics-epidemiology of common birth defects. Nora.

BBGN 603-1. Interviewing and Counseling in Clinical Genetics: Theory and Applications. *Fall, Winter, Spring.* Techniques of interviewing and dynamics of counseling will be presented in didactic

sessions and practical clinical settings. The impact of genetic disease on the family and the role of the genetic counselor in identifying and responding knowledgeably and compassionately to the needs of the family will be stressed. Nora.

BBGN 604-1. Protein Biosynthesis. *Winter.* An interdepartmental course. Current topics relevant to protein biosynthesis and its control will be discussed. Prer., Biochem. 600 or equivalent, consent of instructor. Brown.

BBGN 605-3. Basic Biomedical Electronics. *Fall.* Covers basic electronic concepts through amplifiers and their characteristics, semiconductors, operational amplifiers, types of transducers and their characteristics, electronic filters, and power supplies. Prer., consent of instructor. Rock.

BBGN 606-3. Applied Medical Genetics. *Fall, Winter, Spring.* Study of and participation in the school operation of a genetic counseling clinic, with exposure to records, patient interviews, pedigree construction and analysis, literature searches, and problem solving. Laboratory experience in biochemical genetics, population genetics and cytogenetics. Prer., Biophys-Gen. 502 or a one-semester genetics course. Sujansky and Morse.

BBGN 607-4. Structure and Function of Proteins. *Fall.* An interdepartmental course. Comprehensive treatment of protein structure and enzyme action. Prer., Biochem. 600 and consent of instructor. Bublitz.

BBGN 608-2. Topics in Mammalian Cell Biochemical Genetics. *Winter.* Students will be expected to demonstrate mastery of the current knowledge, logic, and concepts of a particular area of mammalian cell biochemical genetics agreed upon by both student and instructor. In-depth analysis of relevant literature under the supervision of one of the instructors will be undertaken. Topics include (but are not limited to) radiation biology, mutagenesis, cell hybridization and its applications, gene expression and mapping, cell surface antigens, malignancy, and biochemical genetics of mutants. Prer., consent of instructor. Patterson and Jones.

BBGN 609-2. Chemical and Biological Aspects of the Environment. *Winter.* A survey of the chemical changes in the environment and a discussion of the physical and chemical parameters responsible for the alterations. Examples of the production of temporary and permanent changes in the ecology due to exposure to the various pollutants will be discussed. Some social and political aspects essential to the control of the various pollutants will be discussed. Prer., biochemistry or consent of instructor. Reiss and staff.

BBGN 610-1. Seminar: Somatic Cell Genetic Biochemistry and Cancer. *Fall, Winter, Spring.* Consideration of current research progress in genetics, biochemistry, differentiation properties, and malignancy of mammalian cells. Puck.

BBGN 611-2. Evolution of Regulatory Mechanisms. *Winter.* Metabolic controls in prokaryotes and, at the cellular level, in eukaryotes. The relevance of cellular mechanisms of regulation to eukaryotic development. Prer., one-year course in biochemistry or equivalent. Rickenberg.

BBGN 612-3. Eukaryotic Genetics. *Spring.* Is intended to provide a general survey of important developments in genetic analysis of eukaryotic systems. Topics include genetic analysis in somatic cells, structure and function of eukaryotic genes and chromosomes, genetic regulation and differentiation, biochemical genetics in eukaryotes. Other important genetic studies in eukaryotes of current interest will also be selected for discussion. Prer., biochemistry. Kao and staff.

BBGN 614-3. Physical Chemistry of Biological Macromolecules. *Winter, Spring.* Thermodynamics and kinetics of the antigen-antibody and other biologically important reactions; transport properties of biological macromolecules; the importance of polyelectrolyte behavior of DNA in protein-DNA interactions and helix stability; interactions of macromolecules with each other and with small molecules. Cann and Hagerman.

BBGN 615-3. Topics in Molecular Neurobiology. *Spring.* A lecture course designed to give students who lack formal training in neuroscience a basic understanding of neurobiology. An introduction to the embryology, pharmacology, biochemistry, and physiology of the nervous system will be presented. However, the major emphasis will be placed on developmental neurobiology. Prer., biochemistry. Seeds.

BBGN 621-2. Genetic Epidemiology. *Winter.* This discipline underlines a major area of studies of disease causation as investigated in families and populations. The seminar will look at several problems including common birth defects, cancer, IQ, teratology, and coronary disease in a lecture/discussion format. Prer., course in genetics, epidemiology, or biometrics. Nora.

BBGN 622-3. Biology of Cancer Cells. *Fall.* Brief history of neoplastic disease. Association of cancer with natural agents and environmental pollutants. Cancer induction by chemicals, radiation, and viruses. Cellular changes associated with transformation of normal cells to cancer cells. Cellular basis of initiation and promotion in the induction of tumors; growth regulation, tumor progression, and metastasis. Prer., consent of instructor. Webber.

BBGN 624-3. Statistical Methods in Medical Genetics. *Fall.* This course will cover methods employed in studying genetic disorders in regard to familial transmission and patterns of expression in populations. Subject matter will include estimates in populations of gene frequency, selection pressure, mutation rate, genetic drift, and inbreeding, as well as the use of segregation analysis, linkage analysis, polygenic inheritance models, twin method, and estimation of recurrence risks by conditional probability in studying disease expression in family pedigrees. Prer., consent of instructor. Morse and Spuhler.

BBGN 630-5. Laboratory Techniques of Mammalian Cells *In Vitro*. *Fall.* Basic techniques in mammalian cell culture and its applications to study of mammalian cell biology, biochemistry, and genetics. Laboratory exercises include incubator design and operation, media, sterile technique, initiation of cell culture, single cell plating, clone isolation, cell growth kinetics, mutant production and isolation, cell fusion techniques, complementation analysis, chromosome analysis, isoenzyme techniques, antigenic analysis. Waldren and Patterson.

BBGN 650-credit to be arranged. Research in Biochemistry. *All quarters.* Research in biochemistry, biophysics, and genetics. Consent of instructor. Hirs and staff.

BBGN 660-1. Seminar in Biochemistry, Biophysics, and Genetics. *Fall, Winter, Spring.* Analysis and discussion of recent research. Required of all graduate students in biochemistry, biophysics, and genetics. Hirs and staff.

BBGN 700-credit to be arranged. Master's Thesis. *All quarters.*
BBGN 800-credit to be arranged. Doctor's Thesis. *All quarters.*

BIOMETRICS

The Department of Preventive Medicine and Biometrics offers training leading to either an M.S. or Ph.D. degree in biometrics, which includes the areas of biostatistics and medical information sciences. Applicants are expected to have a bachelor's degree in a scientific field with mathematics through intermediate (second year) calculus, two years of course work in the physical and/or biological sciences, and a working knowledge of a higher level computer programming language such as FORTRAN. No beginning students will be accepted who do not have at least a 3.00 grade point average as undergraduates. Applicants should arrange to take the verbal and quantitative portions of the Graduate Record Examination no later than the December testing of the year preceding admission. Complete applications, including transcripts of all colleges and universities attended, letters of reference, and GRE scores should be received by the department by March 1 for admission during the fall quarter.

The master's program consists of three quarters of course work followed by a preliminary oral and written examination given at the beginning of the second year and covering the course work. The second year is devoted mainly to the thesis with a comprehensive final

oral examination covering the area of the thesis topic, and given when the thesis is essentially finished.

Admission to the Ph.D. program requires a master's degree in statistics or its equivalent. The first post-master's year consists of course work in both biometrics and a minor area, and fulfillment of the language requirement. Ph.D. students usually remain in residence during the summer quarter involving themselves in research, possibly in connection with the minor area, and preparing for the Ph.D. comprehensive examination, usually taken at the beginning of the fall quarter of the second year. The student then proceeds with dissertation research with a final oral examination on the dissertation topic given when the dissertation is complete.

Biomet. 601-2. Biostatistics Methods. *Fall.* This is the first of a two-quarter sequence designed primarily to equip graduate students with a practical knowledge of the quantitative methods most frequently used in applied research. This quarter deals with elementary probability, parametric and nonparametric methods for handling one- and two-sample estimation and testing problems with continuous data, and various uses of chi-square statistics with frequency data. Prer., consent of instructor.

Biomet. 602-2. Biostatistics Methods. *Winter.* This is a continuation of Biomet. 601. Includes further applications of the chi-squared statistics, linear and nonlinear regression, parametric and nonparametric correlation, an introduction to analysis of variance, life table methodology, and miscellaneous topics. Prer., consent of instructor.

Biomet. 611-3. Computer-Oriented Statistical Methods. *Fall.* This is the first of a three-quarter sequence designed to acquaint the student with the use of computers in the field of applied statistical methods. Selection, use, and interpretation of packaged statistical programs, such as SPSS and MINITAB, will be emphasized. Prer., consent of instructor.

Biomet. 612-3. Computer-Oriented Statistical Methods. *Winter.* This course will develop the students' proficiency in the use of exploratory data analysis methods. Data manipulation editing and analysis will be presented and discussed thoroughly using MINITAB programs. Prer., Biom. 611.

Biomet. 613-3. Computer-Oriented Statistical Methods. *Spring.* This course is a continuation of Biom. 612 and will emphasize regression analysis, multiple regression, and analysis of variance techniques. SPSS will be emphasized for analyzing medically oriented database projects. Prer., Biom. 612.

Biomet. 621. Consulting Methods. *All quarters.* The practical and computational aspects of research problems. The student will analyze problems of increasing complexity throughout the first two quarters.

Biomet. 631-3. Statistical Theory. *Fall.* This course will present an introductory coverage of the theory of both discrete and continuous random variables and the application of this theory to statistical problems.

Biomet. 632-3. Statistical Theory. *Winter.* This course will present the theoretical development of the standard parametric procedures most used in both theoretical developments and applied work, including detailed coverage of both estimation and statistical testing procedures.

Biomet. 633-3. Statistical Theory. *Spring.* Continuation of Biomet. 632.

Biomet. 640-3. Applied Regression Analysis. *Fall.* Simple and multiple linear regression with emphasis on the applications, computer methods, and interpretation of results; methods of multiple nonlinear regression.

Biomet. 641-3. Analysis of Variance. *Winter.* Introduction to applied analysis of variance with emphasis on problems and designs occurring most frequently in medical data.

Biomet. 642-2. Random Variables and Stochastic Processes. *Spring.* The binomial and Poisson processes; birth-death and birth-death immigration processes; branching processes; the general theory of Markov chains, principles of model construction, and applications. Prer., calculus through differential equations.

Biomet. 643-3. Nonparametric Statistical Methods. Nonparametric methods are used in statistical applications when the more standard techniques are inapplicable. This course will cover the most useful of these tools pertaining to estimation, testing, and measuring association.

Biomet. 644-3. Bioassay. *Winter.* Quantitative methods in bioassay. Parallel line and slope ratio assays, direct and quantal assays, design considerations.

Biomet. 645-3. Sampling and Survey Methods. *Spring.* Introduction to sampling and survey methods. Advantages of sampling over census, sources of error, simple random sampling, stratified sampling, cluster sampling, non-random sampling, case studies.

Biomet. 646-3. Survival Curves and Lifetable Analysis. An introductory course in survial curve analysis with emphasis on medical applications.

Biomet. 647-3. Discrete Data Analysis. *Fall.* Acquaints the student with statistical methodology appropriate for the analysis of discrete data including chi square and logistic regression analysis.

Biomet. 648-3. Design and Execution of Clinical Trials. *Spring.* Discussion of the design, quality control, data management, and analysis problems encountered in conducting the typical multi-center clinical trial.

Biomet. 650. Research. *All quarters.* Credit to be arranged. Staff.

Biomet. 661-3. Applications of Linear Models. *Fall.* This is the first of a three-quarter sequence in the applicaitotn of advanced multivariate techniques. The principal topic in the first quarter is the multivariate general linear model, including the underlying theory and usage of available multivariate computer programs.

Biomet. 662-3. Longitudinal Data Analysis. *Winter.* Continuation of Biomet. 661. The theory and application of multivariate techniques appropriate for longitudinal data are discussed with emphasis on the growth curve models developed principally in the 1960s.

Biomet. 663-3. Longitudinal Data Anaysis. *Spring.* Continuation of Biomet. 662. Students will conduct supervised individual investigations of large data collections which are the center of current research at the Health Sciences Center. They will encounter and solve many of the problems typical of multivariate computer analysis of massive collections of real data while applying the techniques discussed in Biomet. 661 and 662.

Biomet. 665-3. Applied Time Series Analysis. *Spring.* Introduction to time domain analysis of time series including computer assignments. Topics inlcude covariance function, autoregression, ARMA and ARIMA models for prediction with missing observations. Continuous time models for unequally spaced data. Applications including regression and ANOVA. Prer., Biomet. 640.

Biomet. 666-3. Applied Time Series Analysis. *Fall.* Spectrum estimation of univariate and multivariable time series (including coherence and phase) using both mini-computer FFT approaches and windowed covariance function methods involving several passes of the FFT frequency response function estimation.

Biomet. 667-3. Mathematical Modelling in Medicine. *Spring.* Mathematical models of dynamic phenomena are becoming more common in all branches of biology and medicine. This course will survey the mathematical tools necessary for the construction of such models and illustrate some of the currently used models. Swanson.

Biomet. 680. Introduction the The Tandem NS-II Computing System. *All quarters.* Introduction to the Tandem NS-II command language interpreter and several data management and statistical analysis systems. Topics include introduction to data entry systems, database design and creation, file management, Enform, SPSS, and Minitab.

Biomet. 681-3. Introductory Computing Literacy. *Fall.* Survey general principles of using interactive computing systems with specific experience with leading software packages on mini-computers and personal computers. Exercises for students to demonstrate under-

standing of general principles by using software packages on several machines to solve problems.

Biomet. 682-3. Intermediate Computing Literacy. *Winter.* In-depth discussion of hardware and software operating principles for interactive computing systems. Exercises provided for students to practice and demonstrate understanding of these principles. Structured software design and programming in one language included. Prer., Biomet. 681 or consent of instructor.

Biomet. 683-3. Computers in the Medical Sciences. *Spring.* Past, present, and future of digital computer hardware and software. Emphasis on needs of medical computing. Hands-on experience with advanced computing systems with software useful in the medical sciences. Prer., Biomet. 682 or consent of instructor.

Biomet. 689-3. Applied Projects in Medical Computing. *Fall, Winter, Spring.* A significant medical computing project will be selected. Student will proceed through complete system development process; project initiation, structured systems analysis, structured design, system building, and system installation under close supervision.

Biomet. 700-credit to be arranged. Master's Thesis. *All quarters.*

Biomet. 731-3. Advanced Statistical Theory. *Fall.* This is the first of a three-quarter sequence presenting an advanced development of the theory of statistical inference. Prer., Biomet. 631, 632, 633, or equivalent.

Biomet 732-3. Advanced Statistical Theory. *Winter.* Continuation of Biomet. 731. Prer., Biomet. 731.

Biomet. 733-3. Advanced Statistical Theory. *Spring.* Continuation of Biomet. 732. Prer., Biomet. 732.

Biomet. 800-credit to be arranged. Doctor's Thesis. *All quarters.*

CHILD HEALTH ASSOCIATE PROGRAM

Interested students should read carefully the requirements listed below regarding admission to the Master of Science Child Health Associate degree program to determine eligibility.

1. A satisfactory grade on the GRE as established by the Child Health Associate Program.
2. Entrance into the Child Health Associate Program with sufficient hours of college-level credit to be able to complete a bachelor's degree prior to the beginning of the second year of the program.
3. Satisfactory completion of the first four quarters of the Child Health Associate Program.

CHB Biol. 514-1. ENT Lecture Series and Practicum. *Fall.* Includes lectures on medical aspects of otorhinolaryngology as well as sessions on audiology and speech pathology. The class is split into small groups for demonstration and practice of specialized ENT examinations, procedures, and audiography/tympanometry. Jafek and Pashley.

CHB 516-2. Studies in Dermatology. *Fall, Winter, Spring.* Lect., clinic. Provides discussions and practical experience in evaluating and managing patients with skin problems. Division into small groups permits extensive evaluation of patients. Prer., CHB 337 and consent of instructor. Weston.

CHB 519-2. Pediatric Pharmacology I. *Fall.* Discussion of the practical aspects of drug absorption, metabolism, excretion, pharmacologic actions, adverse reactions, and toxicologic effects. Half the major drug categories will be covered this quarter including antipyretics, antitussives, antihistamines, antibiotics, vaccines, bronchodilators, minor and major analgesics, anticonvulsants, and emergency drugs. Staff.

CHB 524-1. Advanced Pediatric Emergency Medicine. *Fall.* Lect. and lab. A discussion of the principles and management of medical and surgical emergency situations and wound healing. Includes experience in intubating and suturing in an animal laboratory. Prer., consent of instructor. Roark.

CHB 529-2. Pediatric Pharmacology II. *Winter.* Discussion of the practical aspects of drug absorption, metabolism, excretion, pharmacologic actions, adverse reactions, and toxicologic effects. The major drug categories covered this quarter include local anesthetics, sedatives, tranquilizers, muscle relaxants, local and systematic steroids, thyroid drugs, anti-hypertensives, antacids, cardiac glycosides, antiemetic and antidiarrheal agents and others. Staff.

CHB 531-2. Problem Solving in Medical-Surgical Pediatrics I. *Fall.* Discussion of various medical and surgical pediatric conditions covering pathophysiology, diagnosis, and management followed by case presentations requiring application of this knowledge in problem solving. Common pediatric entities will be emphasized. Areas covered include: hematology, oncology, neurology, allergy, infectious disease, and laboratory medicine. Staff.

CHB 532-4. Problem Solving in Medical-Surgical Pediatrics II. *Winter.* Discussion of various medical and surgical pediatric conditions covering pathophysiology, diagnosis, and management followed by case presentations requiring application of this knowledge in problem solving. Common pediatric entities will be emphasized. Areas covered include renal disease, neonatology, genetics, pulmonary disease, dentistry, endocrinology, and ophthalmology. Staff.

CHB 533-4. Problem Solving in Medical-Surgical Pediatrics III. *Spring.* Discussion of various medical and surgical pediatric conditions covering pathophysiology, diagnosis, and management followed by case presentations requiring application of this knowledge in problem solving. Common pediatric entities will be emphasized. Areas covered include pediatric surgery, gynecology, cardiology, orthopedics, and gastroenterology. Staff.

CHB 534-1. Emergency Medicine in Practice. *Winter.* Provides students with the knowledge and skills to handle various types of emergent situations. Didactic sessions will be held and application emphasized by the use of demonstrations, simulations, manikins, animal laboratories, and audiovisual support. Each student will spend about 10-15 evenings rotating in four different emergency rooms. Roark.

CHB 537-2. Pediatric Clinical Preceptorship I. *Fall.* Involves approximately 9 hrs per wk of time in one-on-one assignments with preceptors in various clinic sites (general pediatrics, adolescent, allergy, emergency rooms) and the proficiency laboratory. Students under the tutelage of individual preceptors must perfect clinical skills, establish assessments, and derive management plans, thus developing problem-solving capabilities of common pediatric problems. In the laboratory they must demonstrate proficiency of 35 essential clinical psychomotor and laboratory procedures necessary for primary care practice. Prer., CHB 337 and consent of instructor. Roark.

CHB 538-3. Pediatric Clinical Preceptorship II. *Winter.* See CHB 537 for description.

CHB 539-3. Pediatric Clinical Preceptorship III. *Spring.* See CHB 537 for description.

CHBT 520-1. Advanced Quantitative Methods. *Spring.* Stresses the epidemiological approach to various medical problems and the interpretation of medical data and journal articles as well as drug advertisements, thereby relating quantitative methodology to the practice of pediatrics. Prer., consent of instructor. Lezotte.

CHP 512-2. Psychosocial Problem Solving. *Spring.* Emphasizes communicating with patients to obtain information needed for diagnosing and treating psychosocial problems. Role playing, videotapes, and other specialized techniques are utilized. A paper or project is done by graduate students concerning patient(s) with a social or emotional problem. Prer., CHB 337 and consent of instructor. Zakus.

CHP 517-1. Graduate Seminar I. *Fall.* Provides time to discuss topics of interest which could not be included elsewhere in the curriculum. Unstructured time is also provided for topics students desire to explore in greater depth. Emphasis is on the art of pediatrics and practical pediatrics. Silver.

CHP 518-2. Psychosocial Aspects of Pediatrics I. *Fall.* Discussions of the evaluation and management of commonly encountered emotional psychosomatic disorders in pediatric practice, including healthy emotional development, "normality," colic, behavior modification techniques, discipline, sleep and eating problems, toilet training and

soiling, dependency problems, responsibility problems, and family crises. Schmitt.

CHP 527-1. Graduate Seminar II. *Winter.* See CHP 517 for course description. Silver.

CHP 528-2. Psychosocial Aspects of Pediatrics II. *Winter.* Discussions of commonly encountered emotional psychosomatic illnesses in pediatrics. Topics to be discussed include child abuse and neglect, enuresis, poisoning repeaters, psychosocial indications for pediatric hospitalization, side effects of hospitalization, managing difficult parents, obesity prior to adolescence, adjustment to acute disease, and adjustment to chronic static disease. Prer., consent of instructor. Schmitt.

CHP 532-1. Pediatric Sexual Problems. *Spring.* Discussions of the evaluation and management of commonly encountered sexual problems in a pediatric practice. Topics to be discussed include normal and abnormal psychosexual development, masturbation, psychosexual aspects of the genital examination, menstrual problems, contraception, out-of-wedlock pregnancy, abortion counseling, venereal disease, and rape. Prer., consent of instructor. Roark.

CHP 537-1. Graduate Seminar III. *Spring.* See CHP 517 for course description. Silver.

CHP 538-2. Psychosocial Aspects of Pediatrics III. *Spring.* Discussions of commonly encountered emotional and psychosomatic illnesses which emphasize their evaluation and management. Topics include an approach to pain in general, recurrent headaches and abdominal pain, school phobia, office anticipatory guidance to prevent emotional problems, patient satisfaction and compliance, a review of pediatric emotional therapy, and when and how to refer to a mental health clinic. Prer., consent of instructor. Schmitt.

CHA 620-credit to be arranged. Master's Project — Proposal. *All quarters.* This first segment of the clinical research project involves formulating a worthy problem for investigation including an in-depth review of the literature, overview of the methodology, analysis of data, and timetable of the study. An expert in the field and a program faculty sponsor should be solicited as advisors. Schmidt.

CHA 621-credit to be arranged. Master's Project — Final Report. *All quarters.* This second segment of the project includes carrying out all field work and data collection of the approved proposal, analysis of data, and preparation of the final complete report. Advisors/consultants should be utilized to monitor each step as it proceeds. Schmidt.

CHA 622-credit to be arranged. Master's Project — Oral Presentation. The third segment of the graduate project demands an oral presentation of the completed project to CHAP faculty, students, instructors, project sponsors, and other interested parties. Preparation of effective audio-visual aids and fielding questions after the presentation are integral parts of this presentation. Schmidt.

CHA 623-5. Internship Summary Report. *All quarters.* Completion of a summarizing report of the internship clinical experiences and accomplishments quantitating numbers and types of patients seen; comparing health care services and provision formats in the varied clinical sites; delineating patient, preceptor, other health care personnel acceptance; noting variations in self-utilization at different sites; discussion of other factors impinging on them as nontraditional health care providers; discerning factors both positive and negative as relates to the internship goals; describing personal and professional accomplishments during the year. Schmidt.

CHA 950. Independent Study-credit to be arranged. *All quarters.* Students, after consultation regarding their special interests and needs, may select a topic for in-depth independent study with credit hours commensurate with time given to study. This effort must be documented by written or verbal presentations and demonstrated functional knowledge on the topic studied. Schmidt.

HUMAN AND MOLECULAR GENETICS

This interdepartmental program leading to the Ph.D. degree provides training in genetics with specialization extending from basic molecular studies to more clinically oriented research and genetic counseling. The faculty is drawn from the Departments of Biochemistry, Biophysics, and Genetics; Microbiology and Immunology; Pediatrics; Medicine; and Obstetrics and Gynecology of the University of Colorado Health Sciences Center School of Medicine.

A wide range of course work and research training is provided in the first year of study. This includes studies in genetics as well as training in allied fields. Students do laboratory rotations in four areas of genetics: (1) molecular and microbial genetics, (2) somatic cell genetics, (3) biochemical genetics, and (4) clinical and cytogenetics. During the second year of the program they select a faculty advisor for advanced research training.

Candidates for admission should have theoretical and laboratory training in general biology, including genetics, inorganic and organic chemistry, physics, physical chemistry, calculus, and statistics. Students must meet all the usual requirements of the University of Colorado, including the foreign language stipulation. Students are required to take the Graduate Record Examination (GRE) and have their scores forwarded prior to admission.

The following courses are taken as required or electives in the Genetics Training Program.

BBGN 502-3. Medical Genetics and Biophysics. *Fall.* Human Genetics and its biological basis. Two hrs., one hr. demo. and disc. Freshman medical students and graudate students. Seeds and staff.

BBGN 600-5. General Biochemistry. *Fall, Winter, Spring.* Five lec. hrs. and one hr. disc. per week. This is a three-quarter course, with 5 hours of credit each quarter. The course stresses the relations between molecular structure and function in biological systems. It is designed for students whose aim is a career in research and teaching in biochemistry and allied disciplines, particularly biophysics and genetics. The major areas of biochemistry and molecular biology will be covered and should provide a foundation for more comprehensive treatment of specialized subjects that a student may wish to pursue further in advanced courses or in the laboratory. Prer., organic chemistry, calculus. Hirs and staff.

BBGN 608-2. Topics in Mammalian Cell Biochemical Genetics. *Winter.* Students will be expected to demonstrate mastery of current knowledge, logic, and concepts of a particular area of mammalian cell biochemical genetics agreed upon by both student and instructor. In-depth analysis of relevant literature under the supervision of one of the instructors will be undertaken. Topics include (but are not limited to) radiation biology, mutagenesis, cell hybridization and its applications, gene expression and mapping, cell surface antigens, malignancy, and biochemical genetics of mutants. Prer., consent of instructor. Patterson and Jones.

BBGN 610-1. Seminar: Somatic Cell Genetic Biochemistry and Cancer. *Fall, Winter, Spring.* Consideration of current research progress in genetics, biochemistry, differentiation properties, and malignancy of mammalian cells. Puck.

BBGN 612-3. Eukaryotic Genetics. *Spring.* Is intended to provide a general survey of important developments in genetic analysis of eukaryotic systems. Topics include genetic analysis of somatic cells, structure and function of eukaryotic genes and chromosomes, genetic regulation and differentiation, biochemical genetics in eukaryotes. Other important genetic studies in eukaryotes of current interest will also be selected for discussion. Prer., biochemistry. Kao and staff.

BBGN 623-1. Cytogenetics Laboratory. *Spring.* Practical exercise in current cytogenetic techniques including various banding and other new techniques on a variety of human tissues. Robinson and Ward.

BBGN 630-5. Laboratory Techniques of Mammalian Cells In Vitro. *Fall.* Basic techniques in mammalian cell culture and its applications to study of mammalian cell biology, biochemistry, and genetics. Laboratory exercises include incubator design and operation, media, sterile

techniques, initiation of cell culture, single cell plating, clone isolation, cell growth kinetics, mutant production and isolation, cell fusion techniques, complementation analysis, chromosome analysis, isoenzyme techniques, antigenic analysis. Waldren and Patterson.

IDPT 624-2. Microbial and Molecular Genetics. *Winter.* A lecture course with emphasis on modern microbial genetics and recombinant DNA technology. Betz and staff.

IDPT 629-2. Human Inborn Errors of Metabolism. *Spring.* Examines human diseases which result from mutations of catalytic, transport, and structural proteins. Emphasis on the mechanisms through which abnormal phenotype is produced as well as on recent advances in the prevention and treatment of these conditions. Patients will be presented when possible. Goodman.

IDPT 644-3. Principles of Gene and Metabolic Regulation: An Aid to Understanding Human Diseases. *Fall.* Principles of metabolic regulation ranging from the level of the cell to the human organism. The role of altered metabolic regulation in the etiology of clinical diseases will be discussed at each level where examples exist. Prer., BBGN 600 or equivalent. McCabe and Davidson.

Microbiol. 629-2.5. Immunology. *Fall.* This course is the same as Microbiol. 524, the medical core course, but is adapted for graduate students. Such students will not be required to attend clinical correlation sessions, but will attend a weekly in-depth discussion of the material presented in lectures at a time to be chosen. J. Cohen.

MICROBIOLOGY AND IMMUNOLOGY

Candidates for admission to graduate work in microbiology and immunology should have theoretical and laboratory training in general biology, inorganic and organic chemistry, physics, physical chemistry, calculus, and statistics. Some knowledge of genetics and the history of biology is desirable.

The Graduate Record Examination is required.

Students wishing to pursue graduate work in microbiology leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees and Graduate School Admission Requirements.

The Department of Microbiology and Immunology has no specific Ph.D. foreign language requirement, but proficiency in at least one foreign language is required.

All courses in microbiology are quarter-hour courses.

Microbiol. 520-5. Properties of Bacteria, Viruses, and Protozoa and Their Interaction With Their Hosts. *Fall.* A one-quarter course of 11 weeks, introducing students to certain fundamental features of microorganisms and their ability to cause disease. Includes a description of the properties of varous pathogenic bacteria, viruses, fungi, and parasites and the diseases caused by these organisms. Patients will be presented to illustrate a number of these diseases. Also included will be a description, at the cellular and molecular level, of bacterial physiology, microbial genetics, virus structure, and virus reproduction. Four lect. per wk., one hr. of Infectious Disease Clinic. Pizer and staff.

Microbiol. 521-3½. Microbiology Laboratory. *Fall.* A seven-hour lab. course accompanying Microbiol. 520 and 524 and concerned with the growth and properties of microorganisms and fundamental techniques of immunology. Roberts and staff.

Microbiol. 602-2. Special Topics in Immunology. *Spring.* This is a set of seminars by graduate students and faculty on areas of very current interest in immunological research, both cellular and humoral. All enrolled students will present at least one seminar. Claman and staff.

Microbiol. 625-2. Microbial Physiology. *Spring.* Macromolecular syntheses and regulatory processes governing them. Biosynthesis of small molecules and their regulation. Differentiation: sporogenesis and germination. Gill.

Microbiol. 627-4. Molecular Virology. *Spring.* Lecturers will be concerned with the molecular events that take place following the virus infection of animal cells. The topics covered will include viral structure; the genome organization, replication, and expression of viral genome; mechanisms of action of tumor viruses and cytopathic viruses; and the action of interferon. Siddiqui.

Microbiol. 629-2.5. Immunology. *Fall.* A comprehensive course of basic and clinical immunology. This course is the same as Microbiol. 524, the medical core course. Graduate students are not required to attend the clinical correlation sessions, but other meetings may be arranged at convenient times. Cohen and Claman.

Microbiol. 630-3. Advanced Immunology. *Spring.* An advanced course in immunology focusing on immunochemistry *or* advanced topics of cellular immunology. Students must have a considerable background in immunology. Kubo and Claman.

Microbiol. 631-3. Immunobiology. *Winter.* A lecture course providing current information on various aspects of cellular and molecular immunology. Topics covered include molecular biology of MHC and Ig genes, immunobiology of T and B lymphocytes, lymphokines and cell-interactions, idiotypes, transplantation biology, tolerance and suppression, immediate hypersensitivity, and host defense mechanisms. Students must have completed MICB 629 or its equivilent. Moorhead.

Path. 636-3. Viral Pathogenesis. *Spring.* A lecture and literature review course emphasizing current methods of experimental analysis of virus infections of mammalian hosts. Includes a discussion of viral strategies of evading normal host resistance, immunopathogenesis, host/viral evolution, tumor virology, and interferon. Lehman.

Microbiol. 650-credit to be arranged. Research in Microbiology and Immunology. *All quarters.* Independent research in microbiology and/or immunology open to all graduate students with approval of their individual departments or advisors. Arrangements will be made with the microbiology and immunology faculty member under which research is done. Prer., training in microbiology/immunology and biochemistry. Pizer and staff.

Microbiol. 700-credit to be arranged. Master's Thesis. *All quarters.* Pizer.

Microbiol. 800-credit to be arranged. Doctor's Thesis. *All quarters.* Pizer.

PATHOLOGY

Students wishing to pursue graduate work in pathology leading to candidacy for advanced degrees should read Requirements for Advanced Degrees and Graduate School Admission Requirements.

Candidates with the B.S. or B.A. degree as well as those with the M.D. degree are considered for the Ph.D. in pathology.

The Ph.D. program requires a minimum of 45 hours of graduate work, including anatomy, biochemistry, biophysics, cytology, genetics, advanced organic chemistry, physical chemistry, and a selection of the graduate courses given by the Department of Pathology. In addition, extensive experience leading to a thesis is required.

A stringent two- to three-year program for postdoctoral students who wish to attain a real understanding of and research competency in modern biology is also available. In addition to regular course work, the first year can be spent in rotating through three or four research laboratories of varied interests. The second and possibly third years are then spent in one laboratory, determined by the experience and interest of the individual toward the close of the first-year rotation. Areas of research interest include virology, cell biology, mem-

brane structure and biochemistry, tumor biology, and experimental pathology.

Detailed brochures are available.

Path. 501a-11½. General and Systemic Pathology. *Winter, Spring.* A survey of human disease with emphasis on clinical-pathologic correlation in preparation for the practice of medicine. A short introduction covers disease mechanisms. This is followed by a series of lectures and laboratory sessions devoted to each of the organ systems. Staff.

Path. 501b-11½. General and Systemic Pathology. *Winter, Spring.* As in Path. 501a, this course presents a survey of human disease in preparation for the practice of medicine. In addition, the biologic bases and mechanisms of disease are presented in depth and are integrated with clinical-pathologic manifestations. Lectures, seminars, and small group study of cases are used. Staff.

Path. 600-3 Mechanisms and Models of Disease. *Spring.* Current concepts of models and mechanisms of disease. Selected topics will be covered and changed on a yearly basis. Topics will include inflammation, diabetes, neoplasia, atherosclerosis, hematological disorders, selected infectious diseases, and inborn errors of metabolism. Evans.

Path. 602-1. Chemical Characterization of Proteins. *Spring.* Methods for chemical and immunochemical analysis of proteins will be studied. Students dealing with proteins in their research should be able to apply concepts and reactions from the lectures to their research problems. Carson.

Path. 605-2. Topics in Experimental Oncology. *Spring.* Lectures and seminars covering selected topics of interest in the field of experimental oncology. This year's topics will include cytogenetics in cancer, surface changes in cancer cells, oncofetal antigens, and fine structure of cancer cells. Sophomore medical students and graduate students. Prer., first quarter of Path. 501. Lehman and staff.

Path. 613-1. Research Seminars and Journal Club. *Fall, Winter, Spring.*

Path. 614-2. Automated Cytology and Flow Cytometry. *Winter.* This course will present the techniques and technology utilized in cytology and flow cytometry. This includes staining and analysis of cells for DNA content, and immunofluorescence, as well as cell separation. Lehman and staff.

Path. 640-2. Lectures in Reproductive, Endocrine, and Developmental Biology. *Fall, Winter.* Lectures on the research interests of the faculty of the University of Colorado Intercampus Program in Reproductive, Endocrine, and Developmental Biology (UCRED). Will include modern concepts in reproductive endocrinology, developmental biology, and tumor biology. Miller and staff.

Path. 641-2. Laboratory Techniques in Reproductive, Endocrine, and Developmental Biology. *Winter, Spring.* Techniques used in the disciplines of Reproductive, Endocrine, and Developmental Biology (UCRED program). Will include laboratory experience in surgery, histology, immunohistochemistry, cell, tissue and embryo culture, autoradiography, chromatography, radioimmunoassay, receptor assay, RNA-DNA hybridization, gene cloning, etc. Prer., Path 605. Miller and staff.

Path. 650. Research in Pathology. *All quarters.* Credit to be arranged.

Path. 700-credit to be arranged. Master's Thesis. *All quarters.*

Path. 800-credit to be arranged. Doctor's Thesis. *All quarters.*

IDPT 602-3. Basic Oncology. *Winter, Spring.* A course designed for both medical and graduate students, part of the content of which is based upon the cell biology and molecular biology of the cancer cell. The focusing of this knowledge to the understanding of the problems and management of the cancer patient is emphasized. While clinical illustrations are used, this is not a course in the systematic management of the cancer patient. Lehman.

PHYSIOLOGY

Students wishing to pursue graduate work in physiology leading to candidacy for advanced degrees should read carefully Requirements for Advanced Degrees and Graduate School Admission Requirements.

The Department of Physiology has no Ph.D. tool foreign language requirement.

Prerequisites. The preliminary training of the student desiring to major in physiology should include:

1. One year of advanced biology (genetics, embryology, invertebrate or comparative zoology, general or cellular physiology).
2. Physics (one year), chemistry (including physical), and mathematics (including calculus and statistics).

Physiol. 501-9.5 Principles of Mammalian Physiology. Lectures, demonstrations, and laboratory. Graduate students may elect lectures only for 8.0 credits. Martin and staff.

Physiol. 613-3. Cellular Neurobiology. *Winter.* Lectures and student presentations covering basic mechanisms involved in the action potential, synaptic transmission, neural integration, and other selected topics. Prer., consent of instructor. Betz, Caldwell, Levinson, Martin, Roper, and Wickelgren.

Physiol. 614-2. Cardiorespiratory Physiology. *Winter.* Selected topics in mammalian cardiovascular and/or respiratory physiology with special emphasis on fundamental principles. Lectures and demonstrations. Prer., Physiol. 501 or equivalent. Banchero.

Physiol. 615-2. Development, Maintenance, and Plasticity of Neuronal Connections. *Spring.* Focuses on cellular mechanisms that underlie long-term changes in the organization of the nervous system. Prer., consent of instructor. Betz, Caldwell, Roper, and Wickelgren.

Physiol. 650-credit to be arranged. Research in Physiology. Laboratory and library problems. Primarily for graduate students. Martin and staff.

Physiol. 700-credit to be arranged. Master's Thesis. *All quarters.* Study for the master's degree is not encouraged except in special situations. Martin.

Physiol. 800-credit to be arranged. Doctor's Thesis. *All quarters.*

PHARMACOLOGY

Students wishing to pursue graduate work in pharmacology leading to candidacy for the Ph.D. degree should read carefully Requirements for Advanced Degrees and Graduate School Admission Requirements.

Prerequisites. The preliminary training of students desiring to major in pharmacology should include the following college courses:

1. Biology: introductory biology or general zoology, or their equivalent. Work in invertebrate and comparative zoology and genetics is desirable.
2. Chemistry: at least two years of college chemistry, including inorganic, organic, and physical chemistry.
3. Physics: general introductory. Advanced physics, particularly in mechanics and electricity, is desirable.
4. Mathematics: differential and integral calculus.
5. Language: a reading knowledge of a foreign language is required. This may be demonstrated by satisfactory performance on an examination or by satisfactory completion of the second semester of a second-year college language course. The department strongly recommends German as the most appropriate foreign language for pharmacology.

PHCL 510-3.5. Pharmacology. *Fall.* Intensive study of the drugs used in medical practice. This quarter includes general principles, endocrine therapy, antimicrobial and cancer chemotherapy, toxicology and drug metabolism. Lectures and clinical correlations. Prer., physiology and biochemistry. Weiner and staff.

PHCL 511-1. Laboratory in Pharmacology. *Winter.* Second year. Laboratory exercises are designed to provide a basis for discussion of basic pharmacologic principles in a laboratory setting. Prer., biochemistry and physiology. Mosimann.

PHCL 514-5. Pharmacology. *Winter.* Intensive study of the drugs used in medical practice. This quarter includes autonomic pharmacology, cardiovascular pharmacology, central nervous system pharmacology, developmental pharmacology, and evaluation of drugs in clinical practice. Lectures, clinical correlations, tutorials and student presentations. Prer., Pharmacology 510 or equivalent. Weiner and staff.

PHCL 601-3. Spectroscopic Methods. *Spring.* Problem-solving course using infrared, ultraviolet, nuclear magnetic resonance, liquid scintillation, and mass spectroscopic techniques to determine structures of organic molecules of biochemical interest. The use of the techniques in present biomedical research is also stressed. Prer., Biochem. 600. Murphy and Fennessey.

PHCL 602-3. Introduction to Methods in Pharmacology. *Winter.* Designed to introduce the student to laboratory techniques and procedures pertinent to the study of pharmacology. Prer., pharmacology. (May be taken concurrently.) Mosimann.

PHCL 606-3. The Regulation of Metabolism and Cell Function. *Winter.* Detailed treatment of mechanisms by which cells regulate metabolic processes and macromolecular synthesis. Emphasis will be placed on mechanisms of hormonal regulation, on the regulation of enzyme activity by protein phosphorylation and calcium-dependent processes, and on enzyme regulation by allosteric mechanisms. Prer., Biochem. 600 or equivalent. Langan, Maller, Cooper, and Ingebritsen.

PHCL 609-3. Biochemistry of Neurotransmission. *Spring.* Lecture topics will include (1) the synthesis, metabolism, storage, and release of norepinephrine, acetylcholine, and other putative transmitters in the pheripheral and central nervous systems; (2) the identification and assay and properties of receptors; (3) CNS neuropharmacology. Weiner, Hoffer, and Zahniser.

PHCL 610-3. Membrane Pharmacology. *Fall.* Lecture and discussion concentrating on multiple aspects of membrane structure and function. Special emphasis will be placed on the interactions of drugs with biological membranes in general as well as with specific components of membranes. Polokoff and Zahniser.

PHCL 612-3. Drug Metabolism and Drug Interaction. *Spring.* The chemical transformations that a drug molecule can undergo in the mammalian system will be discussed. The classification of metabolic pathways will focus on structural features and functional groups contained within the drug. Emphasis will be given to the enzymatic mechanisms by which drugs are altered in the body. Prer., biochemistry. Deitrich and Murphy.

PHCL 618-3. Neurophysiological Techniques. *Winter.* Principles of, and practical experience in, microelectrode construction, iontophoresis, measurement of responsiveness of excitable cells, use of computers in this research, and other techniques relevant to neurophysiology and neuropharmacology will be presented. Prer., PHCL 510. Hoffer and Dunwiddie.

PHCL 620-3. Introduction to Pharmacology. *Fall.* Principles of pharmacology, including pharmacokinetics, receptor-ligand interactions, dose-response and structure-activity relationships, and drug metabolism are presented. Masserano.

PHCL 650. Introduction to Research in Pharmacology. *All quarters.* Directed laboratory research in selected area by the faculty. Credit to be arranged. Weiner.

PHCL 700-credit to be arranged. Master's Thesis. *All quarters.* Weiner.

PHCL 800-credit to be arranged. Doctor's Thesis. *All quarters.* Weiner.

PHYSICAL THERAPY

Students wishing to pursue graduate work in physical therapy leading to candidacy for an advanced degree should read carefully. Requirements for Advanced Degree and Graduate School Admission Requirements.

Prerequisites. Students comtemplating graduate work in physical therapy must have completed an undergraduate major in the field or an approved professional course in physical therapy. Undergraduate courses must have included general biology, physics, organic chemistry, algebra, trigonometry, and introductory statistics. Additional biological sciences, such as histology and embryology, and inorganic chemistry, are desirable.

A reading knowledge of one foreign language is recommended.

P.T. 631-6. Physical Therapy Seminar. *Summer, Fall.* Students will prepare oral reports based on a comprehensive survey of literature on assigned topics. Both the content and the presentation of the reports will be evaluated by an audience of faculty, staff, and graduate students. Cenkovich.

P.T. 632-5. Advanced Physical Therapy. *Summer, Winter.* Practice teaching in curriculum in physical therapy. Advanced skills in patient evaluation and treatment in selected areas, i.e., muscle testing and training, electrical diagnosis and treatment, gait, functional training, neurodevelopmental evaluation, therapeutic exercise. Barnett.

P.T. 633-2. Physical Principles in Physical Therapy. *Fall.* Application of principles of physics and mechanics in physical treatment. Gait analysis, physiology of skeletal muscle, dynamics of respiration and cardiovascular dynamics. Cenkovich, Sexton, Gersten.

P.T. 634-2. Introduction to Research. *Winter.* Methods in research. Problem areas in basic and clinical research. Writing a grant request. Selection of an individual problem and preparation of research design. Statistical principles in biological research. Barnett.

P.T. 650-6. Research in Physical Therapy. *Spring, Summer.* Independent research under guidance of a staff member. Gersten.

P.T. 700-credit to be arranged. Master's Thesis. *All quarters.* Faculty.

PREVENTIVE MEDICINE

The M.S. in preventive medicine provides advanced training for persons interested in community-oriented careers that could include epidemiology, community needs assessment, planning, and evaluation of public health services. Students will develop a comprehensive grounding in the core content and methodological areas of community health and will be encouraged to select an area of concentration of particular relevance to their present or future responsibilities. Analytic skills required for population-based research and for effective application of findings in areas of public health planning and policy and management are emphasized. This program would be of interest to persons presently working or expecting to work in academic settings, industry, government health agencies, or international health.

PRMD 602-3. Medical Anthropology. *Spring.* Concerned with the underlying determinants of health manifested in biological, cultural, and environmental factors. The operation of these three determinants is considered in the context of contemporary American society and selected other cultures. Spring semester at the UCD campus. Moore.

PRMD 603-3. Health Care Systems I. *Fall.* Organization and structure of U.S. health care system including historical trends in public and private sector and at primary, secondary, and tertiary care levels. Topics include how to define and measure health, health status of Americans, kinds of health service organizations and manpower, and financing of health services. Martini.

PRMD 604-3. Health Care Systems II. *Spring.* Extends the concepts in PRMD 603 and develops in greater depth issues pertaining to the operation and administration of health organizations. Topics include planning and policy in health services; principles of management, personnel, and governance; cost-benefit analysis; and basic health economics. Prer., PRMD 603 or consent of instructor. Martini.

PRMD 607-2. Medicine and Law. *Spring.* This seminar will introduce students to issues in law and medicine. Covered among these issues are the relation of law to medicine, significant court decisions regarding the autonomy of patients, informed consent, the rights of physicians and other health care professionals, and general issues in medical malpractice. Marsh.

PRMD 608-3. Ethical Decision Making in Health Professions. *Fall, Winter.* Interdisciplinary faculty-student seminars to explore various ethical and legal problems which arise in the delivery of health care. Assigned and elective readings and presentations in the areas of overlap between the health professions, ethics, and law will be discussed and applied to real life decision making in the health professions. Cobb and Marsh.

PRMD 609-3. Advanced Studies in Bioethics. *Spring.* This seminar focuses on specific topics in medical ethics, particularly ethical issues in patient management, such as ethical and legal issues of informed consent and ethical issues in equity of access to health care. Prer., prior course in medical ethics or consent of instructor. Marsh.

PRMD 610-3. Social and Community Factors in Health. *Winter.* An examination of epidemiological frameworks which are inclusive of social and community factors and their influence on heath status and health care; particular focus on social, economic, and political dimensions of person, place, and time; and review of implications of social and community factors for appropriate health intervention strategies. Stromberg.

PRMD 612-3. Concepts of Health. *Fall.* This interdisciplinary seminar, primarily for medical students and other health professionals, will discuss readings and examine the implications of various concepts of health to the responsibilities of health professionals and to the future of medical practice. Staff.

PRMD 614-3. Introduction to Occupational and Environmental Health. *Winter.* Presents an overview of information needed to assess the relationship between the environment/work place and health. Topics include facets of industrial hygiene, air and water pollution, radiation monitoring, toxicology studies, clinical occupational medicine, and biologic monitoring. The emphasis throughout is on the epidemiologic link between exposure and health. Savitz.

PRMD 616-2. Principles and Practices of Community Health Education. *Winter.* Introduces basic concepts and implementation strategies for health education and behavior change on one-to-one, small group, and mass levels. The interaction of the individual, family, community, and health professionals will be stressed. Topic areas include the health care system from the consumer's viewpoint, cost-containment measures that can be developed through consumer education; trends in consumerism. Tabak.

PRMD 617-3. Scientific Basis of Health Promotion and Disease Prevention. *Winter.* Epidemiological, physiological, and intervention studies related to health promotion and disease prevention will be reviewed and their implications and possible applications discussed. Policy implications of health promotion will be discussed using morbidity and mortality data from Western countries, including the United States, as the basis of the discussions. Iverson.

PRMD 619-3. Perspectives in International Health. *Spring.* A review of a number of universal health care issues and the ways in which various national health care systems are organized or have evolved to deal with these issues. Several contrasting national health care systems will be reviewed in depth. The role of governmental, multigovernmental, philanthropic, voluntary, and commercial organizations in the international health area will be examined. Core faculty and both local and international participants will contribute to the practical understanding of various national health care systems. Stromberg.

PRMD 620-2. Growth and Development. *Winter.* Teaches the principles of screening, the organization and monitoring of community screening programs, an awareness of childhood screening procedures and skills in the actual administration and interpretation of such tests, and the application of such principles in the context of current screening programs. Frankenburg.

PRMD 621-2. Maternal and Child Health. *Spring.* Introduces students to several current issues in MCH, including adolescent pregnancy, electronic fetal monitoring, well-child care, accidents, child abuse, chronic illness, and child advocacy. Dawson.

PRMD 622-2. Nutrition for Public Health. *Winter.* Introduces students to the field of nutrition as it applies to health promotion and disease prevention. Topics will be chosen to reflect broad areas of nutrition research and policy in the context of medical and public health disciplines. Franklin.

PRMD 624-3. Community Diagnosis. *Winter.* Community diagnosis provides the means of assessing the social, economic, physical and environmental status of a community, as they affect the health of its population. Students will learn to use national and local demographic and health data resources. Orleans.

PRMD 626-credit to be arranged. Research Methods in Community Health. *Spring.* Covers research methods, topics, e.g., clinical trials, medical care evaluation and survey research. Lectures and discussions cover hypothesis formulation, study design, data collection and analysis. Participants and faculty address specific methodologic issues as encountered by students in their research. Orleans.

PRMD 628-2. Technology Assessment and Medical Care. *Spring.* Considers some of the current approaches to the assessment of medical technology. The differing methodological requirements of current modes of assessment will be reviewed, including consensus conferences, evaluation research, the review of literature as to the nature of evidence, and the movement toward controlled trials. Prer., Epidemiology or Research Methods. Orleans and Murphy.

PRMD 630-4. Epidemiology. *Fall.* Epidemiology offers an introduction to the approaches and methods used in describing the natural history of disease in the community, for locating clues to the causes of disease and of ways to develop and evaluate preventive strategies and other medical services. Lecture-discussions supplemented with problem-solving exercises. Marshall and Hamman.

PRMD 631-3. Advanced Epidemiologic Methods. *Spring.* Extends epidemiologic concepts and methods through lectures, readings, and in-depth exercises. Subjects include study of design issues, matching, use of person-years, methods to estimate prognosis and survivorship, measurement and control of observer variability, and introduction to sampling, among others. Hamman and Savitz.

PRMD 633-3. Cancer Epidemiology. *Winter.* A survey of present knowledge of causes of human cancer, emphasizing critical analysis of published reports and ways of obtaining further evidence. Student reports are presented and discussed. Designed for medical students (after pathology) and graduate students with background in biometrics, epidemiology, or other biomedical sciences. Berg.

PRMD 635-3. Epidemiology of Communicable Diseases. *Spring.* Epidemiology of selected communicable diseases. Methods for their prevention and control, and assessment of these methods will be treated primarily through case studies. Prer., basic courses in epidemiology and microbiology or consent of instructor. Hopkins.

PRMD 650-credit to be arranged. Research in Preventive Medicine. *All quarters.* Staff.

PRMD 660-credit to be arranged. Field Practicum. *All quarters.* Students may work in state and local health departments or industry, investigating disease outbreaks or environmental hazards. Students can participate in ongoing studies in chronic and infectious disease epidemiology, environmental health, and community health planning, or develop their own project in conjunction with a preceptor. Prer., consent of preceptor. Staff.

PRMD 670-credit to be arranged. Topics in Preventive Medicine. *All quarters.* Special interest areas of current preventive medicine re-

search and controversy are analyzed in depth. The course format is lecture and discussion or seminar. Staff.

PRMD 700-credit to be arranged. Master's Thesis. *All quarters.* Staff.

RADIOLOGY

Graduate study leading to candidacy for the M.S. degree is offered in the fields of medical physics and radiation biology.

Departmental Requirements. Students planning to pursue graduate work in radiology should read carefully the section Requirements for Advanced Degrees, and Graduate School Admission Requirements.

Prerequisites. The undergraduate training of students wishing to major in radiology should include one year of biology, one year of physics, and differential and integral calculus. Additional undergraduate requirements include one year of advanced physics or its equivalent, differential equations, and introductory probability theory and statistics for students wishing to study physics; and one year of advanced biology or its equivalent and organic chemistry for students wishing to study radiation biology.

Course Requirements. For students interested in medical physics, two plans of study are available. Plan I includes a thesis, certain required courses, and electives. Plan II includes required courses and electives but does not require a thesis. Only Plan I is available to students wishing to study radiation biology.

Language. The department has no tool requirement in foreign languages.

Qualifying Examination. Students must pass a written qualifying examination during the first 14 weeks of the first semester of graduate study.

Comprehensive-Final Examination. After other requirements for the master's degree are completed, each candidate must take an oral comprehensive-final examination. If the student is following Plan I, in which a thesis is required, the examination will include the thesis.

Radiol. 600-2. Clinical Experience. *All quarters.* Practical experience available in all areas of radiology. Students will spend six to eight weeks in the major clinical divisions. An additional three to four weeks will be spent in each of several other activities. Students spend their time primarily with the physicists in the various divisions, but also will interact with clinicians and technologists during a variety of clinical procedures. Hendee and staff.

Radiol. 610-1. Clinical Radiology. *Fall, Spring.* Consists of lectures by clinicians covering practical clinical aspects of radiology: Diagnostic radiology, nuclear medicine, ultrasound, and radiation therapy. Paquette, Taubman, Johnson, and staff.

Radiol. 612-4. Radioisotopes in Biological Research. *Spring.* Topics include radioisotope safety; dose units; dose rates from radioactive sources; working levels; regulatory and advisory agencies; federal, state, and institutional regulations, licensing procedures; properties of the atom and nucleus, radioactive decay; secular and transient equilibrium; production of radioactive nuclides, synthesis of radioactive compounds; analysis, purity; stability and availability of radioactive compounds. Ritenour.

Radiol. 613-2. Basic Radiological Physics. *Fall, Spring.* Topics include structure of matter, radioactive decay, decay schemes, transient and secular equilibrium; production of radioactive nuclides; interaction of particulate radiation; production of x-rays, x-ray tubes and circuits; radiation-generating equipment; interaction of electromagnetic radiation; attenuation of x and gamma rays; radiation intensity, exposure, and dose; introduction to radiation protection. Includes experiments at the TRIGA reactor and at the cyclotron. Hendee and staff.

Radiol. 614-2. Radiation Biology. *Spring.* Emphasizes the effects of irradiation on human tissues, effects of radiation on cellular, molecular organs and whole organism levels, and late effects of ionizing radiation including mutation and carcinogenesis. Prasad.

Radiol. 615-2. Physics of Radiation Therapy. *Fall.* Topics include interactions of x- and gamma rays in tissue, backscatter, depth dose, tissue-air ratios, design and operation of medical linear accelerators, Bragg-Gray theory, calibration of high-energy photon and electron beams, treatment planning, isodose distributions, corrections for surface obliquities and heterogeneities. Hendee and Ritenour.

Radiol. 616-2. Physics of Medical Imaging. *Fall.* Conceptual approach to medical imaging, illustrating principles such as unsharpness, contrast, distortion and noise, with applications to roentgenography and nuclear medicine. Characteristics of imaging systems and quantifiable aspects of the image forming process are explored in depth. Hendee, Spitzer, and Rossi.

Radiol. 617-2. Physics of Medical Imaging. *Spring.* Conceptual approach to medical imaging, illustrating principles such as unsharpness, contrast, distortion and noise, with applications to ultrasound and computed tomography. Characteristics of imaging systems and quantifiable aspects of the image forming process are explored in depth. Hendee, Spitzer, and Rossi.

Radiol. 623-2. Radiopharmacy and Human Physiology. *Summer.* Human anatomy and physiology with emphasis on radiologic imaging. Radiopharmaceutical selection and production, properties of routine and investigational radiopharmaceuticals, and quality assurance. Staff.

Radiol. 625-2. Health Physics. *Spring.* Radiation units, radiation protection, standards and their development, radiation dose from external sources in various configurations, shielding calculations and room design, internal radiation dosimetry, physiologic models for dose estimates, tracer kinetics and their application to dose estimates, maximum permissible exposures, health physics instrumentation, radiation safety operations, decontamination procedures. Hendee.

Radiol. 631-1. Special Topics in Radiology I. *Fall.* Current research topics in radiology; experimental design; recent advances in imaging methodology and therapeutic equipment; new techniques in dosimetry, quality assurance, and treatment planning; federal, state, and local regulations and guidelines; professional ethics; business practices in medical physics. Hendee.

Radiol. 632-1. Special Topics in Radiology II. *Spring.* Continuation of Radiol. 631. Hendee.

Radiol. 650-credit to be arranged. Research in Radiology. *All quarters.* Available as an elective to a limited number of students. Students must have an acceptable protocol or qualifications appropriate for participation in ongoing departmental project. Hendee, Rossi, Scherzinger, Spitzer, and Ritenour.

Radiol. 700-credit to be arranged. Master's Thesis. *All quarters.* Prer., completion of master's course work. Hendee, Cacak, Rossi, Spitzer, Kirch, Banjavic, and Ritenour.

INTERDEPARTMENTAL COURSES

The following interdepartmental courses are taken as required or as elective courses in the above intergraduate programs at the Health Sciences Center.

IDPT 607-2. Drugs and the Developing Organism. *Fall.* Designed to provide an understanding of basic physiologic mechanisms involved in pediatric pharmacology. It covers liver enzymes, renal function, placenta-barrier, and blood-brain-barrier. Child disorders such as the hyperkinetic syndromes, epilepsies, and newborn addiction are discussed. Presented by the Departments of Pharmacology and Psychiatry. Prer., biochemistry and physiology. Vernadakis and Manchester.

IDPT 608-credit to be arranged. Clinical Research Techniques and Studies of Human Disease. *Spring.* The course will focus on experimental design, execution, and interpretation of clinical research studies with reference to current techniques and effective use of methods. Discussions of current and future clinical research problems will be presented by members of different divisions and departments. Gordon

IDPT 609-3. Membranes and Transport. *Spring.* Membrane structure and function will be considered in a lecture-discussion format. Student presentations and readings from current journals will supplement lectures on such topics as membrane structure and fluidity, electrolyte and nutrient transport across membranes, energy transduction in membranes and membrane potentials. Neville, Harold, and Sinensky.

IDPT 615-1. Physiology of Skeletal Muscle and Bone. *Fall.* Cellular contractile mechanisms, functional and exercise aspects of muscle contraction and relationship of muscle and bone. Jointly by Departments of Physiology, Physical Medicine and Rehabilitation, and Orthopedic Surgery, Lectures and demonstrations. Gersten, Miles, Cenkovich, and Solomons.

IDPT 616-1. Neuroscience Seminar. *Fall.* Designed to demonstrate current neuroscientific research and its applications in the study of neurological diseases. The student attends weekly lectures in which faculty members present current neuroscientific investigations in their laboratories. Ringel.

IDPT 624-4. Molecular Genetics. *Winter.* A lecture course with emphasis on modern microbial genetics, primarily of *Escherichia coli* and its phages. Sadler, Betz, Plato.

IDPT 628-2. Gerontological Pharmacology. *Fall.* The course will consist of lectures by Dr. Antonia Vermadakis and invited guests from the University of Colorado, and outside speakers—internationally recognized experts in the field. Topics will include CNS aging (morphological, biochemical, and functional); neuroendocrine mechanisms and aging, drug metabolism (liver and kidney function); cellular aging; and pathological aging. Vernadakis.

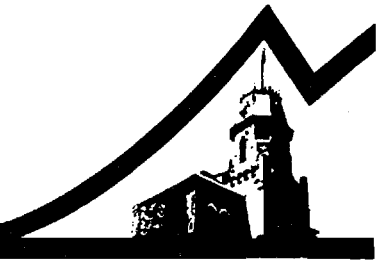
IDPT 629-2. Human Inborn Errors of Metabolism. *Spring.* Examines human diseases which result from mutations of catalytic, transport, and structural proteins. Emphasis on the mechanisms through which the abnormal phenotype is produced as well as on recent advances in the prevention and treatment of these conditions. Patients will be presented when possible. Goodman.

IDPT 635-1. Cultural Factors in Health Care Delivery. *Spring.* Will cover the world view and value systems of three cultural groups—Black, Hispanic, and native American—as they impact health care delivery. The purpose of the course is to provide information which will help future practitioners place in proper context cultural beliefs and behavioral patterns as they influence receptivity and access to health care. Cordova and Yardley.

IDPT 64001.5 to 2.5. Mammary Gland Biology, Lactation, and Breast Feeding. *Spring.* An interdisciplinary approach to the funciton of the human mammary gland as it relates to infant nutrition. Topics include the mechanism and control of milk secretion and let down, the mammary gland and human reproduction, immunologic properties of milk, mastitis, drugs in milk, the biology of the mammary cell, and practical techniques in breast feeding. Course is 1.5 hours; students may earn 1 hr. of additional credit by undertaking a reading program in the research literature. Neville.

IDPT 644-3. Principles of Gene and Metabolic Regulation: An Aid to Understanding Human Diseases. *Fall.* Principles of metabolic reluation ranging from the level of the cell to the human organism. The role of altered metabolic regulation in the etiology of clinical diseases will be discussed at each level where examples exist. Prer., BBGN 600 or equivalent. McCabe and Davidson.

School of Journalism



INFORMATION ABOUT THE SCHOOL

Russell E. Shain, Dean
Office in Macky 229

History and Purpose

Formal instruction in journalism began at the University of Colorado, Boulder, in 1909. Journalism was made a department of the College of Arts and Sciences in 1922 and became a College of Journalism within the College of Arts and Sciences in 1937. The Board of Regents authorized a separate School of Journalism effective with the fall semester of 1962.

The School of Journalism provides a sound academic foundation for the student who plans a career in some phase of journalism or mass communication. The school offers its majors superior professional instruction with a broad education in the liberal arts. It conducts research into mass communications and provides service to the mass media, other state educational instructions (including high schools), and the public at large. The School of Journalism makes courses available to nonjournalism majors within the limits of space and equipment upon which journalism majors properly have first claim.

Career Opportunities

The school offers options in advertising, news-editorial, public relations, and radio-television sequences. Students in the news-editorial sequence choose to major in either news or public relations. Students in radio-television elect an option in either broadcast news or broadcast production management. Graduates find careers in newspapers, magazines, radio, television, advertising and public relations firms, science, industry, and government, and in secondary and higher education. The School of Journalism assists students in career planning and job placement.

Accreditation

The School of Journalism is accredited by the American Council on Education for Journalism and Mass Communications, specifically for the graduate professional program and the news-editorial and advertising sequences. It is a fundamental principle of the ACEJMC that education for journalism be broadly based. Accordingly, undergraduate journalism students at the University of Colorado take approximately three-fourths of their college work in the arts and sciences and approximately one-fourth in journalism courses.

Accredited journalism programs, as described by the American Council on Education for Journalism and Mass Communications, are distinguished by the following characteristics:

1. They maintain a professional curriculum with one or more special sequences, leading to a bachelor's degree and/or advanced degree or degrees in journalism.
2. They carry on the professional training of general practitioners for the field of journalism while giving due consideration to service, the profession, and research.
3. They strive to serve national media as well as media of their own states.
4. They are committed to a philosophy of professional training that places strong emphasis on liberal arts studies.
5. They provide close relationships between students and teachers.

Facilities

Laboratories. Journalism students work in laboratories for reporting, editing, advertising, radio, television, and photojournalism. They have opportunities for using the Associated Press wire service, videotape cameras and recorders, video display terminals, and radio studios.

Reading Room. A reading room for journalism students contains daily and weekly newspapers for Colorado and elsewhere, professional and general magazines, and other material.

Internships. Majors in journalism are encouraged to seek internships, and the school assists in internship placement. In addition to working for the school's newspaper, the *Campus Press*, students intern with weekly and daily newspapers, advertising and public relations agencies, social service agencies, and radio and television stations. Students also work for the *Colorado Daily* and KAIR, the University of Colorado radio station.

Honors

Journalism students may graduate with General Honors and/or School of Journalism Honors. Students interested in General Honors must consult the Honors Program office. The School of Journalism may award the bachelor's degree with honors to students who have

a 3.25 cumulative grade point average and a 3.5 grade point average in journalism courses, complete an independent study in journalism involving scholarly research effort, and demonstrate a high degree of professional skill. Application for School of Journalism honors must be made to the dean at the beginning of the student's final semester.

Scholarships and Awards

The following scholarships, loan funds, and awards are available annually to officially admitted journalism majors.

Applications must be submitted to the dean of the School of Journalism by February 15 of the year in which the scholarship is to become effective.

Boulder Press Club Scholarship ($300). Check with School of Journalism Office.

Christopher Michael Burns Memorial Scholarship ($300) to a man or woman in the advertising sequence.

Cervi Memorial Scholarship ($400) to a senior man or woman.

Colorado Advertising Education Foundation Scholarship ($300) to a man or woman student.

Colorado Press Women Scholarship ($150) to a woman student.

Denver Press Club Scholarship (tuition and fees) to a senior man or woman from the Denver metropolitan area.

Denver Press Club-Mile High Kennel Club (tuition and fees) to a senior man or woman from the Denver metropolitan area.

Denver Woman's Press Club, Frances Belford Wayne Merit Award ($500) to a woman student.

Dominic F. Manzanares Memorial Scholarship ($100) to a minority and/or Colorado resident journalism major.

Raymond B. Johnson Award ($150) to an outstanding student.

Journalism Faculty Scholarship ($400).

L. C. Paddock Memorial Scholarship (tuition and fees) to a man or woman student.

Raymond B. Johnson Memorial Fund for loans to needy students.

William M. Long Memorial Fund for loans to needy students.

Blumberg Prize ($200). Award given to outstanding graduating senior in the broadcast sequence.

KMGH-TV Special Merit Award ($200). Award given to outstanding broadcast major.

Gannett, Al Flanigan Scholarships. Check with School of Journalism office.

The Denver Foundation, Palmer Hoyt Memorial Scholarship. Check with the school office.

Student Organizations

Through an elected Student Council, students conduct a wide range of activities and assist in formation of policies of the school.

The school has chapters of the Society of Professional Journalists, Sigma Delta Chi; Women in Communication; American Advertising Federation; Public Relations Student Society of America; and Kappa Tau Alpha, honorary scholastic society in journalism.

Study Abroad Programs

The School of Journalism along with the Office of International Education urges journalism students to participate in the University's study abroad programs. Since the year of study abroad usually is undertaken during the junior year, prospective journalism majors are advised to plan early and seek counseling from the journalism faculty. Programs are offered in Costa Rica, Egypt, France, Germany, Great Britain, Israel, Italy, Mexico, Peru, Spain, and Taiwan. In addition to a journalism degree, students can earn an area studies degree in the College of Arts and Sciences during a five-year period including study abroad semesters. Information and application forms are available at the Boulder Campus Office of International Education, in the basement of the Environmental Design Building, Campus Box 123.

UNDERGRADUATE DEGREE PROGRAMS

Requirements for Admission

The undergraduate degree offered is the Bachelor of Science degree in journalism.

Students planning to major in journalism at the University of Colorado normally enroll as prejournalism freshmen in the College of Arts and Sciences or complete their freshman and sophomore years in some other collegiate institution.

University of Colorado students wishing to transfer into the School of Journalism should file an application for intrauniversity transfer with the school early in the second semester of their sophomore year.

Students may be admitted to the school if they:

1. Complete a minimum of 60 semester hours with a grade point average of at least 2.50.
2. Fulfill the requirements in the College of Arts and Sciences as outlined below:

Humanities	two 2-semester courses
Natural sciences	two 2-semester courses
Social sciences	two 2-semester courses

These courses may or may not be sequential, according to the college list.

3. Complete both Jour. 100 and Jour. 250.
4. Establish a grade point average of at least 2.5 in all journalism courses attempted prior to applying for transfer.

Meeting the minimum requirements, however, does not guarantee a student admission to the School of Journalism.

Prejournalism

1. Prejournalism students are enrolled in the College of Arts and Sciences until eligible to transfer into the School of Journalism, normally at the end of the sophomore year. These students must consult with advisors in the School of Journalism.

2. Prejournalism majors normally take courses that meet area requirements in the College of Arts and Sciences, listed below under Requirements for Graduation. They are encouraged to take English composition and a foreign language.

Transfer Credits

Credit in subjects transferred from other institutions to the University of Colorado is limited to the amount of credit given for similar work at the University of Colorado. The transfer of credits in journalism is limited to 12 semester units and is subject to approval of the dean of the School of Journalism. A proficiency examination in journalistic writing and language skills may be required of those who wish to transfer credit equivalent to Jour. 250.

Requirements for Graduation

A total of 124 semester hours with a grade point average of not less than 2.25 overall and 2.5 in journalism courses is required for the B.S. degree in journalism. Of these 124, at least 40 must be upper division credits; 12 hours must be upper division in a field of concentration, and 28-34 must be in journalism. No student may take more than 34 hours of journalism in the 124 hours required for graduation. The upper limit is imposed to insure wide exposure of journalism majors to liberal arts courses. Students who wish to develop expertise in a particular journalistic specialty are advised to take courses in science, business, political science, or the relevant area.

DOUBLE-DEGREE AND COMBINED-DEGREE PROGRAMS

Some students complete requirements in two fields and in some cases receive two degrees from the University. Such a combined program is available combining journalism and business. The student must make application for the combined program in both the School of Journalism and the College of Business and Administration. Any other such combined programs must be arranged by consulting *both* schools or colleges involved.

RESIDENCE REQUIREMENTS

A candidate for a degree from the School of Journalism must earn the last 30 hours in residence in the school. This may include courses taken on the campuses at Boulder, Denver, and Colorado Springs.

SENIOR REQUIREMENTS

Seniors should file a diploma card with the School of Journalism by October 1 of the academic year in which they expect to graduate. Diploma cards are available at the office of the School of Journalism.

Journalism and prejournalism majors are required to consult an advisor at each registration period. However, the student alone is ultimately responsible for the fulfillment of all degree requirements.

Journalism Sequences

Three sequences of professional study are available in the School of Journalism.

ADVERTISING SEQUENCE

The advertising sequence is designed to prepare students for careers with newspapers, magazines, radio, television, and advertising and public relation firms.

Required Courses	*Semester Hours*
Jour. 100. Contemporary Mass Media	3
Jour. 250. Reporting	3
Jour. 340. Principles of Advertising	3
Jour. 345. Advertising Copy and Layout	3
Jour. 346. Advertising Media	3
Jour. 377. History of Journalism	3
Jour. 440. Advertising Campaigns	3
Jour. 443 Retail Advertising	3
Jour. 497. Advertising Practium	3
Jour. 490. Mass Communication and Public Opinion	3
Journalism electives	1-7
Mk. 300. Principles of Marketing	3
Econ. 201. Principles of Economics I	3
Econ. 302. Principles of Economics II	3

NEWS-EDITORIAL SEQUENCE

The news-editorial sequence is designed to prepare students for positions as reporters, editors, and writers for newspapers, news services, magazines, trade and technical publications, company publications, government, and public relations.

Required Courses	*Semester Hours*
Jour. 100. Contemporary Mass Media	3
Jour. 250. Reporting	3
Jour. 350. Reporting of Public Affairs	4
Jour. 355. News Editing	3
Jour. 377. History of Journalism	3
Jour. 450. Advanced Reporting	3
Jour. 465. Journalism and the Law	3
Jour. 490. Mass Communications and Public Opinion	3
Journalism electives	3-9

Public Relations Option

Required Courses	*Semester Hours*
Jour. 100 Contemporary Mass Media	3
Jour. 250. Reporting	3
Jour. 350. Reporting of Public Affairs	3
Jour. 377. History of Journalism	3
Jour. 427. Principles of Public Relations	3
Jour. 428. Public Relations Programs	3
Jour. 429. Public Relations Practices or	
Jour. 498. Internship	3
Jour. 465. Journalism and the Law	3
Jour. 490. Mass Communications and Public Opinion	3

And at least one of the following:

Jour. 310. Press Photography	3
Jour. 355. News Editing	3
Jour. 360. Radio and TV News	3
Jour. 480. Magazine Article Writing	3
Jour. 485. Publication Design and Production	3

BROADCAST SEQUENCE

Students may choose either of two options within the broadcast sequence. The news option is designed to prepare students as news directors, reporters, editors, and

writers for television or radio stations. The broadcast production management option is designed to prepare students for other careers in radio-television, including positions in programming, advertising, promotion, and management.

Broadcast News Option

Required Courses	*Semester Hours*
Jour. 100. Contemporary Mass Media	3
Jour. 250. Reporting	3
Jour. 350. Reporting of Public Affairs	4
Jour. 360. Radio and TV News	3
Jour. 364. Principles of Broadcast Production	3
Jour. 377. History of Journalism	3
Jour. 462. Radio and TV News Editing	3
Jour. 465. Journalism and the Law	3
Jour. 490. Mass Communications and Public Opinion	3

Broadcast Production Management Option

Required Courses	*Semester Hours*
Jour. 100. Contemporary Mass Media	3
Jour. 250. Reporting	3
Jour. 340. Principles of Advertising	3
Jour. 360. Radio and TV News	3
Jour. 364. Principles of Broadcast Production	3
Jour. 377. History of Journalism	3
Jour. 464. Radio, TV Station Organization, Operation	3
Jour. 367. TV Production II or	
Jour. 461. Advanced Radio Production	2-3
Jour. 490. Journalism and Public Opinion	3
Journalism electives	1-2

MASTER'S DEGREE PROGRAM

A Master of Arts degree in journalism is awarded after the student has demonstrated and advanced understanding of the role of the mass media in society as well as competence or potential as a journalist. Students may come into the graduate program with or without a foundation of educational or practical experience in journalism. Upon completion of the program, students may enter or return to journalism, teach, or continue graduate studies in a doctoral program.

Graduate students should read carefully Requirements for Advanced Degrees in the Graduate School section of the catalog.

Journalism courses are available as a minor in other fields of advanced study to which journalism is a logically related subject.

Requirements

Graduate students without adequate educational or practical experience in the profession may be required to take basic courses in journalism without graduate credit as prerequisites for advanced courses, or they may be asked to pass a proficiency exam in journalistic writing and language skills. Such requirements will be determined individually.

Candidates for the master's degree in journalism pursue either of two plans, depending upon the journalistic background of the student at the time of admission. In either case, the student must present a minor of at least three courses in a supporting field. A minimum of 24 to 30 semester hours of graduate-level work is required.

Every effort is made to suit the course work, both within the journalism curriculum itself and in supporting fields, to the interests and goals of each candidate. For details about the program write the Graduate Director, School of Journalism, Campus Box 287, University of Colorado, Boulder, Colorado 80309.

ACADEMIC POLICIES

Attendance Regulations

Students are expected to attend classes regularly and to comply with the attendance regulations specified by their instructors. At the beginning of each semester, students will be informed by their instructors of policies governing attendance in their classes. A student who does not attend any of the first week's sessions of a class during a term may be dropped from the class.

Uniform Grading and Pass/Fail, Drop/Add, and Withdrawal Procedures

The University has adopted a standard policy concerning grades and pass/fail, drop/add, and withdrawal procedures. These policies are outlined in the General Information section of this catalog.

School of Journalism majors may not take any journalism course pass/fail, but any nonjournalism course may be taken pass/fail. Up to 16 hours of nonjournalism courses may be taken pass/fail, except for transfer students for whom the limit is 1 hour in every 8 attempted at the University of Colorado. Only 6 hours of pass/fail may be taken in any one semester.

Students may be administratively dropped from courses for failure to attend, especially during the first two weeks of each semester.

Scholastic Suspension

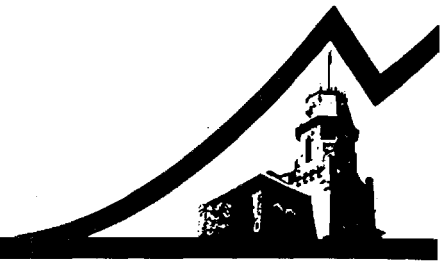
Majors (students who have transferred into the School of Journalism) are subject to suspension if they do not maintain a cumulative University grade point average of 2.25 and a cumulative journalism grade point average of 2.5.

Students whose grade point averages fall below either of these levels are normally placed on probation for one semester during which they have an opportunity to raise their averages to the required levels. Students whose averages continue below the required levels are subject to suspension from the School of Journalism and will be notified in writing.

Scholastic records will be reviewed as soon as possible after each semester, and students will be informed in writing if they are to be placed on probation or suspension.

The normal period of suspension is two regular semesters (one academic year, excluding summer sessions). The period of suspension will be stated in the suspension notice to the student. A student suspended a second time will be reinstated only on the basis of unusual circumstances, which the student should state in a petition to the dean of the school.

School of Law



INFORMATION ABOUT THE LAW SCHOOL

Betsy Levin, Dean

History and Purpose

The School of Law was established in 1892. It is a charter member of the Association of American Law Schools, organized in 1901, and has been on the list of approved law schools of the American Bar Association since the first publication of such a list in 1923. Such approval is based upon high scholastic standards, a three-year program of full-time resident study, a well-qualified faculty, good library facilities, and high admission qualifications. At the University of Colorado School of Law, a relatively small student body of 470 and a favorable faculty-student ratio produce classes of a size that encourages discussion. Classes normally consist of no more than about 80 students, and many are much smaller. In addition, faculty are readily available for informal conferences with individual students.

Courses are offered in a wide range of law-related subject matter (see course descriptions). Students are free to take almost all second- and third-year courses as electives after a required first-year curriculum. Special emphasis in areas of particular curricular strength at the Law School such as commercial law, natural resources, and criminal law and procedure is possible. Graduates are academically qualified to take the bar examination in all 50 states provided that, in choosing their curricula, students comply with any individual requirements of states in which they intend to practice.

Affirmative Action

It is the policy of the University of Colorado School of Law not to discriminate on the basis of sex, handicap, race, color, religion, or national or ethnic origin in its educational programs, admissions policies, employment policies, financial aid, or other school-administered programs, except as provided for under affirmative action programs. See Admission Procedures. This policy is supported by federal law under Title IX of the Education Amendments of 1972, Titles VI and VII of the Civil Rights Act of 1964, and sections 503 and 504 of the Rehabilitation Act of 1974. Inquiries regarding compliance with these statutes may be directed to the Dean's Office, School of Law, University of Colorado, Boulder, Colorado 80309, telephone (303) 492-8047, or to the Office of Affirmative Action, Regent Hall 207, telephone (303) 492-6706.

Law Building and Law Library

The School of Law is housed in the Fleming Law Building, located in the southeastern part of the campus. Teaching facilities include an excellent library, classrooms, seminar rooms, a complete trial and appellate courtroom, and videotape equipment. The building also contains suites for the Legal Aid and Defender Clinical Program, Natural Resources Litigation Clinic, offices for various student organizations, faculty and administrative offices, and a student lounge. The building has ample space to accommodate the student body of 470 now enrolled.

The law library contains one of the best legal reference collections in the western United States. The collection consists of approximately 165,000 volumes, including a comprehensive collection of American case law from all jurisdictions, statutes of all of the states (in annotated form when available), and the major digests, encyclopedias, periodicals, and texts dealing with American law. The English and Canadian materials are almost as complete, and there are substantial holdings in other Commonwealth materials. A collection of books in German, French, and international law materials provides a basis for comparative law studies.

Methods of Instruction

Law school classes are conducted primarily as discussions rather than by lecture. Judicial opinions and statutes are critically analyzed and the principles extracted are used in arguments about hypothetical situations. Other methods of instruction include research and writing, seminars, and practical experience both in clinical programs and by simulation.

Transmission of knowledge of established law is only one element of legal education. The School of Law seeks to train students to use the law, to research and analyze the relevant materials, to speak and write effectively, and to evaluate arguments. Significant changes in the law occur frequently and knowledge of specific laws may become obsolete, but the skills to analyze, argue, and evaluate endure.

Career Opportunities and Placement

The School of Law has an active placement service. Liaison is maintained with law firms, government agencies, courts, and businesses that seek the services of students and young lawyers.

The 1983 graduating class included 152 graduates. Of the 127 who reported their employment status, 91 percent were employed and, of these, 97 percent were working in law-related areas. More than half were in private practice; 22 percent were clerking for judges; and 12 percent were employed by government on local, state, and federal levels. The remainder were working in business, legal services, military, and academic areas. Information collected revealed that the beginning average salary for a 1983 graduate was slightly under $27,000 per year. Graduates of this class have located in California, Colorado, Hawaii, Minnesota, Missouri, New Mexico, New York, Washington, and Canada.

Prelegal Preparation

The School of Law of the University of Colorado prescribes no specific prelaw curriculum. Students should pursue their interests, the offerings of their particular colleges, and their personal objectives in studying law. In general, the prelaw student should place primary emphasis on the acquisition of excellent methods of study, thought, and communication, especially writing. Obviously, these skills can be acquired in a number of different areas, and successful law students and lawyers have college majors in almost every field. College courses should be chosen with care to produce a balanced pattern of skills and insights. An undergraduate major field should be one which requires rigorous application of one's abilities.

Part-Time Employment

The study of law is essentially a full-time task. Most students devote from 50 to 70 hours a week to classroom attendance, preparation for class, and other activities directly related to their legal education, such as participation in appellate briefing and argument competition, and work in the school's Clinical Program. As a consequence, the opportunity for self-support through employment while attending law school is limited. Students are strongly advised against outside employment during the first year; however, law-related employment for a limited number of hours may actually enhance the educational experience of second- and third-year students. Students should avoid committing themselves to employment of more than 15 hours per week, or to any schedule of employment which will interfere with class attendance.

The Law Placement Office assists students who wish to secure law-related part-time employment. The University's Career Development and Placement Services and the Office of Student Employment Services aid those who wish to find conventional employment or work-study placement.

Special Lectures and Professorships

The Charles Inglis Thomson Trust Fund, created in 1913, enables the School of Law to bring to Colorado once a year a leading authority in a selected field of law. Recent Thomson professors have been Joseph L. Sax, the Philip A. Hart Distinguished University Professor at the University of Michigan Law School; Archibald Cox, the Carl M. Loeb University Professor at Harvard University Law School; Richard C. Maxwell, professor of law at Duke University and former dean of the University of California at Los Angeles Law School; John Dawson, long-time law professor at Harvard University; Edward W. Cleary, professor of law, Arizona State University; Herbert Wechsler of Columbia University; David Daube, Paul J. Mishkin, and Stefan Riesenfeld, professors of law, of the University of California, Berkeley; Rudolf B. Schlesinger, formerly of Cornell University; and S.F.C. Milsom, professor of law and fellow, St. John's College, Cambridge University, England.

In 1955 the late Adrian S. Coen established a trust fund in memory of her husband, the late John R. Coen, to bring to the School of Law once each year a prominent jurist or statesman to deliver a lecture to the students and faculty of the School of Law. Lecturers in this series have included Ruth Bader Ginsburg, United States Circuit Judge for the Court of Appeals for the D.C. Circuit; Marvin Frankel, former United States District Judge, A. Leon Higginbotham Jr., United States Circuit Judge for the Third Circuit; Walter V. Schaefer, retired Supreme Court Justice, Illinois Supreme Court; Guido Calabresi, professor of law, Yale University; Richard A. Posner, professor of law, University of Chicago; Brigitte M. Bodenheimer, professor of law, University of California at Davis; Leonard Boudin, senior partner, Rabinowitz, Boudin, and Standard, New York City; Rex E. Lee, dean, Brigham Young University School of Law, and former U.S. Assistant Attorney General; James B. White, professor of law, University of Chicago Law School; and Irving Younger, professor of law, Cornell University.

Numerous other leading American and international scholars, jurists, and practitioners visit the law school each year to speak to gatherings of students and faculty. This provides rich opportunities for expanding legal inquiry beyond the classroom.

Special Programs

The Legal Aid and Defender Program allows students supervised by full-time clinical faculty who are experienced trial attorneys to represent low income clients in civil and criminal cases in Colorado courts. These attorneys also supervise students working with nearby legal services and public defender programs.

The National Wildlife Federation's Natural Resources Clinic involves students in administrative and judicial proceedings concerning environmental problems. Students in this program work closely with clinical faculty on a range of issues, e.g., water resource and mineral development, land use, air pollution, and energy development. Although some clinic group meet-

ings are held to discuss issues and strategy of general interest, instruction is primarily conducted on a one-to-one (faculty-to-student) basis.

Activities

The School of Law offers many activities in addition to those available for students in the University as a whole. The Rothgerber Moot Court Competition offers students an opportunity to refine their research skills, as well as develop skills in appellate brief writing and oral argument. Students thoroughly prepare and brief hypothetical cases and then argue before panels of distinguished judges and lawyers.

The *University of Colorado Law Review*, a professional journal edited entirely by students, publishes scholarly articles and comments on matters of concern to the legal profession at both the national and state levels.

The Student Bar Association represents the interests of law students generally. Other student organizations include the American Bar Association Law Student Division, the Nicholas R. Doman Society of International Law, American Indian Law Students Association, Black Law Students Association, Chicano Law Students Association, National Lawyers Guild, Environmental Law Society, and Women's Law Caucus. Student organizations regularly sponsor programs of interest to the bar and community, such as Women in the Law Day, a Placement Conference, a symposium on Energy Mineral Development in the Rocky Mountains, etc.

Expenses and Financial Aid

Colorado residents paid $1,545 in tuition and fees for the 1983-84 academic year; nonresidents, $5,035. The law school admissions office will tentatively classify applicants as residents or nonresidents, but the final decision will be made by the Tuition Classification Officer, Office of Admissions, Regent Administrative Center 125. Living expenses, books, and incidental costs in the amount of $4,000 to $6,000 per year should be added to tuition figures in estimating yearly expenditures.

Grants-in-aid are available on a limited basis to eligible resident students and are awarded on the basis of need and timeliness of filing the financial aid application. Nonresident students may not be awarded grants from state funds under present state policy but may be considered for loans and work-study. Students applying for financial aid, including grants, National Direct Student Loans, and work-study, must file the ACT-FFS (American College Testing Service-Family Financial Statement). This application may be obtained from local high schools or colleges, but if the form is not available, students should request one from ACT Student Need Analysis Services, P.O. Box 4005, Iowa City, Iowa 52243. Deadline for receipt of application forms by ACT is *March 1*. In order to insure preferential status, students should mail the FFS to ACT no later than February 20. Although the financial aid application will not be processed until a student has been officially admitted to the law school, it should nevertheless be timely filed with ACT. The ACT code number for the University of Colorado, Boulder is *0532*. In the event that an ACT form cannot be obtained, a College Scholarship Service Financial Aid Form (CSS-FAF) may be used in its stead. The CSS code number for the University of Colorado, Boulder is *4841*. Applications for federally insured student loans may be obtained at participating banks.

Students who are awarded financial aid have the right to decline any part or all of their financial aid. Students who accept financial aid awards have the responsibility of reporting to the Financial Aid Office all changes in their financial, marital, or tuition status. They must be registered as full-time students in a degree program at the institution during each term aid is accepted. Students receiving financial aid must affirm that these funds will be used solely for expenses related to attendance or continued attendance at the institution.

Any inquiries regarding financial assistance may be directed to the Assistant Dean, School of Law, University of Colorado, Boulder, Colorado 80309; telephone, (303) 492-8047.

ADMISSION PROCEDURES

Requirements and Standards

The School of Law grants admission to qualified applicants who have received a baccalaureate degree from a properly accredited institution, based on at least 90 semester hours or 135 quarter hours of credit (exclusive of credit earned in nontheory courses such as hygiene, domestic arts, physical education, vocal or instrumental music, studio art, and ROTC, and exclusive of work taken by correspondence).

The applicant must also show substantial intellectual promise and give evidence of high moral and ethical standards. The entering class in 1983 had credentials which fell generally in the following ranges: 3.5 GPA, LSAT scores in the 88th percentile.

While admission standards are based heavily on undergraduate grade point average and the Law School Admission Test score, other factors are also important because they may indicate ability and motivation, and because diversity in the student body contributes to the educational process. Other factors that are considered include variation in economic, social, or cultural background; geographic diversity; variation in undergraduate or graduate program or institution; unusual employment or other experience; demonstrated and unusual quality of leadership; special achievement in overcoming personal handicaps or disadvantages; and the ability to contribute the perspectives of racial or ethnic minorities or other distinctive communities. In its efforts to offer equal opportunity for obtaining a legal education, the law school will take race affirmatively into account as an important factor in the competitive weighing of individual applications. Colorado residency is also given special consideration, since the University is a state-supported school.

Personal interviews are neither required nor encouraged. Every applicant is invited to submit a personal statement and to ask people familiar with his

or her ability to write letters of recommendation in support of the application.

Beginning students are admitted in the fall semester only. Normally, students are admitted only on a full-time basis. The law school does not have an evening division of study.

The school conducts an introductory summer program for those persons admitted whose qualifications suggest that prior assistance may be particularly helpful for successful law study. In addition, tutorial assistance will be available for first-year students who desire it and whose qualifications suggest that this type of support might be beneficial.

Usually 10 to 15 second-year transfer students are accepted each year. Decisions are based heavily on law school performance, in addition to the factors considered for beginning students.

Because of the large number of applications which must be processed, the deadlines set must be strictly observed.

How and When to Apply

1. Request application blanks and instructions from the School of Law, Fleming Law Building, University of Colorado, Campus Box 403, Boulder, Colorado 80309.

2. Students must return a completed Application for Admission, an LSAT/LSDAS Law School Application Matching Form, and a nonrefundable application fee by March 1. In addition, the following credentials must be completed and received by March 1 (with each item mailed directly from its source to the School of Law):

   a. An evaluation of all college and nonlaw school postgraduate work undertaken that is provided by the Law School Data Assembly Service. The evaluation must be based on not less than the equivalent of six semesters or nine quarters of regular undergraduate college work. To obtain registration forms, applicants should write directly to Law School Admissions Services, Box 2000, Newton, Pennsylvania 18940. A registration form to utilize the service must have been received by LSDAS no later than February 1.

   b. Results of the Law School Admission Test. The test is administered by the Law School Admissions Services, Box 2000, Newton, Pennsylvania 18940, four times each year at a number of places. Applicants should take the test no later than December in the year prior to the term they expect to attend law school. For further information and arrangements contact the Law School Admissions Service.

   c. At least one letter of evaluation from a college instructor from whom a course has been taken and, if the applicant has entered into postgraduate employment, from a person having supervision over the applicant's work. The evaluator should be someone who has had the opportunity to observe and can write about the applicant's abilities and performance.

The applicant is responsible for arranging for submission of the above supporting documents, including materials from the Law School Data Assembly Service, and for ensuring that materials are received by the School of Law prior to established deadlines.

Because of the large number of applications that must be processed, the deadlines must be met. Late applications will be accepted, but they will be considered only after all of the timely applications. Only the strongest late applicants have any substantial chance of admission.

Transfer Students

Transfer students must meet all standards and requirements set forth above for students who have not previously attended law school.

Applicants must arrange to have sent, in addition to the above items: (1) two copies of transcripts of all law school work undertaken and (2) upon completion of all law school work, a letter from the law school dean stating that the applicant is in good standing and eligible to continue without condition.

Students who have been accepted for admission and who have attended a law school not on the approved list of the American Bar Association will receive no credit for any work completed in that law school.

Students who have previously attended other fully accredited law schools may receive advanced-standing credit for work done in such law schools in an amount and on such conditions as determined by the Office of the Dean. In no event will credit be given toward graduation for any course taken in another law school in which a grade of less than *C* or its equivalent has been recorded.

Confirmation

As credentials are completed, the Admissions Committee will act upon applications. In most cases notification of an initial decision (admit, hold, or deny) should be received by April 1. A waiting list will be established in early May and efforts will be made to notify students on the list promptly of the likelihood of their admission. Applicants who are accepted for admission must send a nonrefundable deposit, which will be credited toward tuition for the first semester, to the School of Law no later than the time stated (normally within two weeks) in the letter giving notice of admission.

Transcripts — Withdrawal of Admission

At least one week prior to enrolling in the School of Law, all students who have been admitted and have confirmed their admission must submit two official transcripts from *each* college and law school attended showing all college and postgraduate work completed. Such transcripts must show the student has received a baccalaureate degree from a properly accredited institution. These transcripts must also show any subsequent work which was undertaken whether or not the work was included in the LSDAS evaluation. If such subsequent work is not of substantially similar quality to that included in the LSDAS evaluation, or if the transcripts fail to show the student has received the re-

quired baccalaureate degree, the student's prior admission may be withdrawn.

Summer Session

Any student who has completed at least one year in an accredited law school may register for courses offered during the summer session upon submission of a summer application form together with a letter of good standing from his or her law school. Students may register for a number of courses offered in the summer. The maximum number of credit hours to be earned during the summer session will be determined by the Dean's Office.

The summer curriculum is designed for students with advanced standing. All courses offered in the Law School will run for the full session unless otherwise announced. A *Schedule of Summer Courses* with an application form may be obtained by writing to the Assistant Dean for Admissions, School of Law, University of Colorado, 80309.

GRADUATION REQUIREMENTS

The right to change the academic performance requirement and requirements for graduation is expressly reserved to the dean and faculty.

The Juris Doctor (J.D.) degree will be conferred on students who have satisfactorily completed the six-semester curriculum in accordance with Law School rules. All law school work must be taken in residence that is to say, in the classroom or under direct personal supervision of the instructor and not by correspondence or extension. No credit toward graduation from the School of Law will be given for any prelaw courses.

The requirements for the J.D. degree are:

1. Completion of 86 semester hours of credit with a numerical average of 72 or better.
2. Completion of all required courses. These are listed under Law School Curriculum.
3. Completion of one seminar.
4. Study for at least six semesters or equivalent in residence at this or some other accredited law school, at least 42 hours in residence at the University of Colorado School of Law. A semester in residence is earned where the student has been enrolled in and passed a minimum of 10 hours of course work.

Half a semester's time and residence credit may be earned in a summer session. By enrolling in two summer sessions and taking a minimum of 5 hours of work in each, the student can obtain a full semester of residence credit and earn a degree one semester earlier than normal.

5. Satisfaction of any conditions imposed at the time of admission.

The Juris Doctor degree is the only degree awarded by the School of Law.

ACADEMIC POLICIES

Honor System

On the premise that academic dishonesty is incompatible with the dignity and responsibility of the legal profession, the School of Law operates under an honor code which is subscribed to by all entering students. The honor code is a system of rules administered by student officers and demands high ethical conduct, prohibiting, for example, resorting to unauthorized sources in examinations. The same code also allows students considerable individual freedom and responsibility.

Grading and Point System

Grades are recorded by the University of Colorado as *A, A−, B+, B, B−, C+, C, C−, D+, D, D−,* or *F.*

The School of Law also grades on a numerical basis: *A* = 93-100; *A−* = 90-92; *B+* = 86-89; *B* = 83-85; *B−* = 80-82; *C+* =76-79; *C* = 73-75; *C−* = 70-72; *D+* =66-69; *D* = 63-65; *D−* = 60-62; *F* = 50-59.

One semester hour of credit represents one 55-minute class period per week through a semester.

In courses designated as pass/fail or pass/graded, the grade of *pass* is given when in the judgment of the instructor the quality and quantity of work is such that on a graded basis the work would be the equivalent of at least a *C* (72). If the instructor judges the work not the equivalent of a *C* (72), the work is assigned that letter and numerical grade between the *F* (50) and *C* (71) which the instructor determines is appropriate.

Academic Performance Requirements

Subject to certain qualifications for which the rules of the Law School should be consulted, students with a cumulative average below 72 at the end of any session or semester are normally excluded at the end of the next semester of attendance, unless by then their cumulative average has been raised to 72.

Normal Course Load; Dropping Courses

The normal course load is about 14 or 15 hours per semester. Students may not register for more than 16 hours or fewer than 10 hours without special permission, and the first-year students must obtain permission in order to register for less than a full schedule. A student who discontinues a course at any time without notifying the Office of the Dean and processing the necessary papers will receive an *F* (50). All first-year students must obtain the permission of the Dean's Office prior to dropping any course.

No student shall be permitted to drop without discredit any seminar or other course with enrollment limited below the maximum at any time after enrollment for the course has reached capacity, except by approval of the Dean's Office upon a petition showing good cause. Second- and third-year students may not be permitted to drop any seminar or course with enrollment limited below the maximum which did not reach capacity without discredit after the end of the fifth week, or any other course without discredit after the tenth week of any semester or the fourth week of the summer session, except by approval of the Dean's Office of a petition showing good cause.

Withdrawals

Students may withdraw from the School of Law at any time up to two days before the beginning of final examinations by obtaining permission of the Dean's Office.

Transcripts of Credit

Official transcripts of credit should be ordered from the Office of Records transcript section, Regent Administrative Center 125. Official transcripts are prepared only at the student's request submitted in person or in writing. Requests for letters of certification indicating class standing, numerical averages, and attendance dates may be made in person or in writing to the Law School Registrar, Room 141.

Classification of Students

To be ranked in the second-year class, a student must have passed 28 semester hours of work; to be ranked in the third-year class, 56 hours of work.

Attendance

A student who has been absent from more than 20 percent of the total number of classes in a course will be excluded from the final examination and will not receive a passing grade in the course, unless the attendance rule is waived in advance by the instructor.

LAW SCHOOL CURRICULUM

The curriculum of the School of Law is designed to give students a thorough training in fundamental principles of English and American law, to permit moderate specialization in areas of personal interest, and to prepare them to practice in any state or country where Anglo-American law prevails.

The first-year curriculum of contracts, torts, civil procedure, criminal law, property, legal writing, and appellate advocacy is required of all students. The second and third years are largely elective; the only required courses are constitutional law, professional responsibility, a seminar, and either trial advocacy or two semesters in the legal aid and defender program. A maximum of 10 clinical hours is allowed.

Students have the responsibility of planning their second- and third-year schedules so as to complete all required courses and obtain a full schedule of work in each semester.

The value of the course in semester hour credits is indicated by the figure following the identifying department number. For example, in Law 510-3, Law 510 is the identifying department number, and the -3 indicates that the course is for 3 hours of credit.

The right to change the schedule of courses and instructors is expressly reserved to the dean and faculty.

Program for the Academic Year

First-Year Students

Law 510-3. Contracts I[1]
Law 511-3. Contracts II[1]
Law 520-1. Legal Writing[1]
Law 521-1. Appellate Court Advocacy[1]
Law 530-3. Civil Procedure I[1]
Law 531-3. Civil Procedure II[1]
Law 540-3. Torts I[1]
Law 541-3. Torts II[1]
Law 550-4. Criminal Law[1]
Law 561-4. Property[1]

Second and Third-Year Students

Law 606-3. Real Property Security and Conveyancing
Law 610-3. Agency-Partnership
Law 612-3. Public Land Law
Law 618-4. Commercial Transactions
Law 625-4. Corporations
Law 631-3. Water Resources
Law 635-3. Evidence
Law 640-3. International Law
Law 650-3. Labor Law
Law 651-3. Criminal Procedure
Law 655-3. Legal Accounting
Law 660-4. Income Taxation
Law 661-4. Constitutional Law[1]
Law 662-3. Legal Process
Law 663-2. Economic Analysis of the Law
Law 666-2. Professional Responsibility[1]
Law 669-3. Advanced Taxation
Law 671-2. Legal Aid and Defender
Law 685-4. Legal Aid I-Civil Practice
Law 686-4. Legal Aid I-Criminal Practice
Law 687-3. Legal Aid II-Civil Practice
Law 688-3. Legal Aid II-Criminal Practice
Law 698-3. Wills and Trusts
Law 700-3. Administrative Law
Law 705-3. Conflict of Laws
Law 710-3. Domestic Relations
Law 712-2. Mining Law
Law 714-2. Future Interests
Law 715-3. Federal Estate and Gift Tax
Law 716-3. Copyright and Unfair Competition
Law 717-3. Patent and Trademark Law
Law 718-2. Estate Planning
Law 728-3. Bankruptcy
Law 732-3. Land Use Planning
Law 733-3. Oil and Gas
Law 734-2. Employment Discrimination
Law 735-3. Real Estate Planning
Law 736-3. First Amendment
Law 737-3. American Indian Law
Law 745-3. Securities Regulation
Law 747-3. Environmental Law
Law 748-2. Negotiation
Law 750-3. Antitrust
Law 752-3. Criminal Procedure: Adjudicative Process
Law 753-3. Education Law
Law 754-3. Survey of Creditors' Remedies and Bankruptcy
Law 755-3. Creditors' Remedies and Debtors' Protection
Law 757-3. International Business Transactions
Law 760-3. Local Government
Law 762-2. Trial Advocacy
Law 766-3. Business Planning
Law 768-3. Natural Resource Taxation
Law 770-2. Law Firm Practice
Law 771-1 to 2. Independent Legal Research
Law 778-3. Remedies

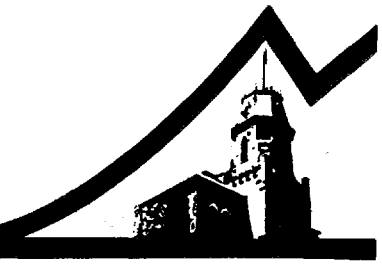
[1]These courses are required; other courses are elective.

Law 787-3. Federal Courts
Law 788-2. Natural Resources/Litigation Clinic
Law 791-1. Rothgerber Moot Court Competition
Law 792-1 to 2. Independent Legal Research-Law Review
Law 793-2. Advance Trial Advocacy
Law 795-1. International Moot Court Competition

Seminars

Law 701-2. Legislation and Administrative Process
Law 706-2. Alternatives to the Adversary System
Law 707-2. Advanced Torts
Law 708-2. Constitutional Theory
Law 711-2. Legal Rights of Children
Law 719-2. Product Liability
Law 720-2. Comparative Law
Law 721-2. Legal History
Law 738-2. Mergers and Acquisitions
Law 739-2. Equal Protection
Law 741-2. Legal Imagination
Law 749-2. Public Choice and Theories of Justice
Law 758-2. Energy Law 1
Law 759-1. Energy Law 2
Law 761-2. Legislative Drafting
Law 769-2. Commercial Drafting
Law 774-2. Toxic and Hazardous Wastes
Law 775-2. Law and Medicine
Law 776-2. Law and Mental Health
Law 777-2. Labor Relations in the Public Sector
Law 782-2. Labor Arbitration
Law 785-2. Social Legislation
Law 786-2. Natural Resources Law: Protection versus Development

College of Music



INFORMATION ABOUT THE COLLEGE

Robert R. Fink, Dean

Mission

The widely varied functions of music in the world today present many challenging and interesting opportunities for persons in the profession as teachers, performers, creative artists, technicians, and commercial personnel. While these different pursuits require specialized emphases, the faculty of the College of Music recognizes the musical and educational experiences that are common to all. Each curriculum of the College of Music is designed, therefore, to present music as an integrated whole. Solo performance and techniques, ensemble performance, historical and theoretical studies, concert and recital opportunities, and elective courses both inside and outside the college are intended to give the student a balanced approach to musical understanding and musicianship. The faculty has assumed the responsibility of making students aware of this unity in the curriculum and will strive to point out the relevance of each part to the whole. It is the student's responsibility to attempt to develop all the techniques and approaches presented in the curriculum. Only in this way, with the contributions of both faculty and students, can the aim of the curriculum be achieved: the development of well-trained musicians.

The faculty has set up a program of training which in the first year allows students to establish themselves and to resolve in their minds the courses of study to be pursued. After a first year of study and counseling with a principal professor, students may determine the particular area in which they are qualified and in which they may wish to work.

The College of Music was established by the Regents of the University of Colorado in 1920 and is a full institutional member of the National Association of Schools of Music.

Facilities

The Music Building and Macky Auditorium contain studios, classrooms, rehearsal rooms, and practice rooms in which students work. In Macky Auditorium the equipment includes seven practice organs, as well as a large, four-manual Austin concert organ for teaching and performance experience.

The Music Library, located in the Music Building, contains 100,000 books, scores, sound recordings, and periodicals. These incude 40,000 scores, 40,000 sound recordings, 20,000 books, and 250 periodicals. Computerized listening facilities are provided for listening to recordings and studying scores. A cathode-ray terminal is available for computer-based reference searching.

The library provides a collection of scores, collected editions and complete works of composers, bibliographies, dictionaries, histories, and treatises. The record collection contains many rare music recordings for research and teaching purposes.

The total facilities of the College of Music include 86 practice rooms; 54 studios and offices; band, choral, opera and orchestral rehearsal halls; piano and electronic laboratories; and auditoriums with seating capacities of 2,500, 500, and 200.

Concerts and Recitals

Student recitals are an integral part of the student's life through both listening and participation. All students must attend appropriate class recitals, which are held each week.

Student Activities

The student body of the College of Music has its own organization, which is directed by a student council and a faculty advisor. Honorary music fraternities are Phi Mu Alpha, Sigma Alpha Iota, Kappa Kappa Psi, and Tau Beta Sigma. Pi Kappa Lambda, the national scholastic honorary music fraternity, is also an active organization on this campus. Music education majors are eligible for membership in the student chapter of the Music Educators' National Conference.

The College of Music is organized to provide:

1. Specialized training in music to prepare for professional work or advanced study.
2. A background in music education that will prepare the student to teach music in the schools.
3. Training in music as the basis for general cultural attainment.

The preceding pursuits are not determined by interest alone but by qualifications and demonstrated abilities to meet the problems that are concomitant with success in the chosen area of endeavor.

Students concerned with understanding other languages, particularly those in voice, should consider study abroad. The year-abroad program in Regensburg,

Germany, open to students at the junior level or above, offers applied music study for all instruments and voice as well as music history and music education. Consult the Office of International Education.

Major Fields and Degrees

Specifically, the following courses of study are available to students in the College of Music.

Instruction in the undergraduate division of the College of Music leads to the Bachelor of Music degree with concentrated areas in voice, piano, harp, guitar, violin, viola, violoncello, string bass, organ, flute, oboe, clarinet, bassoon, saxophone, trumpet, French horn, trombone, baritone, tuba, theory/composition, history and literature of music, or church music.

Instruction that culminates in the Bachelor of Music Education degree leads to a field of concentration in the teaching of either general, choral, or instrumental music, or a combination of these interests.

The areas of study culminating in the degree Bachelor of Arts in Music are widely varied: American folk music, music-broadcasting, music-business, music-dance, music history, music-journalism, music-theatre, music theory/composition, piano pedagogy, string pedagogy, voice pedagogy, wind/percussion pedagogy, elementary education, and arts management.

Qualified students may receive both the Bachelor of Music and Bachelor of Music Education degrees by taking the required extra work (approximately 30 additional hours). Intent to be admitted to candidacy for both degrees should be indicated as soon as possible, preferably in the sophomore year. Written approval of the dean of the College of Music is required.

Additional information concerning undergraduate degrees is presented in the various undergraduate curricula listed elsewhere in this catalog. Questions regarding particular details of the various curricula may be directed to the associate dean for undergraduate studies, College of Music.

An applicant for the Master of Music or Master of Music Education degree must be a graduate of a university or college of recognized standing where the requirements for graduation are substantially the same as those required by this University for the degrees Bachelor of Music or Music Education. Examinations will be given to entering students so that the student and the advisor may determine a program of future study.

The Doctor of Musical Arts degree, with a field of concentration in composition; literature and performance of choral music; instrumental conducting and literature; organ performance; performance, literature and pedagogy of piano; or process of group environments is available through the Graduate School to qualified students.

The Doctor of Philosophy degree in music, with music education or musicology as a field of specialization, is available through the Graduate School to qualified students.

Additional information concerning graduate degrees is presented elsewhere in this catalog. Correspondence regarding details not included in this publication should be directed to the associate dean for graduate studies, College of Music.

Scholarships, Grants, Awards

Several scholarships are designed specifically for students in the College of Music:

Performance Scholarships
Carroll Maxton Butts Memorial Scholarship
Clark/Bailey Scholarships
Berton Coffin Singing Scholarship
Carolyn "Puny" Cook Memorial Scholarship
Edith Edwards Memorial Scholarship
Frances Fink Memorial Scholarship
Wallace F. Fiske Memorial Scholarships
Graduate Assistantships
Honors String Quartet Scholarship
Jessie and Albert Henry Scholarships
Eugene Hilligoss Memorial String Scholarship
Horace Jones Violin Scholarship
Kappa Kappa Psi Scholarship
Shirley Mariner Memorial Scholarship
Peercy-Roth Memorial Scholarship
Theodore Presser Scholarship
Quaffenyak Scholarships
"Spike" Robinson Saxophone Scholarship
Sawhill Award for Excellence in Piano Performance
Sigma Alpha Iota Scholarship
Special Performance Scholarships for Summer
Frank "Crick" Streamer Memorial Scholarship
Tau Beta Sigma Scholarship
Howard Waltz Piano Scholarship

ACADEMIC POLICIES

See General Information section.

Normal Course Schedule

The normal academic load for an undergraduate student in the College of Music is 16 to 19 semester hours. Schedules of fewer than 12 or more than 19 hours must have approval of the associate dean for undergraduate studies of the College of Music. (Maximum is 20 hours.)

Pass/Fail Option

Pass/fail hours are to be selected from nonmusic courses and are in addition to those that may be taken in honors, physical education, and student teaching. Courses so elected will be taken according to the pass/fail policies of the college or school concerned.

For a College of Music major who transferred into this program of study from another University of Colorado school or college or another university the maximum number of pass/fail hours which may be applied toward graduation requirements is 1 hour in every 8 semester hours completed in this College of Music.

Attendance Regulations

Students are expected to attend classes regularly and to comply with attendance regulations as specified by instructors. Unexplained absence from three consecutive class periods must be reported to the student's associate dean's office by the instructor concerned. Attendance at rehearsals, concerts, and concert trips is

also expected under regulations set forth by the conductor of each organization or ensemble.

Scholastic Requirements

Any undergraduate student who has a cumulative grade point average below 2.0 at the end of any semester will automatically be placed on probation for the following semester. If, at the end of the probationary period, the cumulative grade point average is not 2.0 or above, automatic suspension for the following two semesters will result.

Any student who has a cumulative grade point average of 1.5 or below at the end of any semester will automatically be suspended for the following two semesters. (Cumulative grade point average are calculated on grades earned at this University.) However, students who are on probation or who are suspended may attend the summer session to attempt to raise their grade point averages.

Students under scholastic suspension may petition for readmission and may receive a personal hearing before the associate dean for undergraduate studies.

Academic Ethics (Dishonesty, Cheating)

Students are expected to conduct themselves in accordance with the highest standards of honesty and integrity. Cheating, plagiarism, illegitimate possession and disposition of examinations, alteration, forgery, or falsification of official records, and similar acts or the attempt to engage in such acts are grounds for suspension or expulsion from the University.

In particular, students are advised that plagiarism consists of any act involving the offering of the work of someone else as the student's own. It is recommended that students consult with their instructors as to the proper preparation of reports, papers, etc., in order to avoid this and similar offenses.

Appeals

Students are advised that they have the right to appeal decisions of academic dishonesty and to petition for exceptions to the academic policies stated in this catalog. The appeals should be directed to the Office of the Dean.

Dissertations, Theses, Projects, and Individual Study

A copy of all scholarly student papers which generate credit (dissertations, theses, projects, lecture recitals and other document-producing activities), whether undergraduate or graduate, will be placed in the Music Library. More than one copy may be required in individual degree programs. To insure that degree requirements have been met and that the document is appropriate for placement in the Music Library, all faculty-approved documents must be presented to the appropriate associate dean's office at least four weeks before the graduation date.

Any recital which is required for graduation will be recorded. Arrangements will be made through the College of Music office, and a recording fee will be charged. The original tape recording will be presented to the appropriate associate dean's office for placement in the Music Library.

UNDERGRADUATE DEGREE PROGRAMS

Requirements for Admission

In addition to the entrance requirements of the University outlined in the General Information section, freshmen and transfer students must meet College of Music entrance requirements.

An audition and/or interview is required for all entering undergraduate music majors (Boulder and Denver campuses). Audition dates for students entering summer 1986, fall 1986-87, and spring 1986-87 will be held on the following Saturdays: February 1, February 24, and March 8, 1986. These auditions will be held only on the Boulder campus. Applicants may substitute tape recordings. Write to the College of Music, associate dean for undergraduate studies, for audition-interview applications. (Personal recorded auditions should be approximately 10 minutes in length. Cassettes of good technical quality are preferred.

It is expected that all students will have had previous experience in a performance area. Two years of piano training are particularly recommended. In addition, a broad general education background is advantageous. The educational objective is an educated mind and an integrated personality, together with specialized training in the field of music. Careful and intelligent planning on the high school level is an integral part of achieving this goal.

SPECIAL PROVISIONS FOR APPLICANTS WHO DO NOT MEET SUBJECT REQUIREMENTS

Students who are unable to meet the specified subject requirements for the College of Music may petition the dean of the college to enter with provisional standing, provided that such students offer at least three units of English and six additional units in academic fields, and provided also that the provisions of paragraphs one and two under the heading Admission Criteria in the General Information section are met by those presenting such petitions. Such factors as rank in high school graduation class, distribution of subjects, and evidences of preparation for the field of study to which admission is requested will be considered. The audition requirement is applicable.

UNDERGRADUATE TRANSFER STUDENTS

Undergraduate transfer students must meet the requirements of the University. Further, resident students who have taken course work only through the Division of Continuing Education must have a 2.0 (*C*) grade point average in such work before being eligible to apply for admission to the College of Music. Nonresident students must have a 2.5 grade point average. See Audition Requirement.

PROFICIENCY FOR COURSE WORK

Students who have the background to test out of some courses and receive the hour-credit toward their degrees should check with the chairman of the faculty which offers the course. If a proficiency test is available and if the faculty grants permission, the student will then pay the required fee at the Records Office, show the receipt to the faculty chairman, and take the test.

SPECIAL STUDENTS

A special student may not enroll for applied music (private instruction) without permission of the dean. Permission will not be granted unless a student intends to become a degree student the next semester.

A special student may take any other class with written permission of the instructor concerned. In addition, see Audition Requirement.

Requirements for Graduation

The degrees Bachelor of Music, Bachelor of Music Education, and Bachelor of Arts in Music will be granted by the University, upon recommendation of the faculty of the College of Music, to those who have successfully completed prescribed requirements.

Students must file an appropriate request-to-graduate application form by May 1 in the office of the associate dean for undergraduate studies (Music C-103) if they anticipate completing requirements in December, May, or August of the following year.

RESIDENCE REQUIREMENT

Of the hours required for graduation, 56 must be completed in residence in this College of Music. This may be reduced by the faculty because of excellent work done in this University and because of high scholarship exhibited at previous institutions attended. In no case shall the minimum be fewer than 40 hours distributed over three semesters. At least 9 hours in applied music (private instruction) must be earned in this college for the degrees Bachelor of Music and Bachelor of Music Education, and 8 hours for the degree Bachelor of Arts in Music.

CONVOCATION/RECITAL ATTENDANCE REQUIREMENT

All undergraduate degree students in the College of Music are required to enroll for Music 199, Music Convocation, 0 hour credit. Students will be expected to attend 7 convocations/recitals per semester from a list of 7 convocations and 15 selected recitals/concerts that will count toward fulfilling this requirement. (Recitals/concerts in which the student participates as a performer will not count toward the requirement.) The grade of *pass* will be awarded for seven or more attendances each semester at the convocations/recitals on the list furnished. A *fail* grade will be assigned for less than seven attendances.

When a student attends one of the events on the convocation/recital list, a monitor will be available in the lobby of the concert hall to give students attendance slips. Immediately after the event, students are to turn in their attendance slips to the monitor. At the end of the semester the attendances will be counted and a grade recorded (pass/fail).

At the time of graduation evaluation, students' records will be checked for the required number of semesters (six) of the convocation/recital course passed. If the convocation/recital attendance requirement has not been met at the time of graduation, the student will not be allowed to graduate. The deficiency must be made up by attending future convocation/recitals during the academic year.

Convocation is required for transfer students for all semesters in residence excepting the final two before graduation.

HONORS

Upon recommendation of the faculty, honors may be awarded to students who show outstanding ability and who have demonstrated superior musicianship and scholastic accomplishment.

MUSIC HISTORY MINOR

The music history minor is open to students in Bachelor of Music Education degree programs except the history curriculum. It should be elected by the student, in consultation with the major advisor, by the beginning of the student's sophomore year. The minimum is as follows:

Freshman Year	*Semester Hours*
Introduction to Music (Mus. 180-181)	6
Sophomore Year	
History of Music (Mus. 380-381)	6
Junior Year	
History area courses	4
Senior Year	
History area courses	3
	19

Bachelor of Music Degree

The curriculum leading to the Bachelor of Music degree is a professional training course with concentration upon artistic and/or intellectual performance. One of the following concentration areas may be selected: voice, piano, organ or church music, string instruments, guitar, wind and percussion instruments, composition, or history and literature. Performance concentration area students will devote a large portion of their time to developing the vocal or instrumental field of their choice. Proficiency levels (freshman, sophomore, junior, senior) have been established for each instrument and are checked by juries at least once a year. Students who do not meet these levels will receive as grades *Incomplete Fail* or *Incomplete Withdrawal* and cannot progress to the next level until the proficiency is met. Adequate courses in music theory and electives in academic subjects give an excellent theoretical and cultural background.

It is presumed that the student will have had basic preparation in a principal field of study before entering the University. A singer should be able to sing some standard songs in English, on pitch, with good phrasing and musical intelligence. Knowledge of the rudiments of music and an ability to read simple music at sight are expected. Elementary piano study is recommended. Instrumentalists should possess a well-grounded technique sufficient to play music of moderate difficulty. Students with a major in history and literature or theory should have a good working knowledge in a performance field.

Alternative concentration areas are available as follows upon recommendation of the advisor and faculty unit chairman concerned.

A concentration area in the field of church music is available for those qualified. No solo recital will be required. A thorough training in the field of service playing and choir training, with some practical experience in various aspects of church music, must be demonstrated.

COURSES AND CURRICULA

The curriculum for the concentration area in performance consists of a four-year program with an emphasis in performance (voice, piano, organ, string instruments, wind, and percussion instruments). A minor area of performance also is required.

Electives provide enough flexibility to suit individual needs. The student is encouraged to take as many of these hours as possible in liberal arts. A student and advisor may decide together on these areas of study.

A minimum of 244 credit points (with a *C* overall grade point average) and 122 semester hours (usually this number is exceeded) must be earned for the Bachelor of Music degree.

This degree places a premium upon high musical attainment, scholarship, and either interpretative or creative ability of a high order.

Specific ensemble and chamber music requirements are controlled as part of the degree plan in each principal field and are further subject to the advisor's judgment in the best interest of the individual student. Undergraduate music students are required to attend a literature-performance class in their respective areas and are held responsible for checking with their advisors regarding these meetings.

Guitar Performance Concentration Area

The student will submit a repertoire list at the end of each year of study. Minimum requirements in content and extent of standard and contemporary guitar works will be checked from these lists. In the first two years of study, minimum performance requirements will be examined at the end of the second semester of each year of study. During the junior year, the student's repertoire examination will be a half recital, presented before a faculty committee three weeks in advance of the performance date. A full public recital is required the senior year.

Additional work in guitar will be required of the individual student whenever the results of these examinations fall below the minimum standards. Additional details concerning minimum standards may be had upon request from the chairman of the guitar faculty.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
P.Mus. 157. Applied Guitar Instruction (and literature class)	8
P.Mus. 110. Keyboard Musicianship	2
P.Mus. 144. Guitar ensemble (Guitar duets only)	2
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 180. Introduction to Music	3
Mus. 275, 276, or 277.	3
Electives in liberal arts	6

Sophomore Year	
Mus. 199. Convocation	0
P.Mus. 257. Applied Guitar Instruction (and literature class)	8
P.Mus. 110. Keyboard Musicianship	2
Performing organization or chamber ensemble	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 236. Introduction to Accompanying	2
Elective in theory	2
Electives in liberal arts	12

Junior Year	
Mus. 199. Convocation	0
P.Mus. 357. Applied Guitar Instruction (and literature class)	7
Performing organization or chamber ensemble	2
Mus. 317. Conducting I	2
Mus. 380, 381. History of Music	6
Mus. 399. Junior Recital	1
Electives in liberal arts	12

Senior Year	
P.Mus. 457. Applied Guitar Instruction (and literature class)	7
Performing organization or chamber ensemble	2
Mus. 406. Analysis I	2
Mus. 499. Senior Recital	1
Electives in music	4
Free electives	12

History and Literature Concentration Area

Students who wish to have a concentration area in history and literature must have the approval of the chairman of the faculty unit. This area must be declared and approved not later than the junior year, and preferably by the sophomore year.

Students in this area must demonstrate proficiency in at least one facet of performance: voice, keyboard, symphonic, or early instruments. The student should also be able to use the keyboard as a tool in historical study. The history and literature thesis must meet an approved standard of endeavor; one copy must be satisfactorily bound and presented for permanent filing with the College of Music associate dean for undergraduate studies.

A second-year proficiency is required in one foreign language. For those who meet this proficiency in less than 16 hours a second language is recommended. In all cases 30 hours must be earned in liberal arts including foreign language. Mus. 940 (Special Studies) involves library research. A variety in both size and type of ensembles is recommended.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
Applied instruction (and literature class)	4
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 180. Introduction to Music	3
Mus. 275, 276, or 277	3
English elective	6
Foreign language	8
Ensemble	2

Sophomore Year	
Mus. 199. Convocation	0
Applied instruction	4
Mus. 110. Keyboard Musicianship	2
Hist. 101-102, Western Civilization	6
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 380, 381. History of Music	6
Mus. 401. Counterpoint	2
Ensemble	2
Foreign language	8

Junior Year	
Mus. 199. Convocation	0
Applied instruction	4
Period and topical courses in music history (400-level)	8
Mus. 402. Counterpoint	4
Mus. 940. Special Studies	2
Ensemble	2
Mus. 406, 407. Analysis	4
Electives in liberal arts	2
Free electives	6

Senior Year	
Applied instruction	4
Mus. 317. Conducting	2
Period and topical courses in music history (400-level)	8
Mus. 495. Senior Thesis	4
Ensemble	2
Free electives	8

Organ Performance Concentration Area

The organ performance concentration area may be elected by students of above average ability in performance. Concentration will be mainly on concert literature, and two recitals are required.

At the beginning of the senior year, all organ students should be able to transpose at least a major second up or down, play from open vocal score, improvise in simple forms, and accompany selected cantatas, e.g., Effinger's *The St. Luke Christmas Story* and Bach's *Christ lag in Todesbaden.* Graduation will not be permitted until such skills have been creditably demonstrated.

All students will be given a minimum reading study list throughout the course.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
P.Mus. 160. Applied Organ Instruction (and literature class)	8
P.Mus. 131. Ensemble	2
Class minor in performance	2
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 180. Introduction to Music	3
Mus. 181, or 275, or 276, or 277	3
Electives in liberal arts	5
Free electives	2

Sophomore Year	
Mus. 199. Convocation	0
P.Mus. 260. Applied Organ Instruction (and literature class)	8
P.Mus. 131. Ensemble	2
Class minor in performance	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 226. Service Playing Techniques	2
Mus. 317. Conducting I	2
Mus. 401, 402. Counterpoint	4
Electives in liberal arts	5
Free electives	5

Junior Year	
Mus. 199. Convocation	0
P.Mus. 360. Applied Organ Instruction (and literature class)	7
P.Mus. 331. Ensemble	2
Mus. 326, 327. Improvisation	4
Mus. 380, 381. History of Music (see History Minor)	6
Mus. 428, 429. Organ Survey	6
Electives in liberal arts	5
Mus. 399. Junior Recital	1

Senior Year	
P.Mus. 460. Applied Organ Instruction (and literature class)	7
P.Mus. 331. Ensemble	2
Mus. 499. Senior Recital	1
Electives in liberal arts	15
Free electives	5

Church Music Concentration Area

The concentration area of church music will be awarded to students particularly interested in this field. The major concentration will be on church music repertoire and the development of an appreciation of the finest in the field of sacred music. Courses such as history of religion, educational psychology, philosophy, and English literature, which are designed to strengthen the knowledge of aesthetic values and develop the ability to work with people, may be taken as electives.

At the beginning of the senior year, all organ students should be able to transpose at least a major second up or down, play from open vocal score, improvise in simple forms, and accompany selected cantatas, e.g. Effinger's *The St. Luke Christmas Story* and Bach's *Christ lag in Todesbaden.* Graduation will not be permitted until such skills have been creditably demonstrated. (Specific yearly requirements may be obtained from the Organ and Church Music Unit.)

All students will be given a minimum reading study list throughout the course, and students in church music will be required to complete a thesis in the senior year. The thesis requirement will be interpreted freely at the discretion of the major professor. It may consist of several minor research projects, choral arrangements, composition projects, or the preparation and production of a short cantata.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
P.Mus. 160. Applied Organ Instruction (and literature class)	8
P.Mus. 131. Ensemble	2
Class minor in performance	2
Mus. 100, 101. Theory I	6

Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 180 Introduction to Music	3
Mus. 181, or 275, or 276, or 277	3
Electives in liberal arts	5

Sophomore Year

Mus. 199. Convocation	0
P.Mus. 260. Applied Organ Instruction (and literature class)	8
P.Mus. 131. Ensemble	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 226. Service Playing Techniques	2
Mus. 317. Conducting I	2
Mus. 401, 402. Counterpoint	4
Electives in liberal arts	5
Free electives	7

Junior Year

Mus. 199. Convocation	0
P.Mus. 360. Applied Organ Instruction (and literature class)	7
P.Mus. 331. Ensemble	2
Mus. 326, 327. Improvisation	4
Mus. 380,381. History of Music (see History Minor)	6
Electives in liberal arts	5
Free electives	5

Senior Year

P.Mus. 460. Applied Organ Instruction (and literature class)	8
P.Mus. 331. Ensemble	2
Mus. 424. Church Music	6
Mus. 495. Senior Thesis	2
Electives in liberal arts	15

Piano Performance Concentration Area

The student will submit a repertoire list at the end of each year of study. Minimum requirements in content and extent of standard and contemporary piano works will be checked from these lists. In the first two years of study, minimum performance requirements will be examined at the end of the second semester of each year of study. During the junior year, the student's repertoire examination will be a half recital, presented before a faculty committee three weeks in advance of the performance date. A full public recital is required the senior year.

Additional work in piano will be required of the individual student whenever the results of these examinations fall below the minimum standards. Additional details concerning minimum standards may be had upon request from the chairman of the keyboard faculty.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
P.Mus. 162. Applied Piano Instruction (and literature class)	8
Class minor in performance	2
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 112. Keyboard Skills (two semesters)	2
Mus. 180. Introduction to Music	3
Mus. 181 or 275, or 276, or 277	3
Phil. 102 (Ethics) or 112 (Formal Logic)	3
Electives in liberal arts	4

Sophomore Year

Mus. 199. Convocation	0
P.Mus. 162. Applied Piano Instruction (and literature class)	8
Class minor in performance	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 236. Piano Accompanying	2
Chamber music	1
Elective in theory	2
Electives in liberal arts	9

Junior Year

Mus. 199. Convocation	0
P.Mus. 362. Applied Piano Instruction (and literature class)	7
Mus. 317. Conducting	2
Mus. 334-335. Piano Pedagogy I, II	4
Mus. 380, 381. History of Music (see History Minor)	6
Mus. 399. Junior Recital	1
Band, orchestra, or choir	2
Chamber music	2
Electives in liberal arts	11

Senior Year

P.Mus. 462. Applied Piano Instruction (and literature class)	7
Mus. 434. Piano Pedagogy III	3
Mus. 432. Piano literature	2
Mus. 406 or Mus. 407 Analysis I, II	2
Mus. 499. Recital	1
Chamber music	1
Electives in liberal arts	3
Free electives	12

String Performance Concentration Area: Harp, String Bass, Viola, Violin, and Violoncello

Study in the string instruments is designed to build a secure technical foundation upon which the most artistic accomplishment can be established. To this end progressive proficiency in the scales and standard studies is expected, along with the preparation of such works from the concert repertorie as fall within the ability of the student.

String students are required to audition for the University Symphony Orchestra and the University Chamber Orchestra. (Membership in the University orchestras will be determined by the conductor concerned.)

A full solo recital must be presented publicly during the senior year.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
Applied string instruction (and literature class)	8
P.Mus. 110. Keyboard Muscianship	2
Class minor in performance	4
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 180. Introduction to Music	3
Mus. 181, or 275, or 276, or 277	3
P.Mus. 132. Orchestra	2
Electives in liberal arts	2

Sophomore Year

Mus. 199. Convocation	0
Applied string instruction (and literature class)	8
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 207. Instrumentation	2
P.Mus. 132. Orchestra	2
Mus. 317. Conducting I	2
Chamber music	2
Elective in theory	2
Electives in liberal arts	8

Junior Year

Mus. 199. Convocation	0
Applied string instruction (and literature class)	7
Mus. 380, 381. History of Music (*see* History Minor)	6
P.Mus. 332. Orchestra	2
Chamber music	2
Mus. 399. Junior Recital	1
Electives in liberal arts	13

Senior Year

Applied string instruction (and literature class)	7
P.Mus. 332. Orchestra	2
Chamber music	1
Mus. 499. Senior Recital	1
Electives in liberal arts	7
Free electives	12

Composition Concentration Area

Approval for the concentration area in composition is based on (1) evidence of aptitude in composition or of exceptional aptitude in practical arranging, (2) an acceptable level of keyboard proficiency, and (3) probable success in the teaching of theory.

The thesis for composition students is subject to approval of the major advisor and may be in the area of original composition.

All composition students must register for piano until a requirement of five levels of testing has been passed. These examinations will be given at the end of each semester by the piano and composition faculties. They cover proficiency in technique, repertory, sight reading, score reading, figured bass, transposition, and harmonic progressions. This requirement presumes some prior keyboard experience.

Proficiency in performance is expected of composition students. Preferably, there should be high attainment in at least one instrument or in voice. Considerable experience in performance areas other than the principal instrument is also expected.

The student's work is reviewed periodically by the composition faculty unit with appropriate recommendations as to continuance in the program.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
P.Mus. 162. Applied Instruction (and literature class)	4
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 121. Composition Seminar	0
Mus. 153. Composition	6
Mus. 180. Introduction to Music	3
Mus. 181, or 275, or 276, or 277	3
Ensemble	2
Electives in liberal arts	6
	32

Sophomore Year

Mus. 199. Convocation	0
P.Mus. 262. Applied Instruction (and literature class)	4
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 207. Instrumentation	2
Mus. 221. Composition Seminar	0
Mus. 253. Composition	4
Mus. 401, 402. Counterpoint	4
Ensemble	2
Electives in liberal arts	12
	32

Junior Year

Mus. 199. Convocation	0
P.Mus. 362. Applied Instruction (and literature class)	4
Mus. 321. Composition Seminar	0
Mus. 353. Composition	6
Mus. 380, 381. History of Music (see History Minor)	6
Mus. 400. Contemporary Theory	2
Ensemble	2
Electives in liberal arts	12
	32

Senior Year

P.Mus. 462. Composition	4
Mus. 317. Conducting	2
Mus. 404. Orchestration	2
Mus. 406, 407. Analysis I, II	4
Mus. 421. Composition Seminar	0
Mus. 453. Composition	6
Mus. 495. Senior Thesis	0
Ensemble	2
Free electives	12

Voice Performance Concentration Area

Proficiency in the fundamentals of voice production, i.e., breath, vowel formation, intonation, resonance, and diction, is continually stressed in the four years of study. A repertoire that will eventually include representation in all areas of vocal literature is progressively built. Specific attention is given to the art song, including contemporary composition, the opera, and the oratorio.

The student must meet minimum standards at the end of the freshman year and in the comprehensive examination at the end of the sophomore year. Additional work will be required of the student if the minimum standards are not met. Minimum standards will be judged in performance by the voice faculty; progressive technical proficiency is expected.

A half recital will be required in the junior year and a full public recital in the senior year. Students, in their graduation recitals, must demonstrate ability to perform a program of artistic merit in public.

Transfer students working toward the Bachelor of Music degree in voice shall audition for a proficiency rating at the end of the first semester of study at this University. The student should present a list of learned repertoire including six songs from which the voice faculty will choose auditioning numbers.

Students pursuing the bachelor's degree in vocal performance are required to take three years of language study. High school language study may be counted toward these three years but must be validated at the University of Colorado. Languages may not be taken on a pass/fail basis.

The language requirement may be satisfied in one of two ways:

1. One year each of three languages.
2. Two years of one language and one year of a second language.

The elective hours in liberal arts may be used to satisfy this requirement.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
P.Mus. 172. Applied Voice Instruction (and literature class)	8

P.Mus. 131. Ensemble	1
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 110. Keyboard Musicianship	2
Mus. 144. Italian Diction and Repertoire	2
Mus. 145. English Diction and Repertoire	2
Mus. 180. Introduction to Music	3
Mus. 275, 276, or 277	3
Elective in liberal arts including foreign language	3

Sophomore Year

Mus. 199. Convocation	0
P.Mus. 272. Applied Voice Instruction (and literature class)	8
P.Mus. 131. Ensemble	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 210. Keyboard Musicianship	2
Elective in theory	2
Elective in liberal arts including foreign language	15

Junior Year

Mus. 199. Convocation	0
P.Mus. 372. Applied Voice Instruction (and literature class)	7
P.Mus. 331. Ensemble	2
Mus. 447. German Diction and Repertoire	3
Mus. 446. French Diction and Repertoire	3
Mus. 380, 381. History of Music	6
Mus. 399. Junior Recital	1
Mus. 442. Opera Theatre	4
Electives in liberal arts including foreign language	6
Free elective	2

Senior Year

P.Mus. 472. Applied Voice Instruction (and literature class)	7
P.Mus. 331. Ensemble	2
Mus. 317. Conducting I	2
Mus. 444. Vocal Pedagogy	2
Mus. 477. History of the Opera	3
Mus. 499. Recital	1
Electives in liberal arts	6
Free electives	10

Voice Theatre Concentration Area

Proficiency in the fundamentals of voice production (breath, vowel formation, intonation, resonance, and diction) is stressed in the four years of study. General instruction in basic theatre arts is also provided to enable the student to become a better singing actor. The student must meet minimum standards in voice at the end of the freshman year and in a comprehensive examination at the end of the sophomore year.

Minimum standards in performance will be judged at the end of each semester by the voice faculty; progressive proficiency is expected. The student must demonstrate in the senior year ability to perform in an artistic manner. A senior project (senior recital, major role, direction or design of a major show) worked out in consultation with the major advisor and approved by the voice and theatre faculties must be presented publicly during the senior year.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
P.Mus. 170. Applied Voice Instruction (and literature class)	6
P.Mus. 131. Choir	2
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 110. Keyboard Musicianship	2
Mus. 144. Italian Diction and Repertoire	2
Mus. 145. English Diction and Repertoire	2
Mus. 180. Introduction to Music	3
Mus. 275, 276, or 277	3
Elective in liberal arts	3

Sophomore Year

Mus. 199. Convocation	0
P.Mus. 270. Applied Voice Instruction (and literature class)	6
P.Mus. 131. Choir	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 210. Keyboard Musicianship	2
Elective in Theory	2
Mus. 317. Conducting I	2
Thtr. 231. Text Analysis for Performance	3
Thtr. 230. Acting: Beginning	3
Electives in liberal arts	6

Junior Year

Mus. 199. Convocation	0
P.Mus. 370. Applied Voice Instruction (and literature class)	6
P.Mus. 380, 381. History of Music (see History Minor)	6
Mus. 442. Opera Theatre[1]	4
Th.Dn. 276 Stagecraft	3
Thtr. 232. Acting: Intermediate	3
Electives in liberal arts	9

Senior Year

P.Mus. 470. Applied Voice Instruction (and literature class)	6
Mus. 442. Opera Theatre	2
Thtr. 487. History of Costume II	3
Senior project (senior recital—Mus. 499-0, major role, direction or design of a major show)	0
Electives in theatre and dance	3
Electives in liberal arts	8
Free electives	6

Wind/Percussion Instruments Performance Concentration Area

Progressive technical proficiency is expected; and minimum standards in major and minor scales and chords, studies, and solo repertoire are to be met. Minimum standards in performance will be judged at the end of each year by the wind/percussion faculty; progressive proficiency is expected. Students who fail two proficiencies in a row may no longer continue in the program.

A half recital will be required in the junior year and a public full recital in the senior year. The student's graduation recital must demonstrate the ability to perform satisfactorily a program of artistic merit in public. Previews of these recitals must be passed before an instrumental faculty unit committee four to six weeks before the final performance.

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
Applied wind/percussion instruction (and literature class)	8
Band or orchestra	2
Class minor in performance	2
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 110. Keyboard Musicianship	2
Mus. 180. Introduction to Music	3
Mus. 275, 276, or 277	3
Electives in liberal arts	6

[1]Opera Practicum (Mus 441) may be substituted by permission of faculty.

Sophomore Year

Mus. 199. Convocation	0
Applied wind/percussion instruction (and literature class)	8
Band or orchestra	2
Class minor in performance	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 207. Instrumentation	2
Chamber music	2
Elective in theory	2
Electives in liberal arts	12

Junior Year

Mus. 199. Convocation	0
Applied wind/percussion instruction (and literature class)	7
Band or orchestra	2
Mus. 380, 381. History of Music (see History Minor)	6
Mus. 399. Recital	1
Mus. 317. Conducting I	2
Class minor in performance	2
Chamber music	2
Electives in liberal arts	12

Senior Year

Applied wind instruction (and literature class)	7
Band or orchestra	2
Chamber music	2
Mus. 499. Senior Recital	1
Free electives	12

Bachelor of Music Education Degree

The program leading to the Bachelor of Music Education degree is designed to provide superior preparation for the teaching of music in the schools. The various demands made upon music teachers and the opportunities open to them have been carefully considered in formulating the courses of study.

Although most students may ultimately specialize in either general music, choral, band, or orchestral work, some may be called upon in their first professional positions to teach in two, or even three, of these fields. Even the music educator who teaches in only one of these areas must have a sufficiently broad knowledge of the entire music program to be able to understand the role of music in contemporary American education and interpret the music program to colleagues and laymen. The courses of study are designed to provide a suitable balance between specialization and generalization.

Because it is important that the prospective teacher be a competent performer, provision has been made for extensive performance study. Normally, candidates will study their principal instrument (or voice) for seven semesters. Satisfactory proficiency must be demonstrated at the end of each year of study by passing a special examination.

COURSES AND CURRICULA

Three basic curricula are provided for the candidate pursuing the Bachelor of Music Education degree: choral emphasis, general music emphasis, and instrumental emphasis. Within each basic curriculum, options are provided so that students may vary their programs in accordance with their needs and interests.

A minimum of 134 semester hours with an overall grade point average of 2.5 must be earned for the Bachelor of Music Education degree. Forty semester hours in liberal arts are required.

Performance in organizations (orchestra, band, choir) is required of all music education undergraduates for seven semesters.

Undergraduate music students are required to attend a literature-performance class in their respective applied areas and are held responsible for checking with their private teachers regarding these meetings.

LIBERAL ARTS REQUIREMENTS

All students entering the music education program, whether freshmen, transfers, or those holding a degree, shall meet the following requirements in order to receive a degree and/or a recommendation for teacher certification.

	Semester Hours
English composition	3
Humanities	6
Social sciences	6
Natural sciences	6
Electives	19
Total required	40

In each of the humanities, social sciences, and sciences, one two-semester course combination shall be required within the prescription of the current *College List* of the College of Arts and Sciences. If any course combination exceeds the minimum requirement of 6 semester hours, the required hours of electives may be reduced appropriately. An elective may be any course outside of music and education. However, the following courses, which are a part of the required curriculum, may be counted toward meeting the elective requirement as well as fulfilling requirements in music and education.

	Semester Hours
Mus. 275, 276, or 277. History of Music Elective	3
Mus. 380, 381. History of Music	6
Mus. 311. Introduction to the Arts	3
Comm. 230. Principles of Communication I	2

ADMISSION TO TEACHER EDUCATION

Teacher education is a campus-wide function at the University of Colorado. Admission to the music education program in the College of Music does not constitute admission to the Teacher Education Program. Students must apply to the School of Education through the chairman of the music education faculty for admission to this program no later than the second semester of the junior year. *Students may not take courses T.Ed. 412 and student teaching until they are admitted to the Teacher Education Program.*

Requirements for admission to the Teacher Education Program are:

1. A minimum grade point average of 2.5.

2. Satisfactory scores on the California Achievement Test.

3. Satisfactory completion of the first four semesters of course work as prescribed in a music education curriculum.

4. Satisfactory functional piano ability as demonstrated by passing the proficiency examination or completion of prescribed course work.

5. Satisfactory performance ability as demonstrated by meeting the sophomore proficiency requirements in a private applied area of study.

6. Recommendation by the music education faculty.

An interview with each student is held by the members of the music education faculty during the second semester of the sophomore year to review the student's progress and qualifications for recommendation for admission to the Teacher Education Program.

STUDENT TEACHING

Students wishing to receive student teaching assignments must make application to the School of Education through the chairman of the music education faculty early in the semester preceding the student teaching semester.

Prerequisites for student teaching are:

1. Admission to the Teacher Education Program.
2. A minimum grade point average of 2.5.
3. Completion of the first six semesters of course work prescribed in a music education curriculum.
4. Satisfactory performance ability as demonstrated by meeting the junior proficiency requirements in a private applied area of study.
5. Recommendation by the music education faculty.

Since student teaching is a full-time activity encompassing the normal public school day, as well as time devoted to extracurricular activities, students will not be required to register for other course work during this period.

Student teaching assignments are dependent upon the availability of qualified and approved cooperating teachers, usually in the Denver metropolitan area. Students are expected to provide their own transportation to their assignments and will find that, generally, public transportation is unsatisfactory.

Choral Music Emphasis

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
Applied instruction (and literature class)	6
Class minor in performance[1]	2
Performance organization[2]	2
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 180. Introduction to Music	3
Mus. 275, 276, or 277.	3
Liberal arts[3]	12

Sophomore Year

Mus. 199. Convocation	0
Applied instruction (and literature class)	6
Class minor in performance	2
Performance organization[2]	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 210. The Public School Music Curriculum	3
Mus. 311. Introduction to the Arts	3
Mus. 380, 381. History of Music	6
Liberal arts[3]	9

Junior Year

Mus. 199. Convocation	0
Applied instruction (and literature class)	6
Performance organization[2]	2
Mus. 217. Laboratory Choir	1
Mus. 317, 318. Conducting I, II	4
Instrumental or general music minor	3
T.Ed. 410. Foundations of American Education	3
T.Ed. 411. Educational Psychology and Adolescent Development	3
Mus. 412. Teaching Choral Music	3
T.Ed. 441. Reading and Writing in the Content Areas	3
Comm. 230. Principles of Communication I	2
Liberal arts[3]	6

Senior Year

Applied instruction (and literature class)	3
Performance organization[2]	1
Theory elective	2
Teaching Brass Instruments, Teaching Woodwind Instruments, or Teaching String Instruments	3
Instrumental or general music minor	3
T.Ed. 412. Principles and Methods of Secondary Education	3
T.Ed. 446. Teaching the Learning Disabled	2
Mus. 411. Student Teaching Seminar	1
Mus. 416. Introduction to Student Teaching	1
T.Ed. 470, 471. Student Teaching	8

General Music Emphasis

Freshman Year	*Semester Hours*
Mus. 199. Convocation	0
Applied instruction (and literature class)	6
Class minor in performance[1]	2
Performance organization[2]	2
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory	2
Mus. 180. Introduction to Music	3
Mus. 275, 276, or 277	3
Liberal arts[3]	12

Sophomore Year

Mus. 199. Convocation	0
Applied instruction (and literature class)	6
Class minor in performance	2
Performance organization[2]	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 210. The Public School Music Curriculum	3
Mus. 415. Percussion Class and Pedagogy	1
Mus. 311. Introduction to the Arts	3
Mus. 380, 381. History of Music	6
Liberal arts[3]	9

Junior Year

Mus. 199. Convocation	0
Applied instruction (and literature class)	6
Performance organization[2]	2
Mus. 217. Laboratory Choir	1
Mus. 313. Classroom Instrument Laboratory	2
Mus. 317, 318. Conducting I, II	4
Mus. 410. Teaching General Music	3
T.Ed. 410. Foundations of American Education	3
T.Ed. 411. Educational Psychology and Adolescent Development	3
T.Ed. 441. Reading and Writing in the Content Areas	3

[1]May be used to meet minor voice requirements and/or piano proficiency.
[2]A minimum of 4 semester hours must be earned in a choir.
[3]See the requirements in liberal arts.

T.Ed. 446. Teaching the Learning Disabled	2
Liberal arts	6

Senior Year

Applied instruction (and literature class)	3
Performance organization[2]	1
Theory elective	2
Teaching Brass Instruments, Teaching String Instruments, or Teaching Woodwind Instruments	3
Choral or Instrumental Minor	3
Mus. 411. Student Teaching Seminar	1
Mus. 416. Introduction to Student Teaching	1
T.Ed. 412. Principles and Methods of Secondary Education	3
Comm. 230. Principles of Communication I	2
T.Ed. 470, 471. Student Teaching	8

Instrumental Music Emphasis

Freshman Year — *Semester Hours*

Mus. 199. Convocation	0
Applied instruction (and literature class)	6
Class minor in performance[1]	2
Performance organization[2]	2
Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 180. Introduction to Music	6
Mus. 275, 276, or 277.	3
Liberal arts[3]	12

Sophomore Year

Mus. 199. Convocation	0
Applied instruction (and literature class)	6
Class minor in performance[1]	1
Performance organization[2]	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Theory elective	2
Mus. 210. The Public School Music Curriculum	3
Mus. 311. Introduction to the Arts	3
Mus. 321. Teaching Brass Instruments	3
Mus. 380, 381. History of Music	6
Liberal arts[3]	6

Junior Year

Mus. 199. Convocation	0
Applied instruction (and literature class)	6
Performance organization[2]	2
Mus. 217. Laboratory Choir	1
Mus. 315. Teaching Woodwind Instruments	3
Mus. 316. Teaching Stringed Instruments	3
Mus. 415. Percussion Class and Pedagogy	1
Mus. 317, 318. Conducting I, II	4
Mus. 314. Teaching Instrumental Music	3
T.Ed. 410. Foundations of American Education	3
T.Ed. 411. Educational Psychology and Adolescent Development	3
Liberal arts	6

Senior Year

Applied instruction (and literature class)	3
Performance organization[2]	1
T.Ed. 412. Principles and Methods of Secondary Education	3
T.Ed. 441. Reading and Writing in the Content Areas	3
T.Ed. 446. Teaching the Learning Disabled	2
Mus. 416. Introduction to Student Teaching	1
Mus 411. Student Teaching Seminar	1
T.Ed. 470, 471. Student Teaching	8
Comm. 230. Principles of Communication I	2
Liberal arts[3]	3

Bachelor of Arts in Music Degree

The degree Bachelor of Arts in Music has as its goal a broad education in music within a liberal arts context. The curriculum is designed to give the student competency and knowledge to deal with music within the cultural milieu of present-day society. Although students may elect within their programs special courses which will permit them to pursue graduate study or a profession in such areas as musicology, composition, music librarianship, or music-journalism, the major emphasis is on development of basic musicianship, an ability to perform music, and a broad knowledge of principles that will provide an intellectual grasp of art.

A minimum of 124 semester hours with an overall grade average of *C* must be earned for the Bachelor of Arts in Music degree. Of these hours at least 72 must be in nonmusic courses. Thirty must be at the 300 or 400 level. A minimum of 40 hours and a maximum of 54 hours is required in music courses.

The normal pattern for private instruction in this degree is one half-hour lesson per week for 2 semester hours of credit or one hour lesson for for 3 semester hours credit, although some of this study may take place in class instruction. The minimum proficiency is equal to the Bachelor of Music (Education) sophomore level. Not more than 16 semester hours of credit in private instruction may be used toward the degree.

The student is required to register for 2 hours of ensemble and may elect 2 additional hours to be applied to the degree.

A recital may be given with permission of the chairman of the faculty concerned and the student's advisor.

Students are required to write a senior thesis in accord with their goals and interests. Preparation and selection of topics are required in a junior research seminar.

The approved thesis is due in the office of the associate dean for undergraduate studies two weeks before the end of the semester. See *Guidelines for the Preparation of Formal Undergraduate Theses* (available from the associate dean's office) for complete procedures relating to the thesis.

The student may choose to complete requirements from a wide selection of courses offered, with no special area of concentration. If the student wishes to select courses forming a concentrated area of interest, this determination must be made in consultation with the major advisor by the beginning of the sophomore year. Areas of interest available are music-broadcasting, music-business, music-dance, music-elementary education certification, music history, music-journalism, music-theatre, music theory, organ pedagogy, piano pedagogy, string pedagogy, voice pedagogy, wind/percussion pedagogy, American folk music, and arts management.

COURSES AND CURRICULA

Freshman Year — *Semester Hours*

Mus. 199. Convocation	0
Applied instruction (and literature class)	4
Ensemble	2

[1]May be used to meet minor voice requirements and/or piano proficiency.
[2]String players must earn a minimum of 4 semester hours in an orchestra. Wind and percussion players must earn a minimum of 4 semester hours in a band, two of which must be in Marching Band.
[3]See the requirements in liberal arts.

Mus. 100, 101. Theory I	6
Mus. 102, 103. Theory and Ear Training Laboratory I	2
Mus. 180. Introduction to Music	6
Mus. 275, 276, or 277.	3
English language or literature (see 1 below)	6
Foreign language (see 2 below)	8

Sophomore Year

Mus. 199. Convocation	0
Applied instruction (and literature class)	2
Mus. 200. Theory II	3
Mus. 202. Theory and Ear Training Laboratory II	1
Mus. 380, 381. History of Music	6
Foreign language (see 2 below)	4
Electives in liberal arts	12
Free electives	4

Junior Year

Mus. 199. Convocation	0
Mus. 398. Junior Research Seminar	1
Mus. 406. Analysis I	2
Requirement in liberal arts (humanities) (see 4 below)	6
Requirement in liberal arts (social sciences) (see 4 below)	6
Elective in music history	3
Electives in liberal arts (see 3 below)	9
Free electives	6

Senior Year

Mus. 495. Senior Thesis	2
Requirement in liberal arts (humanities) (see 4 below)	6
Requirement in liberal arts (social sciences) (see 4 below)	6
Requirement in liberal arts (natural sciences) (see 4 below)	6
Electives in liberal arts (see 3 below)	3
Free electives	2

MINIMUM REQUIREMENTS

Minimum requirements (no concentrated interest area) are:

1. Two semesters of English (composition or literature).
2. Basic proficiency in one foreign language equal to three semesters at university level. This may be fulfilled by presentation of three years of study in high school in one language or by passing a University proficiency examination.
3. Nonmusic electives to fulfill the mimimum requirement of 70 semester hours of credit.
4. Ten semesters of natural sciences, social sciences, humanities: four semesters (two-semester combinations) from each of two of these areas; and two semesters (one two-semester combination) from the third area. (All areas must be represented.)
5. A Junior Research Seminar and a Senior Thesis.

CONCENTRATED INTEREST AREAS

These course listings are for the purpose of advising only. There are no special requirements.

Music-Broadcasting

Comm. 360-3. Introduction to Broadcasting.[1]
Comm. 362-3. Television Production.[1]
Comm. 367-2. Television Production II.
Comm. 460-3. Radio-TV Station Organization and Operation.
Comm. 467-1, 4. Television Production III.
Jour. 360-3. Radio and Television News.
Th.Dn. 373-3. Acting.[1]
Th.Dn. 374-3. Directing.
Th.Dn. 471-3. History of the Theatre I.
Mus. 477-3. History of the Opera.

Music-Business

Business courses are frequently closed to non-business students. Permission may be obtained from the College of Music associate dean for undergraduate studies for the student to petition the College of Business and Administration dean for permission to enroll in business courses.

Acct. 200-3. Introduction to Accounting.
B.Law 300-3. Business Law.
Econ. 201-3. Introduction to Economics I.
Econ. 202-3. Introduction to Economics II.
Mk. 300-3. Principles of Marketing.
Mk. 340-3. Marketing Institutions and Retailing.
Mk. 350-3. Principles of Advertising.
Or.Mg. 330-3. Organization and Management.

Arts Management

In addition to Arts Management Techniques (Mus. 490), the following courses in the College of Business and Administration are required in the arts management concentration in the Bachelor of Arts in Music. They are part of the requirement of 70 hours outside of music. Students must inform the associate dean for undergraduate studies in music of specific courses they will be taking by the tenth week of the preceding semester.

Acct. 200-3. Introduction to Accounting.
B.Law 300-3. Business Law.
Fin. 305-3. Basic Finance.
Mk. 300-3. Principles of Marketing.
Or.Mg. 330-3. Organization and Management.

Other courses in business may be elected in summer on a space available basis. Other courses outside of music required for this degree are:

Eng. 198-3. Introduction to English Studies.
Eng. 200-3. Critical Writing.
Jour. 340-3. Principles of Advertising.

With approval from the associate dean for undergraduate studies, an internship may be substituted for the Senior Paper.

Music-Dance

Dnce. 101/104-1. Beginning Ballet.
Dnce. 131/134-1. Jazz.
Dnce. 181/188-2. Ballet (by audition).
Dnce. 191/198-6. Modern Dance.
Dnce. 214-2. Improvisation.
Dnce. 280-2. Theatre Dance Forms.
Dnce. 290-3. Beginning Composition.
Dnce. 390-3. Intermediate Composition.
Dnce. 492-3. Dance in the 20th Century.
Dnce. 493-2. Performance Events.

Music-Elementary Education Certificate

This concentration of courses allows a student to study music and, at the same time, gain certification for

[1]Courses fundamental to each interest area and/or prerequisite to other courses. Choice of courses is dependent on student's interests, background, and ability. Classes, especially in the areas of business, dance, journalism, and theatre, should be selected in close consultation with the major advisor and departments and colleges or schools concerned.

teaching in the elementary classroom. It does not give certification for teaching music. Most courses listed below should be elected in the junior and senior years.

Required Courses	*Semester Hours*
T.Ed. 309. Foundations of American Education: Elementary	2
T.Ed. 310. Educational Psychology for Elementary School	2
T.Ed. 311. Child Growth and Development	2
T.Ed. 320. Expressive Arts: Art and Physical Education in the Elementary School	2
T.Ed. 400. Educational Media Laboratory	1
T.Ed. 420. Methods in Elementary Language Arts	2
T.Ed. 421. Methods in Elementary Mathematics	2
T.Ed. 422. Methods in Elementary Reading	2
T.Ed. 423. Methods in Elementary Science	2
T.Ed. 424. Methods in Elementary Social Studies	2
T.Ed. 446. Teaching the Exceptional Child in the Regular Classroom	2
T.Ed. 456. Children's Literature	3
T.Ed. 470. Student Teaching-Elementary School	8
Mus. 310. Teaching General Music	3
Mus. 110. Piano Class (two semesters)	4

Music History

Music. 407-2. Analysis II.[2]
Mus. 471-2. Renaissance Music.[2]
Mus. 479-2. Twentieth-Century Music.
Mus. 482-2. Ancient and Medieval Music.[2]
Mus. 485-2. Seventeenth- and Early 18th-Century Music.[2]
Mus. 487-3, 488-3. Late 18th- and 19th-Century Music.[2]

Music-Journalism

Jour. 100-3. Contemporary Mass Media.[1]
Jour. 250-3. Reporting.[1]
Jour. 427-3. Public Relations.
Jour. 460-3. Editorial Opinion Writing.
Jour. 465-3. Journalism and the Law.
Jour. 470-3. Critical Writing.[1]
Jour. 480-3. Magazine Article Writing.
Jour. 490-3. Journalism and Public Opinion.
Jour. 562-3. Mass Communication and the Arts.
Mus. 401-2. Sixteenth-Century Counterpoint.
Mus. 407-2. Analysis II.[2]
Mus. 432-2. Piano Literature.
Mus. 446-2. Art Song I.
Mus. 447-2. Art Song II.
Mus. 466-3. Chamber Music Literature: Winds and Percussion.
Mus. 468-3. Chamber Music Literature: Strings.
Mus. 476-3. History of Choral Literature.
Mus. 477-3. History of the Opera.
Mus. 481-3. Symphonic Literature.
Selections from history area courses.

Music-Theatre

Th.Dn. 270-3. Introduction to the Theatre.[1]
Th.Dn. 273-2. Acting I.
Th.Dn. 276-3. Stage Craft.
Th.Dn. 321-1,2,3. Costuming Practicum.
Th.Dn. 322-1. Techniques in Theatre Practicum.
Th.Dn. 323-1,2,3. Management Practicum.
Th.Dn. 327-1,2,3. Makeup Practicum.
Th.Dn. 424-1,2,3. Acting Practicum.
Th.Dn. 471-3. History of the Theatre I.
Th.Dn. 473-3. Advanced Acting.
Th.Dn. 474-3. Directing.
Th.Dn. 476-3. Stage Design.
Th.Dn. 479-0 to 4. Theatre Practice.
Th.Dn. 486-3. Stage Lighting Design.
Mus. 442-2. Opera Theatre.

Music Theory

Mus. 205-2. Keyboard Harmony and Improvisation.[3]
Mus. 305-2. Elementary Composition.[3]
Mus. 400-2. Contemporary Theory.[3]
Mus. 401-2. Sixteenth-Century Counterpoint.[3]
Mus. 402-2. Eighteenth-Century Counterpoint.[3]
Mus. 403-2. Scoring and Arranging.[3]
Mus. 407-2. Analysis II.[3]

Organ Pedagogy

Mus. 226-2. Service Playing Techniques.
Mus. 326-2. Improvisation.[1]
Mus. 327-2. Improvisation.[1]
Mus. 401-2. Sixteenth-Century Counterpoint[3]
or
Mus. 402-2. Eighteenth-Century Counterpoint.[3]
Mus. 424-3. Church Music.
Mus. 425-3. Church Music.
Mus. 428-3. Organ Survey.[1]
Mus. 429-3. Organ Survey.[1]

Piano Pedagogy

Mus. 205-2. Keyboard Harmony and Improvisation.[3]
Mus. 235-3. Piano Pedagogy I.[3]
Mus. 402-2. Eighteenth-Century Counterpoint.[3]
Mus. 432-3. Piano Literature.[1]

String Pedagogy

Mus. 358-1. Violin Pedagogy.
Mus. 359-1. Cello Pedagogy.
Mus. 468-3. Chamber Music Literature: Strings.
Mus. 481-3. Symphonic Literature.

Voice Pedagogy

Mus. 144-2. Italian Diction and Repertoire.[1]
Mus. 145-2. English Diction and Repertoire.[1]
Mus. 344-3. German Diction and Repertoire.[1]
Mus. 345-3. French Diction and Repertoire.[1]
Mus. 442-2. Opera Theatre.
Mus. 444-2. Vocal Pedagogy.
Mus. 477-3. History of the Opera.

Wind/Percussion Pedagogy

Mus. 319-1. Woodwind and Percussion Design and Repair.
Mus. 466-3. Chamber Music Literature: Winds and Percussion.
Mus. 481-3. Symphonic Literature.

American Folk Music

Basic requirements in performance: two years of study in voice and/or American folk instruments (30 minutes per week) — banjo, fiddle, guitar, mandolin. Among these five media, the student has one major (two semesters) and two minor areas (one semester each). Continuing Education registrations and fee payment arrangements must be cleared through the College of Music Dean's office.

Students may select in consultation with their advisor courses in black studies, American literature, folklore, American art history, American history, American society and thought, jazz, world music,

[1]Courses fundamental to each interest area and/or prerequisite to other courses. Choice of courses is dependent on student's interests, background, and ability. Classes, especially in the areas of business, dance, journalism, and theatre, should be selected in close consultation with the major advisor and departments and colleges or schools concerned.
[2]It is recommended that students choose 10 to 12 semester hours of credit in theory and composition courses in addition to basic music requirements. Selection should be made from the courses listed above.
[3]It is recommended that students choose 10 to 12 semester hours of credit in history and theory courses in addition to basic music requirements. The courses listed above should be given prime consideration.

American popular song, and America's art and vernacular music.

GRADUATE DEGREE PROGRAMS

The University is approved by the National Association of Schools of Music to offer the Master of Music degree in performance, church music, music literature, composition, conducting, and pedagogy; the Master of Music Education degree with special emphasis in either vocal or instrumental music; the degrees Doctor of Musical Arts in performance, pedagogy, conducting, and composition; and Doctor of Philosophy with an emphasis in either musicology or music education.

The student's program will be directed by the degree program coordinator and the major faculty unit chairman or by the student's doctoral advisory committee.

In support of the candidate's application it is recommended that a report of the Graduate Record Examination aptitude test (verbal and quantitative) and the advanced music examination scores be submitted. Arrangements to take these examinations can be made by writing to the Educational Testing Service, Box 955, Princeton, New Jersey 08540; or 1947 Center Street, Berkeley, California 94704. There are no *pass* or *fail* grades; the scores achieved will be regarded as supplementary to the academic record shown in the student's transcript.

Preliminary Examinations. Students who expect to begin work on a master's or doctoral degree must report to the Music Building as indicated below on the two days prior to the beginning of their first term (see appropriate calendar—fall, spring, or summer). (Areas covered in these examinations include theory, aural perception, history and literature, and the major field.)

The two days of preliminary examinations will consist of the following:

First Day

8:30 a.m.-12	Music theory, aural perception
1-4 p.m.	Music history and literature

Second Day

9 a.m.-12	Master's major field (essay examination)
9 a.m.-12	Doctoral major field
1-4 p.m.	Doctoral major field continues if necessary

At least one week before the examinations are scheduled to begin, the student must give written notice to the office of the College of Music associate dean for graduate studies of intent to take the examinations.

Master of Music Degree

PREREQUISITES

The student is expected to present undergraduate preparation equivalent to that demanded for the corresponding bachelor's degree at this University. See Requirements for Graduation for description of the requirements for the bachelor's degree.

In advance of admission, performance majors must submit a repertoire list and arrange for an audition. All performers should be prepared to demonstrate acquaintance with solo literature of the various historical periods.

Composition majors must submit examples of their work to the College of Music, and music literature majors must submit examples of their research papers or projects.

PRELIMINARY EXAMINATION

Examination questions in theory and history will serve as a basis for recommending specific courses and possible further examination in these areas. In addition, the major field written examination for Master of Music degree students in performance will cover musical styles as well as problems of performance and pedagogy. (See the preceding information on Preliminary Examinations.)

Residence. The minimum residence requirement for this degree is two semesters, plus one summer. Prospective students should contact the chairman of the faculty unit concerned for advice.

DEGREE REQUIREMENTS

Artistic performance or the competent composition of music or excellence in research are the basis of requirements for the Master of Music degree. (For the music literature major a keyboard proficiency sufficient to play a Bach chorale at sight and some score reading is required. Music literature majors must demonstrate proficiency in at least one foreign language—French or German.) A normal plan of advancement and maturity is expected of those registered as graduate students, this plan being formulated under the advisement of the student's degree program coordinator and major professor. Only those well advanced in technique and in professional maturity will be granted this degree. A minimum of 30 semester hours of credit is required. The actual number of hours to be presented varies with the needs of the individual student and is determined by examinations given during the course of study. All parts of the preliminary examination (or appropriate courses)—as required by the major faculty unit—must be passed before the student will be permitted to take the written *qualifying examination.* An oral *comprehensive examination* will be given near the close of work toward this degree.

COURSE REQUIREMENTS

There are four specific areas of study in the master's degree program: music education, music history and literature, performance/pedagogy, and theory/composition. A student must select a major (at least 10 hours) in one of these four areas and a minor (at least 6 hours) from one of the remaining three. The student may also elect a secondary emphasis consisting of at least 8 hours (e.g., major-performance; secondary emphasis-pedagogy). Interdisciplinary degrees including a major in an area of music and a secondary emphasis in another area of music or outside of music are also possible. A minimum of 10 hours must be elected outside the major field.

Major courses in performance emphases include applied study, recitals, and recital-related papers; in conducting, courses in advanced conducting, analytical studies, score reading, orchestration, arranging, performance-related papers, and conducting practicum (thesis); in pedagogy, courses in the psychology of music, the pedagogy and literature of a specific performing area, and thesis; in music literature, courses in music history and literature, and thesis; in music education, courses in the foundations of and research in music education as well as courses in professional music education. Outlines of specific programs may be secured from the office of the associate dean for graduate studies.

Choral conducting, percussion, string, and wind majors are required to participate in a music ensemble. These students should consult with the respective chairmen of their faculty units regarding the specific ensemble in which they will participate.

Thesis Requirements. Thesis requirements are as follows (4 hours of credit):

1. For the major in performance: recital(s) and in some cases research papers, or performance preparation from a repertoire list, or a combination of part or all of these, as required by the major faculty unit.
2. For the major in piano pedagogy: research in piano pedagogy and literature and a full-length recital presented before a faculty committee.
3. For the major in composition: the composition, during the period of graduate study, of several works of major proportion, at least one of which must receive public performance.
4. For the major in church music: the preparation and production of a substantive sacred choral work, or recital(s) and in some cases research papers, or a combination of all three, as required by the major faculty unit.
5. For the major in music literature: two written projects for 2 credit hours each, to provide some focus to the candidate's work.
6. For the major in wind or percussion pedagogy: research in pedagogy of the major area and a full-length recital or proficiency examinations in the major area before a faculty committee.
7. For the major in string pedagogy: research in pedagogy of the major area and a full-length recital or proficiency examinations in the major area before a faculty committee.

Master of Music Education Degree

The Master of Music Education program is designed to augment the student's undergraduate preparation in music education with the more advanced training required for service as both a teacher and a supervisor. This advanced study includes, in addition to contemporary methods and materials, attention to aesthetic, philosophical, and psychological theories and principles of teaching music in today's schools.

PREREQUISITES

The applicant is expected to present undergraduate preparation equivalent to that demanded for the corresponding bachelor's degree at this University (see Bachelor of Music Education degree requirements) and the results of the Graduate Record Examination.

During preliminary examinations students will be questioned regarding general knowledge of philosophy and history of music education; organization and supervision of music education; and methods and materials for the individual area (vocal, strings, or winds). Proficiency examinations in the principal and secondary performance instruments (or voice) will be conducted by appointment during the first three weeks of residence.

COURSE REQUIREMENTS

The Master of Music Education degree has three components: a professional music education component, a minor area of study within music, and an area of specialization related to music education. Each component will total approximately 10 hours, with a total of 30 semester hours comprising the minimum requirement for the degree.

The Professional Music Education Courses. The focus is on the music education profession and aspects of history of music education, philosophy, psychology of music and musical learning, research, curriculum, and administration. Two courses are required in the professional education component: Foundations of Music Education (3 hours) and Research in Music Education (3 hours). Elective courses within professional music education of 3 to 6 semester hours will complete this component. Examples of desirable electives are Psychology of Music Learning, Teaching Music Through Performance, Comprehensive Musicianship for Teachers, and Directions of Contemporary Aesthetic Education.

The Minor Area Within Music. The purpose in this component is to develop both knowledge and craft in music to a more highly refined level. Six hours may be elected in music history and literature, music theory *or* music performance, and pedagogy, and 4 hours are elective in music, but outside the major. Studies in music performance (as well as other study) must be at the graduate level. One member of the student's committee will be from the minor area and it is assumed that at least some part of the student's study will be with that faculty member.

The Area of Specialization. The area of specialization will be selected and structured by the student and an advisor, based on the student's interests and abilities. Music bibliography will be an early required course in this area. The area may be in the traditional areas of general music, choral music, or instrumental music. It could also be in related arts (e.g., music and dance, musical theatre, music and fine arts, etc.) or it could also be in a more individualized area relating to the student's professional interests.

An important aspect of the Master of Music Education degree is the culminating paper. This paper will carry 2 hours of credit, and it will be completed and reported in the course Topics in Music Education. The paper will focus on a vital interest each student has, and it should develop to some degree throughout the student's degree program.

All preliminary examinations must be taken and any deficiencies removed, and all core courses taken before the qualifying examination can be scheduled. This examination normally will be given at the close of the third summer term of study, or during the second semester, and will serve as the basis for determination of the student's status (the actual number of credit hours required for graduation).

Normally the course work for the degree can be completed in one academic year plus one summer or during four summer terms. However, since a wide variety of courses in music education is available during the late afternoons, teachers within commuting distance of Boulder can earn a significant portion of credit toward the degree during the academic year without taking a leave from their teaching positions.

Doctor of Musical Arts Degree

The Doctor of Musical Arts degree is a professional degree for creative and performing students who possess the talent as well as the breadth of knowledge, background, outlook, and scholarly capacity requisite to a doctoral program. Areas of study include composition; literature and performance of choral music; instrumental conducting and literature; organ performance; performance, literature, and pedagogy of piano, voice, strings, winds, and percussion; performance, literature, and pedagogy of piano; process of group environments.

ENTRANCE REQUIREMENTS

Entrance requirements include a master's degree in music or demonstrated equivalency comparable to that of this University, submission of performance tapes and tapes of compositions, personal interview and audition when possible, and demonstration of proficiency in the use of the English language. Among the supplementary application materials, a student must submit evidence of written English language proficiency, such as a previously written term paper, a copy of a master's thesis, or a Graduate Record Examination verbal score in the upper 30th percentile.

RESIDENCE REQUIREMENTS

Residence will be three semesters or equivalent in summer sessions beyond the master's degree, of which at least two academic-year semesters must be in residence at this University and must be consecutive. Not more than one-half semester residence credit may be earned in a summer session. The student must be properly registered to earn residence credit.

A graduate student will be considered to be carrying a full load during a regular semester for purposes of determining residence credit if the student is registered for at least 5 semester hours in work numbered 500 or above or at least 8 semester hours of other graduate work.

A full load for purposes of determining residence credit during the summer session is 3 semester hours of work in courses numbered 500 or above or 6 semester hours of other graduate work.

A student who drops out of school before earning residency must apply for readmission in time to do the necessary administrative details. Such students should investigate the time-out program before dropping out in order to insure their readmission.

CONTINUOUS REGISTRATION

After the residence requirement for the Doctor of Musical Arts program has been satisfied, a student must enroll and pay tuition for fall and spring semesters of each year until attaining the degree or formally resigning. After a student has enrolled in all required dissertation courses, he or she will enroll in Mus. 801, Precandidate for Doctor of Musical Arts, until having become a candidate for the degree. After becoming a candidate, the student will enroll in Mus. 802, Candidate for Doctor of Musical Arts, until the degree is attained. This continuing registration is dependent of whether the student is in residence at this University. (See also section on Residence Requirements.)

CREDIT REQUIRED

A minimum of 30 hours, including dissertation, beyond the master's degree is required. The outlines of specific programs may be obtained in the office of the associate dean for graduate studies.

PRELIMINARY EXAMINATIONS

While not a requirement for admission to the Doctor of Musical Arts program, the preliminary examinations must be taken before the beginning of the first semester or summer of residence, since they serve as important diagnostic tools. Examinations are given in music history, theory, aural perception, and the major field.

QUALITY OF WORK

Students are expected to complete with distinction all work for which they enroll. A grade below *B* is unsatisfactory and will not be counted toward fulfilling the minimum requirements for the degree. Upon recommendation by the advisory committee and the executive officer of the department and with the approval of the dean, a student may be required to withdraw at any time for failure to maintain satisfactory progress toward the degree.

PROGRAM COORDINATION

The various programs comprising the Doctor of Musical Arts degree are coordinated by its Administrative Committee consisting of the associate dean of graduate studies, who acts as chairman, and the principal coordinators for the different emphases. The committee and its coordinators (1) advise the student on the basis of preliminary examinations which course work and independent study will prepare the student for the comprehensive examination, (2) assist the student in setting up a total degree plan (including the preliminary planning of dissertation recitals and repertoire lists where required) for presentation to the student's Permanent Advisory Committee, and (3) generally oversee the student's progress toward completion of the

degree. Items one and two above shall be completed during or before the student's second semester of residency.

THE DOCTORAL COMMITTEE AND DEGREE PLAN

No later than the second semester of residence, the student should submit a specific degree plan for approval to the associate dean for graduate studies in music and the Doctor of Musical Arts Administrative Committee. This degree plan should include (1) nominations for the student's doctoral committee; (2) recommendations as to which committee members will assist the student in preparing for various aspects of the degree such as grading previews and recitals, grading papers and research-lecture projects, and assisting with the preparation of the general-knowledge-about-music component of the degree; (3) remedial and supporting course work; and (4) the projected time for taking the comprehensive and final oral examinations.

The student, in consultation with the degree coordinator, the Administrative Committee, and the associate dean for graduate studies, will form a doctoral committee using the following guidelines. The chairperson should participate in all dissertation projects, but may assign the principal responsibility for certain projects to other members of the committee. All projects require the signatures of at least three committee members or other qualified graduate faculty. The doctoral committee shall consist of the Permanent Advisory Committee (three members including the chairperson) plus at least two additional members to form the extended or examination committee. At least one member of the Advisory Committee should be outside the student's major emphasis. The committee as a whole should be constructed to give reasonable breadth to the student's program and a division of responsibility among the committee members. There should be general agreement among the committee members about their individual responsibilities at the committee's inception. Substitutions or additions to the committee can be made during the course of the student's work; however, the student must petition the associate dean for graduate studies and the committee for such a change or addition.

COURSES AND APPLIED STUDY

Some areas require specific course work prior to or in conjunction with work on dissertation projects. Students may be advised to take course work both in preparation for the comprehensive examinations and for dissertation projects. Although doctoral candidates are expected to have achieved a level of competency that does not require regular lessons, applied music instruction may be elected in some areas for the duration of the residency requirement.

LANGUAGE REQUIREMENT

Each student must be able to read material related to his special field of study in one foreign language. The choice of the foreign language must be approved by the student's advisory committee. A communication knowledge of the language must be demonstrated by one of four options which the Graduate School allows. (See Doctor of Philosophy, Language Requirement.) Students in voice have additional language requirements.

COMPREHENSIVE EXAMINATIONS

A student is eligible to take the comprehensive examinations when all deficiencies (including the foreign language requirement) have been removed, when the degree residence requirement has been satisfied, and with permission of the student's permanent advisory committee. It is recommended that the student complete no more than 10 hours of thesis before attempting the comprehensive examination. This examination is in two phases, written and oral, and must be passed as a unit. The oral examination ordinarily follows the written examination by a period of not less than two weeks. A successful candidate must receive the affirmative votes of a majority of the members of the examination committee. In case of failure, the examination may be attempted once more after a period of time determined by the examining committee.

The comprehensive examination must be taken at least one semester before completion of degree requirements, including the dissertation. Students must be registered at the time they take the examination. Students must file their application for candidacy with the Graduate School two weeks before taking the examination. Comprehensive examinations, final orals, and presentation of dissertation projects will normally not take place during the summer session.

TIME LIMIT

Students are expected to complete all requirements for the degree within seven years of their first registrations.

THESIS REQUIREMENTS

All dissertation projects must be submitted in a professionally acceptable format and quality and will be kept on file in the library. One copy of each written project must be submitted to the office of the associate dean of graduate studies for deposit in the music library. The permanent advisory committee will furnish additional guidelines concerning content and format.

DISSERTATION

Normally, if students show only minor weaknesses on their preliminary examinations, they may be advised to begin work on the dissertation concurrently with preparation for the comprehensive examinations.

The dissertation consists of a specified number of performances (or compositions) and documents. Students' permanent advisory committees will assist them in meeting dissertation requirements. While dissertation outlines for the various major areas are listed below, individual instances may require the permanent advisory committee to exercise discretionary flexibility in tailoring dissertation requirements to the student's artistic and educational advantage.

Students must consult with the appropriate program coordinator to determine their specific requirements.

Area Dissertation Requirements

Literature and Performance of Choral Music

Mus. 821-3. Dissertation Project. Choral Program.
Mus. 822-3. Dissertation Project. Choral Program.
Mus. 823-3. Dissertation Project. Choral projects in score reading and rehearsal techniques.
Mus. 824-3. Dissertation Project. Choral student's performance-demonstration in editing, choral arranging, and continuo realization.
Mus. 825-3. Dissertation Project. Research-Lecture.
Mus. 826-3. Dissertation Project. Research-Lecture.
Mus. 827-1. Dissertation Document.
Mus. 828-1. Dissertation Document.
Mus. 831-3. Repertoire Project.

Composition

Mus. 821-3. Dissertation Project. Compositions.
Mus. 822-3. Dissertation Project. Compositions.
Mus. 823-3. Dissertation Project. Composition Recital (or equivalent in performance of compositions).
Mus. 824-3. Dissertation Project. Composition Recital (or equivalent in performance of compositions).
Mus. 825-3. Dissertation Project. Research-Lecture.
Mus. 826-3. Dissertation Project. Research-Lecture.
Mus. 833-4 to 6. Major Composition Project.

Performance: Organ, Piano, Strings

Mus. 821-3. Dissertation Project. Solo Recital.
Mus. 822-3. Dissertation Project. Solo Recital.
Mus. 823-3. Dissertation Project. Chamber Music Recital.
Mus. 824-3. Dissertation Project. Chamber Music Recital.
Mus. 825-3. Dissertation Project. Research-Lecture.
Mus. 826-3. Dissertation Project. Research-Lecture.
Mus. 827-1. Dissertation Document.
Mus. 828-1. Dissertation Document.
Mus. 829-1. Dissertation Document.
Mus. 830-1. Dissertation Document (not required for organ).
Mus. 831-3. Repertoire Project.

Performance, Literature, Pedagogy: Piano, Strings, Wind, and Percussion

Mus. 821-3. Dissertation Project. Recital.
Mus. 822-3. Dissertation Project. Recital.
Mus. 823-3. Dissertation Project. Recital.[1]
Mus. 824-3. Dissertation Project. Pedagogy Practicum (wind and percussion only).
Mus. 825-3. Dissertation Project. Research-Lecture.
Mus. 826-3. Dissertation Project. Research-Lecture.
Mus. 827-1. Dissertation Document.
Mus. 828-1. Dissertation Document.
Mus. 829-1. Dissertation Document.
Mus. 831-3. Repertoire Project (not required in wind and percussion).
Mus. 832-4. Major Document.

Performance, Literature, and Pedagogy of Piano: Process of Group Environments

Mus. 821-3. Dissertation Project. Recital.
Mus. 822-3. Dissertation Project. Teaching performance.
Mus. 823-3. Dissertation Project. Teaching performance.
Mus. 824-3. Dissertation Project. Master classes in group setting.
Mus. 825-3. Dissertation Project. Teacher effectiveness.
Mus. 827-1. Document. May be combined with Mus. 828 for a lecture-recital.
Mus. 828-1. Document. May be combined with Mus. 827 for a lecture-recital.
Mus. 831-3. Repertoire Project. Administered at two levels: reading and performance.
Mus. 832-4 to 6. Major Document. Implemented with teaching performance.

Performance, Literature, and Pedagogy: Voice

Mus. 821-3. Dissertation Project. Solo Recital.
Mus. 822-3. Dissertation Project. Solo Recital.
Mus. 823-3. Dissertation Project. Chamber Music Recital.
Mus. 825-3. Dissertation Project. Performance Document.
Mus. 826-3. Dissertation Project. A project on vocal literature or performance.
Mus. 831-3. Repertoire Project.
Mus. 832-2 to 6. Major Pedagogical Document.

Upon the recommendation of the student's permanent advisory committee, independent study (Mus. 665, Mus. 960) may be substituted for up to a total of 4 hours of performance-related documents (Mus. 827, 828, 829, 830, 1 hour each).

FINAL ORAL EXAMINATION

After all dissertation requirements have been met, an oral examination in defense of the dissertation documents and upon related topics shall be conducted by the examination committee.

Candidates must be registered at the time they take the final examination.

Doctor of Philosophy Degree (Music Education)

The Doctor of Philosophy degree in music, with music education as a field of specialization, is offered through the Graduate School for the student who demonstrates maturity, a strong interest in the music education profession, and musical and scholarly promise. The requirements for the degree have been established for the purpose of acquainting the student with practical and philosophical problems confronting contemporary music education, while at the same time providing a solid background in the history, philosophy, and theory of music. A significant portion of the degree work will emphasize research and research techniques. The program may be expected to prepare the student for a career as a teacher of music education at the college level or for a supervisory or administrative position in the elementary or secondary schools.

Educational preparation similar to the Bachelor of Music Education and Master of Music Education degrees awarded by the University of Colorado and two years of successful teaching experience are prerequisite for admission to the Ph.D. program in music education. Although the primary emphasis in the Ph.D. program is on scholarship and research, the candidate is expected to have attained an acceptable level of musical performance.

Since students entering the Ph.D. program have a variety of backgrounds and needs, the requirements for the program are flexible and cannot be stated in terms of credit hours; the degree is awarded on the basis of proficiency in a broad field of knowledge. Although the rules of the Graduate School require a minimum of 30 semester hours of graduate credit, most students, in or-

[1]Students may substitute a third research-lecture for Mus. 823.

der to meet the expected scholarly and musical standards, find it necessary to plan a program of approximately 45-50 semester hours of course work plus the Graduate School requirement of 16 semester hours for the dissertation.

The course work for the Ph.D. degree shall include up to 15 hours in background courses as needed, 14 hours in music education, 8 hours in a primary minor field of history or theory of music, 6 hours in a secondary minor field and electives. Any course work needed to meet the language requirement will be in addition to the above.

The required course work in music education shall include: (1) Contemporary Issues in College Teaching, (2) Research Literature and Techniques I (Historical and Philosophical), (3) Research Literature and Techniques II (Survey and Experimental), and (4) Research Practicum in Music Education. All other course work shall be determined by the candidate in consultation with the advisory committee.

Course work designed to satisfy the secondary and elective requirements may be selected from such areas as history and literature of music and music theory (if not selected as a primary minor), private applied music and pedagogy, composition, administration, supervision, curriculum, psychology of education, sociology of education, group keyboard pedagogy, integrated music studies (allied arts, humanities), handicapped or educationally disabled children, early childhood education as well as the traditional areas of band, orchestra, choral or general (classroom) music teaching.

Minimum requirements for all Doctor of Philosophy programs at the University of Colorado are outlined in the Graduate School section of this catalog. Further requirements for the Ph.D. degree in music education are as follows:

1. The language proficiency must be demonstrated in either French or German.
2. A minimum of two semesters of resident credit must be earned after the language requirement has been met. The semester in which the language test is passed cannot constitute one of these semesters.
3. A minimum of 6 semester hours in courses taken in residence, numbered 500 or above, in which a grade of *B* or above was earned and which are applicable toward the degree shall earn one semester of resident credit.

For information regarding preliminary examinations see that section.

Further information may be obtained by writing to the associate dean for graduate studies, College of Music.

Doctor of Philosophy Degree (Musicology)

The program leading to the Doctor of Philosophy degree in music, with musicology as a field of specialization, is offered as a concept-oriented course of study embracing areas of musical scholarship from creative theory to historical research. At present, programs in the various historical periods, historical theory, aesthetics, and American music are available.

The basis of the program is the exposure of students to various concepts of and techniques for looking at music. The object of the program is directed, not at the preparation of the performer, researcher, or classroom teacher, but rather toward the background that well-rounded musical scholars will require to direct their attention to any of these, or other, goals upon completion of their courses of study. Since the basis of all musicology is the stylistic history and theory of music, it is assumed all entrants into the program will have a strong grasp of these areas. Finally, they must show evidence of superior individual work in music theory and history, this condition to be established by the submission of one or more papers or other research projects to the chairman of the faculty unit.

Prerequisites. Before beginning the graduate program in musicology, applicants are expected to comply with entrance requirements for the Graduate School, including submission of an application for admission and all supporting credentials as requested thereon. In addition, they are expected to attain acceptable scores on the Graduate Record Examinations (verbal and quantitative, and the advanced music examination). Finally, they must show evidence of superior individual work in music theory and/or history, this condition to be established by the submission of one or more papers, research projects, or compositions to the chairman of the faculty unit.

Preliminary Examinations. Before the beginning of the first semester of residence, the candidate must take the preliminary examinations and the musicology examination, which includes analysis of a composition; solution of a compositional problem (such as writing a fugal exposition or an invention); score reading; essay questions on historical and theoretical problems; a library research project; and a demonstration of reading ability with or without the aid of a dictionary in at least one foreign language, the passages to be chosen from current periodical literature. All requirements listed under Preliminary Examination must be satisfactorily completed not later than one year after the candidate has begun the program.

Course of Study. Students are responsible for selecting their own course of study with the assistance of their advisors. Because of the basic methodology and techniques involved, Introduction to Music Research (Mus. 570) should be elected as soon as possible in the program. The epoch or period courses constitute general preparation for the comprehensive examination. In addition, the student should have established an area of specialization by the time of the comprehensive examination and have a thorough knowledge of the history and bibliography of the particular area. Therefore, the area of specialization should be determined as soon as practicable in the student's residence, and will involve the selection of an advisory committee as outlined in this catalog, the chairman of this committee to serve as the student's major advisor.

It is the responsibility of the student to convince the faculty that he or she is qualified to be a candidate for the degree Doctor of Philosophy by demonstrating a basic knowledge of philosophical, historical, and theoretical problems; of styles and performance practices in

music; and an ability for oral communication and expository writing about music. Normally, the means to such a demonstration will be active participation in colloquia, courses, seminars, and the advisory examination (to be taken at the end of two semesters' study) as well as the comprehensive examination.

Requirements for the Degree. For information regarding hours, residence, thesis, and final examination requirements, see the general requirements for the Doctor of Philosophy degree as outlined in the Graduate School section of this catalog.

1. Entrance requirements are discussed under the topics Prerequisites and Preliminary Examinations.

2. In addition to the Graduate School foreign language requirement, students must demonstrate reading proficiency of musical materials in both French and German as tested by the musicology faculty. Additional language requirements may be made, depending upon the student's area of specialization. These requirements must be fulfilled before the comprehensive examination.

3. Near the completion of the second semester in the musicology program, the student will meet with the musicology committee in the advisory examination. This examination will be conducted orally and will be concerned primarily with the progress the student has demonstrated, particularly with regard to determining a major area of specialization. Such an area of specialization is not to be conceived narrowly as a thesis topic, but rather as a broader segment in which the student plans to spend an appreciable amount of his or her scholarly career. Advisory examinations may be repeated until such time as the student has satisfactorily defined the area of specialization.

4. Two formal presentations in the Musicology Colloquium are required. Preparation for these presentations may be taken for credit as Seminar in Musicology (Mus. 782-783). Other informal presentations are also expected.

5. The musicology student normally will take both the lecture and seminar sessions of those epoch and topical courses which the advisor and the student consider necessary for the student's program. Lecture sessions may be omitted and seminar sessions only may be taken if in the opinions of the advisor and instructor the student has sufficient proficiency in the area. Students are required to take Musicology Seminar (Mus. 782) each semester until completion of the comprehensive examination.

6. The comprehensive examination will be given upon request after completion of a minimum of 30 hours of course credit, three semesters of residence, and fulfillment of the language requirements. Written notice of intent to take the comprehensive must be presented to the musicology faculty through the student's advisory committee at least three months in advance. The written and oral examinations constituting the comprehensive examination will cover both the general areas of music and musicology, and the candidate's special area.

7. Three copies of the thesis must be submitted: one to the Graduate School, one to the musicology faculty for the music library, and one to be returned to the candidate.

Further information may be obtained by writing to the associate dean for graduate studies, College of Music.

NONDEGREE STUDENTS

All nondegree students must secure consent from the instructor and advisor concerned before registering for any course offered in the College of Music.

School of Pharmacy

V. Gene Erwin, Dean

DEGREES

Bachelor of Science in Pharmacy

The five-year course of study in the School of Pharmacy leads to the Bachelor of Science (Pharmacy) degree.

The School of Pharmacy is a member of the American Association of Colleges of Pharmacy and is accredited by the American Council on Pharmaceutical Education.

Graduate Degrees

The faculty of the School of Pharmacy, through the Graduate School, offers the Master of Science and Doctor of Philosophy degrees in the pharmaceutical sciences.

PHARMACEUTICAL SCIENCES

The Master of Science and the Doctor of Philosophy degrees in the pharmaceutical sciences are offered with the following fields of specialization: pharmacy and biopharmaceutics, medicinal chemistry, pharmacology, and behavioral pharmacogenetics.

Although an undergraduate degree in pharmacy is desirable, it is not a necessary requirement for pursuing graduate work in the pharmaceutical sciences. Students wishing to pursue graduate work in the pharmaceutical sciences leading to an advanced degree should read carefully the Graduate School section for minimum requirements, quality of work, residence, application for admission to candidacy, thesis requirements, etc.

HONORS AT GRADUATION

Qualified students are provided the opportunity to participate in the School of Pharmacy Honors Program. Successful completion of the program entitles participants to graduate with honors or special honors. Students interested in the program should contact the faculty member responsible.

SCHOLARSHIPS AND LOANS

Students needing financial assistance for their education should contact the Office of Financial Aid, Campus Box 106, University of Colorado, Boulder, Colorado 80309. In addition, several scholarships and loans are designed specifically for students in the School of Pharmacy. These are awarded upon recommendation of the Financial Aid Committee of the School of Pharmacy. Information may be obtained from the School of Pharmacy office.

UNDERGRADUATE DEGREE PROGRAM

Requirements for Admission

Since the School of Pharmacy is located on the Boulder Campus, admission to the School of Pharmacy is restricted to matriculation on the Boulder Campus only and is not valid for enrollment at the other campuses of the University.

To be admitted to the School of Pharmacy, the applicant must satisfy the requirements of the University as well as specific requirements of the School of Pharmacy. Two academic years of preprofessional study are required to qualify for admission to the School of Pharmacy. Preprofessional courses or their equivalent as indicated in the first two years of the course of study must be completed satisfactorily with a grade of *C* or better prior to enrollment in the School of Pharmacy and may not be taken under a pass/fail option.

To be eligible for admission, an applicant must have attained a cumulative grade point average of at least 2.0. However, a 2.0 average is a minimal requirement only and does not assure admission to the School of Pharmacy. Each year the Committee on Pharmacy Admissions will establish the grade point average to be used in the selection of applicants.

Selection of applicants for admission will be made according to policies established by the faculty of the School of Pharmacy.

Applications for admission to the School of Pharmacy are considered only for the *fall semester* and must be submitted to the Office of Admissions by *March 1* (or until the enrollment limit is reached) of the year for which admission is desired. Students will be notified of their status after their credentials have been evaluated. Provisional admission is granted when course work is still in progress. The student has the responsibility to make certain that a supplementary transcript is mailed to the Office of Admissions when the course work is completed. Failure to submit this transcript may result in refusal of admission. Former students who were en-

rolled in the School of Pharmacy must meet the readmission requirements of the University and be accepted by the School of Pharmacy.

Students who desire to transfer to the School of Pharmacy from other schools or colleges within the University must submit an intrauniversity transfer application to the School of Pharmacy. The application deadline is March 1 or until the enrollment limit is reached. Intrauniversity transfers that are approved to the School of Pharmacy are effective for the Boulder Campus only and are not valid at the University's other campuses.

The Pharmacy College Admission Test is optional and is recommended for students whose overall grade point average is below 3.0.

Requirements for Graduation

To be awarded the Bachelor of Science (Pharmacy) degree, candidates must complete the required courses indicated in the curriculum, and a sufficient number of additional acceptable electives to make a minimum of 160 semester hours, with credit points equal to twice the number of hours attempted.

RESIDENCE REQUIREMENTS

To be eligible to receive the degree in pharmacy, students who bring advanced credit from other schools or colleges of pharmacy will be required to complete a *minimum* of two academic years or four semesters of residence work at this University.

The American Association of Colleges of Pharmacy requires that a minimum of three academic years of residence work must be completed in an approved school or college of pharmacy regardless of the amount of college credit that may be accepted from other types of institutions. It further provides that none of the professional courses in pharmacy may be taken through correspondence.

To qualify for a semester of pharmacy residency, a student must successfully complete at least 12 hours of credit in the School of Pharmacy on the Boulder Campus. If a student takes a reduced schedule of less than 12 hours for the semester or attends the summer session, pharmacy residency will be granted in proportion to the number of hours completed and the duration of the term. Pharmacy residency will not be granted for enrollment at the other campuses or through the Division of Continuing Education of the University.

ORDER OF STUDIES FOR BACHELOR OF SCIENCE (PHARMACY) DEGREE

First and Second Years (Preprofessional)

To be considered for admission to the School of Pharmacy, applicants must have completed the following requirements with a grade of *C* or better:

	Semester Hours
Chemistry, general (with laboratory) (Chem. 103 and 106)	10
Chemistry, organic (with laboratory) (Chem. 331, 332, 333, and 334)	8
Biology (one year of general zoology or a combination of general zoology and botany) (with laboratory) (MCDB 105 and 106; or EPOB 121, 122, 123, 124)	8
Mathematics (college algebra and trigonometry) (Math. 101 and 102; or 110) *OR* (calculus) (Math. 130)	5
Physics, general (with laboratory) (Phys. 301)	5
English composition (A.S. 100, 110)	6
Economics, *Micro* (Econ. 202)	4
Communication principles (Comm. 102)	3
	49

Additional requirements are listed below. Although applicants are encouraged to complete these courses prior to admission to the School of Pharmacy, deficiencies in these courses may be corrected after enrollment.

General education	9
Social sciences (psychology, sociology, or cultural anthropology)	6
	15

Third Year (Professional)

Fall Semester

PHAR 305. Pharmacy Orientation	2
PHCH 370. Pharmaceutical Chemistry I	1
PHAD 381. Laws of Pharmacy	3
BIPH 390. Pathology I	3
EPOB 343. Human Physiology	5
CHEM 471. General Biochemistry	3
	17

Spring Semester

PHAR 306. Prescription Procedures	1
PHCH 371. Pharmaceutical Chemistry II	3
PHCH 375. Physiological and Clinical Chemistry	3
BIPH 308. Principles of Drug Action	4
BIPH 391. Pathology II	2
PHAD 383. Financial Management	3
	16

Fourth Year (Professional)

Fall Semester

PHAR 410. Pharmaceutics I	4
PHCL 452. Mechanisms of Drug Action I	5
PHCH 472. Medicinal Chemistry I	3
BIPH 450. Infectious Disease	3
	15

Spring Semester

PHAR 411. Pharmaceutics II	4
PHCL 453. Mechanisms of Drug Action II	5
PHCH 473. Medicinal Chemistry II	3
PHCL 474. Toxicology	3
PHAD 486. Pharmacy Management	3
PHAR 412. Industrial Tours	0
	17

Fifth Year (Professional)

Fall Semester

CNPH 421. Clinical Pharmacy and Therapeutics	6
CNPH 422. Therapeutic Aspects of Non-Prescription Products	3
CNPH 425. Drug Literature Evaluation	1
CNPH 449. Clinical Pharmacokinetics	3
	13

Spring Semester

CNPH 426. Community Pharmacy Practice Externship I	4
CNPH 428. Institutional Pharmacy Practice Externship I	4
CNPH 4--. Clinical Pharmacy Rotation (Elective)	4
CNPH 4--. Clinical Pharmacy Rotation (Elective)	4
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A minimum of 160 semester hours is required for the Bachelor of Science (Pharmacy) degree. Sufficient elective hours must be completed, either before or after admission, to assure that this requirement is satisfied.

ACADEMIC POLICIES

Academic Ethics

Students are expected to conduct themselves in accordance with the highest standards of honesty and integrity. The act of or the intent to engage in the act of cheating, plagiarism, illegitimate possession and/or disposition of examinations, alteration, forgery or falsification of records, and similar acts are grounds for suspension or expulsion from the University. Students are advised that plagiarism consists of any act involving the offering of the work of someone else as the student's own.

Course of Study

The course of study in the School of Pharmacy is five academic years, leading to the Bachelor of Science (Pharmacy) degree. The course work is organized in a prescribed sequential manner which provides for an excellent general and professional background.

The normal academic load is 15 to 17 semester hours, and the student must be officially registered for each course to receive credit. Permission to take more than 18 or less than 12 hours may be granted only by the dean. A student must be registered for at least 12 hours for credit on the Boulder Campus to qualify for a semester of residency in the School of Pharmacy.

The proper sequence of both the professional and nonprofessional courses in the curriculum must be maintained. A student may not register for any professional course unless all prerequisites have been satisfied with an acceptable passing grade.

Grading System, Dropping and Adding Courses, Withdrawal

The University of Colorado has adopted a standard policy on these procedures which is outlined in the General Information section of this catalog.

The pass/fail option is not permitted for the nonprofessional or professional courses that are required for graduation. After enrollment in the School of Pharmacy, a maximum of 6 hours of nonprofessional electives may be taken to apply toward the degree under the pass/fail option.

Scholastic Requirements

To remain in good standing in the School of Pharmacy, students must maintain a cumulative 2.0 grade point average for all courses attempted and a 2.0 in all professional pharmacy courses, including human physiology and biochemistry. If any individual semester grade point average (the grade point average achieved for the semester *only*) should drop below 2.0, students will be duly notified by the dean that they have been placed on scholastic probation for one semester. In addition to being placed on probation, the student may have a mandatory reduction of academic load and extracurricular activities imposed.

Students on academic probation must improve their record by attaining a 2.0 (or better) grade point average for the next semester attempted and must attain a 2.0 cumulative grade point average. Any student on probation who does not show such improvement will be placed on scholastic suspension. Credits received by enrollment at other institutions while under scholastic suspension will not be accepted as transfer credit by the School of Pharmacy. A student under scholastic suspension may apply for readmission after one semester and, if reinstated, will be on probation for two semesters, during which time the student must achieve a cumulative 2.0 grade point average. A student suspended a second time will not be reinstated.

No student will be permitted to take fifth-year professional courses unless all professional courses in the third and fourth year have been satisfactorily completed. In addition, the School of Pharmacy administers a qualifying examination during the second semester of the fourth year to certify appropriate knowledge from the basic science courses. Any student not earning an acceptable grade in any section of the examination will be asked to repeat that section. If a student fails a portion of the examination for the second time, the student will be required to repeat appropriate basic science course work and retake the entire examination the following spring semester.

In order to graduate from the School of Pharmacy, a student must have both a cumulative 2.0 grade point average for all courses attempted and a 2.0 grade point average in all professional pharmacy courses, including human physiology and biochemistry.

Convocations

All students registered in the School of Pharmacy are required to attend convocations and special lectures scheduled throughout the year. Usually the programs will be scheduled during the day, but occasionally it may be necessary to attend an evening program. The purpose of the convocations and special lectures is to augment regular classroom lectures and to give students the opportunity to meet and hear outstanding visitors.

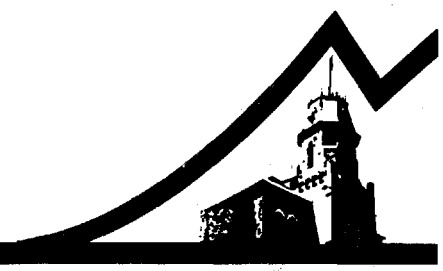
Industrial Tours

All students in the School of Pharmacy are required to participate in field trips to visit pharmaceutical industries. Transportation is the only expense to the student.

Credits at the Denver and Colorado Springs Campuses

While professional courses are not available at the Denver and Colorado Springs campuses, students may complete the two preprofessional years of study, as well as the nonprofessional and elective courses required in the pharmacy curriculum, at these campuses.

Reserve Officers Training Corps Programs



ALL ROTC PROGRAMS

It is important to note that enrollment in ROTC programs is open to both men and women, and ROTC courses are open to all students whether or not they are enrolled in ROTC programs.

AIR FORCE AEROSPACE STUDIES

U.S. Air Force ROTC offers two programs leading to a commission in the U.S. Air Force upon receipt of the baccalaureate degree. Graduate students may be commissioned upon the completion of 12 hours of the Professional Officer Course and a six-week field training program.

Standard Four-Year Course

The program is in three parts: the General Military Course for lower division (freshman and sophomore) students, the Professional Officer Course for upper division students, and Leadership Laboratory (attended by all students). Completion of the General Military Course is a prerequisite for entry into the Professional Officer Course. Completion of a four-week field training program is required prior to commissioning.

Modified Two-Year Program

This program is offered to full-time, regularly enrolled degree students at both undergraduate and graduate levels who will have two years remaining at the University of Colorado at Boulder when they enroll. Selection is on a competitive basis. Applicants should apply directly to the Professor of Aerospace Studies not later than March 15 of the spring semester immediately preceding the academic year in which they desire to enroll in the program. Those selected for this program must complete a six-week field training program during the summer months as a prerequisite for entry into the Professional Officer Course the following fall or spring semester.

Flight Training

Expense-paid ground school and flight training are open to students approved and qualified for future USAF pilot training.

Air Force College Scholarship Program

Students participating in Air Force ROTC may be eligible to compete for Air Force ROTC College Scholarships. Students selected for this program are placed on grants that pay tuition, book costs, nonrefundable educational fees, and subsistence of $100 per month, tax free. (Scholarship cadets are required to take one course in composition, one course in mathematical reasoning, and one course in a foreign language.) All cadets enrolled in the Professional Officer Course receive $100 per month susbsistence during the regular academic year. Students are also eligible to compete for two-, three-, or four-year scholarships open to both men and women.

AFROTC credit for graduation varies with each college. Students should contact the appropriate college or the professor of aerospace studies for determination of credit.

Supplemental Course and Language Requirements

All AFROTC scholarship students in the General Military Course must successfully complete a course in English composition before they can advance to the Professional Officer Course. All AFROTC scholarship students must also successfully complete a course in an Indo-European or Asian language prior to commissioning. All Professional Officer Course students must successfully complete a course in mathematical reasoning prior to commissioning.

USAF Nurse Corps

Air Force ROTC also makes it possible for qualified applicants of nursing schools to enroll in its programs and, upon completion of all academic and licensing requirements, receive commissions as second lieutenants in the USAF Nurse Corps.

NAVAL SCIENCE

All naval science students enroll in N.S. 101, 102, 201, and 202. Those desiring commissions in the U.S. Navy enroll in N.S. 301, 302, 401, and 402 for upper division work. Those desiring commissions in the U.S. Marine Corps enroll in N.S. 310 and 410 for upper division work.

Scholarship Programs

NROTC offers two-year and four-year scholarship programs, and two-year and four-year college (non-scholarship) programs. Navy scholarships may be earned while the student is enrolled in the college program. Scholarship students receive tuition and fees, books, and a $100 per month subsistence allowance. College program students receive a $100 per month subsistence allowance during their last two years in the program.

Naval science scholarship students must complete course work in calculus, physics, specified technical electives, and foreign language. Students should check with their naval science instructor to determine specific course offerings which fulfill the above requirements.

Degree Credits

The number of semester hours of credit for NROTC courses toward fulfillment of the requirements for a degree is a matter for determination by the individual colleges. Students should therefore determine their college's policy when formulating their degree plan.

Commissioned Service

Opportunities for commissioned service are available in surface, subsurface, and aviation specialties in the U.S. Navy. Opportunities in ground and aviation specialties are available in the U.S. Marine Corps. Men and women students interested in other programs leading to commissions in either the U.S. Navy or U.S. Marine Corps are encouraged to contact the NROTC unit on campus. All commissioned opportunities require that the student be working toward, and receive, a college degree.

U.S. ARMY MILITARY SCIENCE

The Department of Military Science offers programs leading to an officer's commission in the active Army, U. S. Army Reserve, or National Guard, in conjunction with earning an undergraduate or graduate degree. Military science courses are designed to supplement a regular degree program by offering practical leadership and management experience. (Field training is required one weekend each semester.)

Four-Year Program

The four-year program consists of two phases: the Basic Course (freshman and sophomore years) and the Advanced Course (junior and senior years). The Basic Course offers a 2- or 3-credit course each semester, covering Army history and organization, and military leadership and management. Laboratory sessions provide the opportunity to apply leadership skills while learning basic land navigation and drill. Enrollment in the Basic Course incurs no military obligation.

The Advanced Course covers leadership, tactics and unit operations, training techniques, military law, and professional ethics, and includes a leadership practicum each semester. The Summer Advanced Camp at Fort Lewis, Washington, provides challenging leadership training, and is a prerequisite for commissioning.

Two-Year Program

The two-year program consists of the Advanced Course, preceded by an on-campus summer program, when offered, or a six-week summer ROTC Basic Camp. Veterans or students who have participated in Junior ROTC, Civil Air Patrol, or similar organizations may be eligible for enrollment in the Advanced Course without attendance at Basic Camp or completion of the Basic Course. Inquiries on advanced placement should be directed to the professor of Military Science.

Scholarship Programs

Four-year college scholarships are available to high school seniors, who should apply before December of their senior year. Competition for two- and three-year scholarships is open to all University of Colorado students, whether or not they are currently enrolled in ROTC. Scholarship students receive full tuition, books, laboratory fees, and a monthly allowance of $100 per month for each academic year. Scholarship cadets serve four years on active duty after commissioning. Students interested in the scholarship program should contact the professor of military science no later than the beginning of the spring semester to apply for the following academic year.

Guaranteed Specialty

Students entering the advanced phase of instruction may be given the opportunity to select a specific specialty in which they will be commissioned. Approximately 40 specialty programs are available.

Simultaneous Membership Program

Nonscholarship students entering the advanced phase of instruction will be given the opportunity to participate with a Reserve or National Guard unit as an officer trainee. Students participating in this program can earn over $100 per month.

Flight Training

Students selected for the advanced course may become qualified as cadets to participate in the Army Aviation Program. These individuals will attend flight school after completion of their Officer's Basic Course while on active duty.

Professional Education

Military science students are required before commissioning to complete courses in written communication, human behavior, and military history. Scholarship cadets have an additional requirement to complete a foreign language. A list of the specific courses which fulfill these requirements can be obtained from the student's military science instructor.

Course Descriptions

Following are descriptions of courses offered in the colleges and schools on the Boulder Campus. *This listing does not constitute a guarantee or contract that any particular course will be offered during a given year.*

For degree requirements, students should refer to the departmental listings in the appropriate college or school information section of this catalog. These requirements are subject to change, and students should check with their department for up-to-date information.

For information on scheduling of classes, students should consult the *Schedule of Courses* issued at the beginning of each semester.

Courses numbered from 100 to 299 are intended for lower division students and those from 300 to 499 for upper division students. Courses numbered from 500 to 599 are primarily for graduate students but in some cases may be open to qualified undergraduates. Normally, courses at the 600, 700, and 800 level are open to graduate students only; see college and school sections for special provisions.

The value of each course in semester hour credits is carried as part of the identifying course prefix and department number. For example, in Anth. 103-3, "Anth. 103" is the identifying department number and "-3" indicates semester hours of credit. Abbreviations used in the course descriptions are as follows:

Coreq.—Corequisite	Prer.—Prerequisite
Lab.—Laboratory	Rec.—Recitation
Lect.—Lecture	Wk.—Week

College of Arts and Sciences

ANTHROPOLOGY

Anth. 103-3. Principles of Anthropology I.[1] *Fall, Spring.* Evolution of man and his culture from their beginnings through the early metal ages. The course covers human evolution, race, prehistory, and the rise of early civilizations.

Anth. 104-3. Principles of Anthropology II.[1] *Fall, Spring.* Survey of the world's major culture areas; culture and its major components, such as subsistence, social organization, religion, and language.

Anth. 200-3. Evolution of Human Sexuality. *Offered irregularly.* Current literature on male and female supremacy is evaluated. The issue of human sexuality is placed in the context of human evolution, is related to human life cycle stages, and is examined in terms of cultural influences on its expansion.

Anth. 201-3. Introduction to Physical Anthropology I. *Fall.* Detailed consideration of human biology, man's place in the animal kingdom, and fossil evidence for human evolution. (Students may not receive credit for both Anth. 201 and 205.)

Anth. 202-3. Introduction to Physical Anthropology II. *Spring.* Continuation of Anth. 201. Quantitative analysis, genetics, and race are emphasized. (Students may not receive credit for both Ant. 202 and 206.)

Anth. 203-1. Laboratory in Physical Anthropology I. *Fall.* A lab. in human osteology and the skeleto-muscular system with an emphasis on comparative primate morphology and adaptation. Coreq., Anth. 201.

Anth. 204-1. Laboratory in Physical Anthropology II. *Spring.* Lab. work consists of problems in quantitative analysis, serological procedures, pedigree analysis, and general problems in human genetics. Coreq., Anth. 202.

Anth. 205-3. Honors—Human Origins I. *Fall.* Understanding how the following two major bodies of evidence for human evolution are used by physical anthropologists in search of human origins: humankind's close physical and behavioral similarity to other living species, particularly the living primates, and the fossil record for human evolution. (Students may not receive credit for both Anth. 205 and 201.)

Anth. 206-3. Honors—Human Origins II. *Spring.* This course surveys evidence for the continuing evolution of *Homo Sapiens.* Emphasis is on how physical anthropologists utilize data and concepts from medicine, genetics, demography, and ecology to understand the evolution of human biological diversity and adaptation. (Students may not receive credit for both Anth. 206 and 202.)

Anth. 208-3. Women, Culture, and Society. (Wm. St. 202) See Women Studies 202.

Anth. 210-3. Frontiers of Cultural Anthropology. *Fall.* Covers current theories in cultural anthropology and discusses the nature of field work. Major schools of thought and actual field studies are explored. Prer., Anth. 104 or instructor's consent.

Anth. 220-3. Introduction to Archaeology. *Fall.* History, basic concepts, techniques, and theoretical construction of archaeological field and laboratory investigations.

Anth. 221-2. Laboratory Course in Archaeological Methods. *Fall.* Study of analytical methods in archaeological research including those employed both in the field and in the laboratory. Instruction will deal with practical exercises illustrating many of the theoretical principles covered in Anth. 220. Prer. or coreq., Anth. 220.

Anth. 222-3. The Neolithic Revolution. *Offered irregularly.* Analysis of the cultural processes involved with man's adjustment to an agricultural-based lifeway in both the Old and New Worlds, and the importance in terms of the subsequent growth of modern societies.

[1] Also available through correspondence study.

Anth. 223-3. Man in the Pleistocene. *Offered irregularly.* Review of evidence pertaining to man's early cultural development. Specific concerns are the interaction of man's physical evolution with the development of culture and man's interaction with his environment.

Anth. 224-3. Urban Revolution. *Spring, alternate years.* The archaeological evidence available and the theories and methods by which urban civilizations arose in the Old and New Worlds.

Anth. 226-3. Old World Archaeology. *Fall.* Prehistory and protohistory of Eurasia and Africa, emphasizes growth of culture and spread of civilization.

Anth. 227-3. New World Archaeology. *Spring.* Prehistory of North, Middle, and South America, emphasizing peopling of the New World, earliest American Indian cultures, and later regional developments.

Anth. 280-3. Nature of Language. *Fall, alternate years.* Survey of the languages of the world. Study of theories of the origin of language, its relationship to other forms of communication, and to systems of writing.

Anth. 300-3. Primate Behavior. *Fall.* Survey of naturalistic primate behavior. Social behavior, behavioral ecology, and evolution emphasized as they lead to an understanding of human behavior. Prer., Anth. 201-202 or EPOB 121-122.

Anth. 301-3. Man, Woman, and Culture. *Offered irregularly.* Deals with the implications of basic anthropological knowledge and understanding as these apply to contemporary problems confronting mankind.

Cultures of the World (Anth. 310-318). Each course will cover the peoples and cultural systems within the areas indicated, including the ways of life of the indigenous populations, their relations with each other and to other peoples, and effects of culture change in recent times.

Anth. 310-3. Africa: Peoples and Societies in Change. *Spring.*

Anth. 311-3. Ethnography of Mexico and Central America. *Spring.*

Anth. 312-3. Peoples of Latin America. *Alternate years.*

Anth. 313-3. Ethnography of North American Indians. *Fall.*

Anth. 314-3. Ethnography of China, Japan, and Korea. *Offered irregularly.*

Anth. 315-3. Culture and Society in South Asia. *Alternate years.*

Anth. 316-3. Peoples of the South Pacific. (Wm. St. 316) *Fall, alternate years.*

Anth. 317-3. America: An Anthropological Perspective. *Alternate years.*

Anth. 318-3. Peoples and Cultures of Central Eurasia. *Offered irregularly.*

Anth. 330-3. Elements of Religion. *Alternate years.* The universal components of religion, as inferred from religions of the world, primitive and civilized.

Anth. 380-3. Languages and People. *Alternate years.* Investigation of the roles which languages play in the building of new nations, in the spread of world religions, in migration, and in the diffusion of writing systems and other customs throughout the world.

Anth. 390-3. Seminar: Physical Anthropology. *Offered irregularly.* Intended to offer the student an opportunity to probe more deeply the topics presented in Anth. 201-202. Prer., Anth. 201-202 or equivalent, and consent of instructor.

Anth. 399-3. Undergraduate Seminar: Anthropology. *Alternate years.* Directed investigation of a specific topic of current importance. The topic may be within the subfields of physical anthropology, archaeology, cultural anthropology, or anthropological linguistics. Prearranged topics will be announced each semester. Prer., consent of instructor.

Anth. 401/501-1 to 3. Teaching Anthropology. *Fall, Spring.* Practicum by special arrangement only in which students learn to teach anthropology by serving as recitation leaders or tutors in introductory courses or as small group leaders in advanced courses. Prer., consent of instructor.

Anth. 403/503-3. Primate Anatomy. *Offered irregularly.* Anatomical correlates of the primate pattern will be investigated through lecture and laboratory dissection of nonhuman primates. Prer., Anth. 201-202 or equivalent.

Anth. 404/504-3. Primate Neuroanatomy. *Alternate years.* Comparative anatomy of the central nervous system in vertebrates, with special emphasis on primates and man. The evolution of the nervous system in relation to function and behavior. Prer., Anth. 201-202 or equivalent.

Anth. 405/505-3. Quantitative Methods in Anthropology. *Fall.* A survey of the ways of deriving meaning from anthropological data by numerical means; including, but not confined to, basic statistical procedures. Prer., Anth. 201-202 or equivalent.

Anth. 406/506-3. Nutrition and Anthropology. *Alternate years.* The nutritional requirements of man and how they have been met by different populations: taking into account differences in soils, climate, natural resources, technology, and cultural practices. Prer., Anth. 201-202 or equivalent.

Anth. 407/507-3. Computer Applications in Anthropology. This course emphasizes using computers, micro-computers, and mainframe computers, for the storage, retrieval, organization, and analysis of anthropological data. It introduces students to computer modeling or simulation of anthropological processes, from human biological evolution to cultural evolution. Prer., Anth. 405/505 and 12 hours of other anthropological course work.

Anth. 408/508-3. Anthropological Genetics. *Offered irregularly.* A consideration of the data and theory of human genetics. Emphasis will be placed upon analytical techniques relating to a genetic analysis of the individual, family, and populations. Prer., Anth. 201-202 and consent of instructor.

Anth. 410/510-3. Human Races. *Fall.* The biological variability of man as shown in geographic races and individual differences; the ways in which races may be formed, maintained, and mixed; survey of the living peoples of the world. Prer., Anth. 201-202 or equivalent.

Anth. 411/511-3. Human Paleontology. *Spring.* A detailed consideration of the fossil evidence for human evolution. Subjects covered are a history of discovery of important fossils and interpretations, descriptive information about the fossils, and data and theory from Pleistocene studies relating to ecology. Prer., Anth. 201-202 or equivalent.

Anth. 412/512-3. Advanced Physical Anthropology. *Alternate years.* An introduction to population genetics and its application to understanding problems of process in human evolution and the formation of races in man. Prer., Anth. 201-202 or equivalent.

Anth. 414/514-3. Human Growth and Development. Individual and population differences in human body size, shape, composition, and function will be considered. Emphasis will be on how these differences arise as a result of the growth process and in relation to genetic variation and environmental influences. Prer., Anth. 201-202 or equivalent.

Anth. 415/515-3. Human Ecology I. A study of demographic and ecological variables as they relate to man. Aspects of natural selection, overpopulation, and environmental deterioration will be considered. Prer., Anth. 103-104.

Anth. 417-3. Forensic Anthropology. *Offered irregularly.* Anthropological techniques for identifying individuals and for use in legal proceedings. Techniques, which include anthropometry, the analysis of blood and other body fluids, fingerprints, and genetic identification, are introduced in terms of historical use in specific crimes.

Anth. 420/520-3. North American Archaeology. *Offered irregularly.* Prehistoric and protohistoric cultures and areas of North America, excluding the American Southwest.

Anth. 421/521-3. Southwestern Archaeology. *Alternate years.* Prehistoric cultures of the American Southwest, their origins, characteristics, and relationships.

Anth. 422/522-3. Archaeology of Mexico and Central America. *Fall.* Prehistoric and protohistoric cultures and areas of Mexico and Central America, including the Aztecs and Mayas.

Anth. 423/523-3. Settlement Archaeology. *Offered irregularly.* Study of the manner in which primitive man adapts his residence to the physical environment and his social needs. Consideration of prehistoric settlement data as well as inferences to be derived: population, community organization, architecture, and land use.

Anth. 424/524-3. Archaeology of South America. *Offered irregularly.* Prehistoric and protohistoric cultures of South America, their origins, characteristics, and relationships, including the high civilization of the Andean area.

Anth. 426/526-3. Biblical Archaeology. (General Classics 426/526.) *Alternate Years.* Old Testament history in the light of archaeological investigation; the Old Testament in the framework of the literature of the ancient Near East.

Anth. 431/531-3. Archaeology of Ancient Near East. (General Classics 486/586.) *Offered irregularly.* Emphasis is placed on the similarity and differences between the archaeological material of the nations of the Middle East and the archaeological influences which were exchanged between such nations.

Anth. 432/532-3. Archaeology of Ancient Egypt. (General Classics 425/525.) *Fall.* The archaeology of Ancient Egypt in the light of recent excavations; the link between the history and archaeology of the nations of the Bible in the North, and Egypt, Nubia, Ethiopia, and Yemen in the South.

Anth. 433/533-3. Environmental Archaeology. *Offered irregularly.* A survey of the method of culture ecology as it can be applied to archaeological investigations.

Anth. 434/534-3. Archaeological Method and Theory. *Alternate years.* A review of the methods of culture theories employed in investigating and explaining the archaeological record. Prer., Anth. 220.

Anth. 435-2 to 6. Archaeological Field and Laboratory Research. *Summer session only.* Students will participate in archaeological field research and conduct laboratory analysis of archaeological materials and data. Open only to University of Colorado anthropology majors. Prer., consent of instructor.

Anth. 438/538-3. Lithic Analysis and Replication. *Spring, alternate years.* A diversity of approaches to the analysis of ancient stone tools are used, including fracture mechanics, lithic technology, materials, heat treatment, and functional analysis. Percussion and pressure flaking experiments are performed. Prer., Anth. 103 or 220 or equivalent.

Anth. 450/550-3. Cross-Cultural Aspects of Socioeconomic Development. *Offered irregularly.* Examines the goals of international agencies which support development in underdeveloped countries. Anthropological perspective is provided for such issues as urban planning, health care and delivery, population control, rural development, and land reform.

Anth. 451/551-3. Applied Cultural Anthropology. *Alternate years.* Analysis of problems of cultural change due to contacts between people of different cultures.

Anth. 452-3. Symbolic Anthropology. *Spring, alternate years.* An exploration of anthropological approaches to the study of symbolic systems, including patterns of belief, ritual, art, and myth. Theoretical issues involve the nature of symbols, the impact of modes of communication, and the interpretation of meaning cross-culturally. Prer., Anth. 104 or consent of instructor.

Anth. 453/553-3. History of Anthropology. *Fall.* History of the growth of anthropology from the earliest times, various schools of thought, outstanding contributors and their works, to the mid-20th century.

Anth. 454/554-3. Culture, Mind, and Experience. *Alternate years.* A sampling of contemporary work in the field of psychological anthropology, including culture and personality, culture and cognition, altered states of consciousness, cultural models of diagnosis and cure, the ethnography of experience, and psychological dimensions of social change.

Anth. 455/555-3. Culture Dynamics. *Alternate years.* Culture change with emphasis on the role of individual motivation in promoting or inhibiting such change. Survey of the literature and analysis of selected case material, including problems of directed change.

Anth. 456/556-3. American Indian Acculturation. *Spring.* Domination of Indian areas and cultures by Europeans and resulting modification of Indian cultures.

Anth. 457/557-3. Maritime Peoples. *Alternate years.* Archaeological studies of maritime peoples are considered first, followed by detailed study of contemporary maritime peoples, emphasizing fishermen and fishing communities. A consideration of contemporary issues involving humanity's present and future use of the seas concludes the course. Prer., Anth. 104 or junior standing.

Anth. 458/558-3. Power: the Anthropology of Politics. *Fall, alternate years.* Covers the nature and distribution of power in state and stateless societies, the evolution of political stratification, the political economy of colonialism, and selected aspects of power in modern society.

Anth. 459/559-3. Urban Anthropology. *Spring.* A comparative study of urban life.

Anth. 460/560-3. Human Ecology II. *Offered irregularly.* A descriptive and analytical study of change in demographic and ecological variables within one or more specific cultures undergoing rapid assimilation. Aspects of breeding isolates, population structures, settlement patterns, and family and community institutions will be compared.

Anth. 476/576-3. Ethnography of Southeast Asia and Indonesia.

Anth. 480/580-3. Languages of Primitive People. *Alternate years.* The methods used to record and analyze the languages of nonliterate societies. Students will be able to work with languages recorded by native speakers of nonwestern languages from around the world.

Anth. 481/581-3. Language and Culture. *Alternate years.* Relationship of language to human behavior; the typological classification of languages; the study of linguistic universals, and the evolutionary implications of such studies. Prer., Anth. 480 or consent of instructor.

Anth. 483/583-3. Egyptian Hieroglyphics I. (General Classics 483/583.) *Fall.* A study of the culture of the ancient Middle East to shed light on the history of its languages. Reading and translating hieroglyphics into modern languages.

Anth. 484/584-3. Egyptian Hieroglyphics II. (General Classics 484/584.) *Offered irregularly.* Reading and translating hieroglyphics into modern languages.

Anth. 491-3. Departmental Honors in Anthropology I. *Fall.* The course work is built around a theme of research design as a means of integrating previous training in the field of anthropology as well as providing an opportunity to perform creative scientific investigations.

Anth. 492-3. Departmental Honors in Anthropology II. *Spring.* Continuation of Anth. 491.

Anth. 498/598-3 to 6. Archaeological Ruins Stabilization. *Summer session only.* Practical and administrative aspects of ruins stabilization. Includes "on-the-job" training in this speciality and review of the policies and legal bases which govern ruins stabilization. Prer., consent of instructor.

Anth. 509-5. Gross Anatomy. *Alternate years.* Lectures on the gross anatomy of the human species and laboratory dissection of human cadavers. Prer., Anth. 201-202 and consent of instructor.

Anth. 513-3. Advanced Osteology. *Alternate years.* Detailed study of the human skeleton with special attention to health and demographic conditions in prehistoric cultures and the evaluation of physical characteristics and genetic relationships of prehistoric populations. Prer., Anth. 201 and 202.

Anth. 519-3. Conservation Archaeology. *Offered irregularly.* Philosophy and legislation involved with conservation (contract) archaeology. Contract negotiations and budgetary involvements of government agencies and university. Analysis of environmental impact statements for archaeological projects.

Anth. 536-2 to 6. Anthropological Field Work. *Summer Session.* Students will assist in the supervision of archaeological field research and conduct laboratory analysis of archaeological materials and data. Open only to University of Colorado advanced anthropology students enrolled in a regular degree program.

Anth. 539-3. Research Methods in Archaeology I. *Offered irregularly.* Methods and theory of archaeology, emphasizing the

interpretation of materials and data and the relationships of archaeology to other disciplines.

Anth. 578-3. The Anthropology of Language Acquisition. *Offered irregularly.* Consideration of various cultural and psycholinguistic factors that may determine group behavior or personality.

Anth. 586-3. Biocultural Foundations of Language. *Alternate years.* An investigation of species-specific language behavior as it relates to the hominoid fossil record, primate communication, and physiology. Evidence will be drawn from archaeological data and from cultural anthropology.

Anth. 600-3. Seminar: Current Research Topics. *Yearly.*

Anth. 601-3. Seminar: Ethnological Theory. *Yearly.*

Anth. 602-3. Seminar: Physical Anthropology. *Yearly.*

Anth. 603-3. Seminar: Archaeology. *Yearly.*

Anth. 604-3. Seminar: Anthropological Linguistics. *Yearly.*

Anth. 613-3. Interdisciplinary Seminar. *Alternate years.* A consideration of interdisciplinary problems that involve anthropology and related fields such as history, the behavioral disciplines, and the natural sciences.

Anth. 614-3. Seminar: Archaeology of Selected Areas. *Alternate years.* Consideration of the archaeology of a specified area, either geographical or topical. Areas to be selected in terms of current research interests.

Anth. 615-3. Seminar: Physical Anthropology of Selected Areas. *Offered irregularly.* A detailed consideration of the morphological and genetic range of variability of major continental divisions of mankind.

Anth. 630-3. Seminar in Research Methods in Cultural Anthropology.

Anth. 700-1 to 6. Master's Thesis.

Anth. 800-30. Doctor's Dissertation. All doctoral students must register for no fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Anth. 920-1 to 3. Independent Study (Undergraduate, Lower Division). Consent of instructor required.

Anth. 940-1 to 3. Independent Study (Undergraduate, Upper Division). Consent of instructor required.

Anth. 950-1 to 3. Guided Study. For graduate students only. A concentrated study of a topic of anthropological concern where there is no intention of developing new data. Consent of instructor required.

Anth. 960-1 to 3. Independent Research. For graduate students only. Original research aimed at developing a solution to an originally conceived research problem. Consent of instructor required.

Anth. 999-000. Candidate for Degree.

ARTS AND SCIENCES

A.S. 100-3. General Expository Writing. Instruction in the essential techniques of exposition by means of practical criticism of student writing and model essays and a review of fundamental grammar and basic compositional skills.

A.S. 110-3. Advanced Expository Writing. Develops rhetorical skills and the techniques of research writing. Prer., A.S. 100.

A.S. 221-3. Human Sexuality. (Formerly Psych. 221). Covers in substantive form the interdisciplinary field of human sexuality. Anatomical, physiological, anthropological, sociological, legal, and artistic aspects of the subject are included.

A.S. 250-3. Basic Business Tools. An intensive survey course designed to provide students with basic accounting and financial skills. The accounting part of this course is designed for nonbusiness students to help them understand the meaning of, and terminology contained in, financial statements.

A.S. 940-2 to 6. Senior Thesis for Individually Structured Major.

ASIAN STUDIES

A.St. 499-3. Senior Project in Asian Studies. This is an individually supervised research paper or creative project in Asian studies. It is required of, and open only to, seniors majoring in Asian studies.

A.St. 940-variable credit. Independent Study.

ASTROPHYSICAL, PLANETARY AND ATMOSPHERIC SCIENCES

APAS 111-3. General Astronomy. *Fall, Spring.* Principles of modern astronomy for non-science majors, summarizing our present knowledge about the earth, the moon, planets, the sun, and the origin of life. APAS 111 and APAS 112 may be taken in either order. In both courses there is considerable use of the Fiske Planetarium, but only limited use of telescopes. Students desiring more extensive laboratory and observing experience should also register for APAS 121.

APAS 112-3. General Astronomy. *Fall, Spring.* Principles of modern astronomy for non-science majors summarizing our present knowledge about the sun, stars, birth and death of stars, galaxies, and the structure and origins of the universe. APAS 111 and APAS 112 can be taken in either order. Students desiring more extensive laboratory and observing experience should also register for APAS 122.

APAS 113-3. Dynamic Earth I — Introduction. (Geol. 113.) *Fall.* Origin and evolution of the earth as a planet. Alternative energy resources. Composition of the earth, continental drift, and plate tectonics.

APAS 114-3. Dynamic Earth II — The Solid Earth. (Geol. 114.) *Spring.* Basic concepts of the physics of the solid earth, earthquakes, their causes and prediction. Earth structure, earth's gravity and magnetic fields, paleomagnetism.

APAS 115-3. Dynamic Earth III — Meteorology and Oceanography. (Geol. 115.) *Spring.* Composition and structure of the atmosphere and the oceans. Ocean-current systems, waves, and tides. Air-sea interaction. Weather phenomena. Man's impact on the ocean and atmosphere.

APAS 121-1. General Astronomy Laboratory. *Fall, Spring.* Optional lab. for APAS 111, centered around the solar laboratory but involving other telescope, laboratory, and planetarium experience, emphasizing the solar system. One three-hour period per week. Coreq., APAS 111.

APAS 122-1. General Astronomy Laboratory. *Fall, Spring.* Optional lab. for APAS 112 involving observatory, planetarium, and laboratory experience, emphasizing sun, stars, and galaxies. One scheduled hour per week plus additional day- and night-time hours to be arranged. Coreq., APAS 112.

APAS 319-3. Topics in Meteorology. (Geog. 319.) *Fall.* Topics vary from year to year and may include weather-map analysis and prediction, weather modification, severe storms, air quality, and aviation weather. Nonmathematical. Prer., APAS 115, or Geog. 100, or instructor consent.

APAS 320-3. Topics in Climatology. (Geog. 320.) *Spring.* Topics vary from year to year and may include climatic change, snow and ice, mountain weather and climate, and applied climatology. Nonmathematical. Prer., APAS 115, or Geog. 100, or instructor consent.

APAS 321-3. Topics in Solar-System Astronomy. *Fall.* Topics in modern solar-system astronomy are pursued. Topics may vary but often include nature and evolution of the sun, life in the universe, origin and nature of the planets, space science. Nonmathematical. Prer., APAS 111.

APAS 322-3. Topics in Stars and Galaxies. *Spring.* Topics in modern astronomy outside the solar system are pursued. Topics may vary but often include stars, black holes, galaxies, quasars, and cosmology. Nonmathematical but physical concepts introduced. Prer., APAS 112.

APAS 350, 351, 352-variable credit. Special Topics in Astrophysical, Planetary, and Atmospheric Sciences. Special topics

intended to acquaint undergraduate students with topics of current interest and research in astrophysics and planetary and atmospheric sciences.

APAS 391-3. The Earth's Atmosphere and Oceans. *Fall.* The physical structure and processes occurring in the atmosphere and oceans; radiation and cloud physics; atmospheric winds and ocean currents; general circulation; gulf and jet streams; formation of severe storms. Prer., general physics and calculus.

APAS 392-3. Planetary Physics. *Spring.* The evolution of the solar system and formation of the inner and outer planets; evolution of planetary atmospheres; results from planetary exploration with space probes; comparative planetology. Prer., general physics and calculus.

APAS 393-3. Astrophysics. *Fall.* The structure and evolution of the sun and stars. Stellar winds, interstellar matter, and galaxies. Origin and propagation of various types of radiation, generation of energy and production of the elements in the stars, cosmic electrodynamical processes. Prer., general physics and calculus.

APAS 394-3. Cosmology and Relativity. *Spring.* Special and general relativity as applied to astrophysics, cosmological models, observational cosmology, experimental relativity, the early universe. Prer., general physics and calculus.

APAS 421-3. Photochemistry of the Earth's Upper Atmosphere. *Fall.* This course will present the theory of the photochemistry of the Earth's stratosphere and upper atmosphere. Spacecraft observations of ozone will be described, particularly the natural variations that occur. Man's influence on the chemistry of the atmosphere will also be included. The theory of the photochemistry of the early atmosphere is the final part of the course. Prer., Chem. 103 and 106; Phys. 111, 112, and 213.

APAS 422-3. Photochemistry of Planetary Atmospheres. *Spring.* This course will first describe the photochemistry of the atmospheres of Mars and Venus. The photochemistry of these atmospheres will be compared to the photochemistry of the Earth's atmosphere. The photochemistry of Jupiter, Saturn, and their moons will also be part of the course. The photochemistry of comets and the 1986 observations of Halley's comet will be the final part of the course. Prer., Chem. 103 and 106; Phys. 111, 112, and 213.

APAS 433-3. The Sun. See APAS 533.

APAS 440-3. Introduction to Controlled Fusion. Overview of research in controlled thermonuclear fusion for power uses; world energy problems; elementary plasma physics relevant to fusion reactors; confinement schemes (toroidal devices, magnetic mirrors, magnetic pinches, laser-plasma systems); nuclear reactions; Lawson criterion for reactor feasibility; heating methods. Prer., Phys. 321, 332 or consent of instructor.

APAS 505-3. Atmospheric Physics I. *Fall.* Physical processes in the atmosphere. Application of statics, atmospheric thermodynamics, cloud physics, and radiative transfer.

APAS 506-3. Atmospheric Physics II. *Spring.* Atmospheric motions, planetary boundary layer theory, elementary turbulence theory, energy transformations, general circulation of the atmosphere. Prer., APAS 505, APAS 540, or consent of instructor.

APAS 511-3. Internal Processes in Gases. *Fall.* Thermal, mechanical, quantum, and radiative processes in gases and plasmas, with emphasis on spectroscopy, atomic and molecular physics, and statistical mechanics applicable to planetary and stellar atmospheres, interstellar matter, and other cosmic phenomena.

APAS 514-4. Experimental Plasma Physics. (Phys. 514/414.) *Spring.* A combined lect. and lab. course in which fundamentals of plasma physics are demonstrated in student hands-on experiments. Gas-discharge physics, statics and dynamics of plasmas. One lect. and one three-hr. lab. session weekly. Prer., senior standing in physics or equivalent by consent of instructor.

APAS 515-3. Introductory Plasma Physics. (Phys. 515.) *Spring.* Basic phenomena of ionized gases, static and dynamic shielding, linear waves, instabilities, particles in fields, collisional phenomena, fluid equations, collisionless Boltzmann equations, Landau damping, scattering and absorption of radiation in plasmas, elementary nonlinear processes, WKB wave theory, controlled thermonuclear fusion concepts, astrophysical applications, experimental plasma physics (laboratory). Prer., APAS 554 or equivalent; Phys. 331 or equivalent.

APAS 516-3. Intermediate Plasma Physics. (Phys. 516.) *Fall.* Continuation of APAS 515. Topics vary yearly but include nonlinear effects such as wave coupling, quasilinear relaxation, particle trapping, nonlinear Landau damping, collisionless shocks, solitons; nonneutral plasmas; kinetic theory of waves in a magnetized plasma; anisotropy; inhomogeneity; radiation ponderomotive force, parametric instabilities, stimulated scattering; plasma optics; kinetic theory and fluctuation phenomena. Prer., APAS 515 or instructor consent.

APAS 517-3. Advanced Plasma Physics. *Spring.* Continuation of APAS 516. Radiative transfer of plasma waves, advanced kinetic theory of plasmas, spontaneous emission, transport phenomena, fluctuation-dissipation theorems, modulational instability, wave trapping and collapse, turbulence, special topics. Prer., APAS 516 or instructor consent.

APAS 520-3. Meteorology of the Upper Atmosphere. *Spring, alternate years.* The structure and dominant physical processes that occur in the neutral atmosphere from 20-100 km. Radiation, photochemistry, general circulation, transport phenomena. Also probing techniques, rockets, satellites, etc.

APAS 525-3. Planetary Aeronomy. *Fall, alternate years.* Basic physics of the processes that occur in the upper atmosphere between 80 km and several earth radii. Photodissociation, diffusion, and thermal conductivity of the thermosphere. The structure and composition of the D, E, and F regions of the ionosphere. Escape of gases from the exosphere.

APAS 530-3. Introduction to Magnetospheres. (Aero. 573.) *Spring, alternate years.* Introduction to solar and stellar winds, planetary and stellar magnetospheres. Guiding center theory for particle motion, magnetospheric topology, convection, radiation belts, magnetic storms and substorms, auroras.

APAS 533/433. The Sun. *Spring.* Physical processes of the sun, including the interior, photosphere, chromosphere, and corona. Topics covered include properties of the electromagnetic spectrum (X-ray, UV, visible and radio wave-length), magnetic fields, velocity fields, and flare phenomena and interpretation. Prer., Phys. 321-322, Phys. 331-332, and Phys. 341 or equivalent.

APAS 540-3. Fluid Dynamics I. *Fall.* Laws of fluid motion relevant to, Earth's oceans and the atmospheres of Earth, the planets and the sun. Scale analysis, effects of rotation, viscosity and compressibility.

APAS 541-3. Fluid Dynamics II. *Spring.* Continuation of Fluid Dynamics I. Stratified flows, hydrodynamic instability, thermal convection, waves, and transition to turbulence. Prer., APAS 540.

APAS 542-3. Geophysical and Astrophysical Turbulence. *Spring.* Scale analysis, deterministic and statistical descriptions of turbulent flows. Application to planetary boundary layers, large- and small-scale circulations of atmospheres and oceans, and convection in stars. Prer., APAS 540 and 541 or equivalent.

APAS 554-3. Mathematical Methods. *Fall.* A course in applied mathematics designed to provide the necessary analytical background for courses in plasma physics, fluid dynamics, E and M and radiation transfer. Subjects to be covered: integration techniques, linear and nonlinear differential equations, WKB and Fourier transform methods, adiabatic invariants, partial differential equations, integral equations, and integrodifferential equations. Illustrative examples will be drawn from above areas of physics. Prer., undergraduate or graduate complex variables.

APAS 555-3. Radiative Transfer. *Spring.* Physical processes involving radiative transfer; radiative equilibrium; mathematical solutions of radiative transfer equation applied to problems such as coherent scattering, line formation, frequency redistribution, gray and nongray absorption, anisotropic scattering, emission-dominated processes. Prer., APAS 511 or consent of instructor.

APAS 556-3. Radiative Processes in Planetary Atmospheres. *Fall, alternate years.* Application of radiative transfer theory to problems in planetary atmospheres, with primary emphasis on the earth's atmosphere; principles of atomic and molecular spectroscopy; infrared band representation; absorption and emission of atmospheric gases; radiation flux and flux divergence computations; radiative transfer

and fluid motions; additional applications such as inversion methods, climate models, etc. Prer., APAS 555 or consent of instructor.

APAS 560-3. Introduction to Astrophysics. *Fall.* Introduction to basic astronomical data and techniques; stellar classifications; stellar motions; stellar populations, star clusters, HR diagrams, semiempirical approach to stellar evolution; survey of various astrophysical disciplines.

APAS 562-3. Stellar Interiors. *Spring, alternate years.* Solar photosphere, chromosphere, and corona; solar activity and solar wind; physical basis for stellar interiors, opacity, energy transfer, stellar models, stellar evolution; elementary pulsation theory, variable stars. Prer., APAS 560 or equivalent.

APAS 563-3. Physics of the Interstellar Medium. *Spring, alternate years.* Properties of interstellar matter; galactic structure and dynamics; radio astronomy, emission processes and measurement, galactic and extra-galactic radio sources, X-ray and gamma-ray astronomy; introductory cosmology. Prer., APAS 560 or equivalent.

APAS 566-3. Galaxies and Cosmology. *Fall, alternate years.* Galaxies: classification, structure, content, dynamics; radio galaxies; quasars; clusters of galaxies; extra-galactic X-ray sources. Cosmology and cosmogony: cosmic distance scale, Hubble's law, source counts, physics of the early universe, chemical evolution of galaxies. Prer., APAS 560 or equivalent.

APAS 583-3. Solar Physics. *Fall, alternate years.* Topics include solar interior and dynamics; energy transfer by radiation and convection; structure and energy balance of the atmosphere; solar activity cycle, including sunspots, flares, and coronal evolution. Prer., or coreq., APAS 515, 540, and 555 or equivalent.

APAS 595-3. Seminar: Climatic Change. (Geog. 523; Geol. 595.) A cross-disciplinary survey of the evidence for and theories of climatic change. Prer., consent of instructor.

APAS 596-3. Theories of Climate and Climate Variability. (Geog. 525.) *Fall, alternate years.* A critical review of the current theories of climatic variability based on analysis of the different physical processes affecting climate. Prer., graduate student in the physical sciences or consent of instructor.

APAS 613-3. Geophysical Fluid Dynamics. *Spring, alternate years.* Brief review of basic ideas of fluid dynamics and radiative transfer relevant to the study of the motions of planetary atmospheres. Dimensional and scale analysis of the governing equations and the general classification of circulatory regimes. Barotropic and baroclinic instability. Finite amplitude effects and the formation of fronts. Large-scale wave interactions and geostrophic turbulence applied to planetary atmospheric and oceanic circulations. Prer., APAS 540, 541.

APAS 614-3. Astrophysical Fluid Dynamics. *Spring, alternate years.* Varying topics in modern application of nonlinear fluid dynamics in astrophysics. Topics will include compressible convection in stars, including the coupling to rotation and magnetic fields; acoustic-gravity waves and pulsational modes; dynamics of accretion discs and mass exchange in binary systems; stratified turbulence; stellar winds. Prer., APAS 540-541; APAS 613 recommended.

APAS 615-3. Magnetohydrodynamics. *Fall, alternate years.* Development of MHD equations, approximations, MHD flows, waves and shocks, double adiabatic theory, stability theory, boundary layers, convection, and turbulence. Astro-geophysical applications (will vary somewhat according to instructor). Prer., APAS 515, 540.

APAS 624-3. Physics of Planetary Airglows. *Fall, alternate years.* Theory of the physical processes that lead to the excitation of the airglows. Ground- and space-based observational techniques used to measure the nightglow, twilightglow, and dayglow. The determination of the structure and composition of planetary atmospheres from airglow measurements. Prer., APAS 511, 525; Phys. 656.

APAS 630-3. Advanced Magnetospheric Physics. *Spring, alternate years.* Current research problems in the physics of the solar and stellar winds, terrestrial, planetary, and stellar magnetospheres, auroras, space plasmas. Prer., APAS 515, 530, or consent of instructor.

APAS 640-3. Radio Astronomy. *Fall, alternate years.* Observations and interpretation of the radio emissions from the sun, planets, and galactic and extragalactic sources. Topics include a limited amount of antenna and receiver theory, the representation of random noise, polarization, and the theory of the physical processes which produce radio emission. Prer., APAS 554.

APAS 650, 651, 652, 653, 654, 655-variable credit. Special Topics in Astrophyscial, Planetary, and Atmospheric Sciences. Intended to acquaint students with current research in astrophysical, planetary, and atmospheric sciences. (Topics vary each semester.)

APAS 661-3. Stellar Atmospheres. *Alternate years.* Stellar energy distributions, radiative transfer, stellar atmospheres; line absorption coefficient, broadening mechanisms, line formation in stellar atmospheres; applications to stellar spectroscopy. Prer., APAS 555 is strongly recommended.

APAS 665-3. Observational Astronomy. *Alternate years.* An introduction to the observational techniques of modern astronomy. Topics include optical, photographic, and electronic instrumentation for astronomical observation and the basic principles involved in their operation. Prer., APAS 560 or equivalent.

APAS 667-3. High-Energy Astrophysics. *Fall, alternate years.* Explosive phenomena in stars and galaxies; origin and propagation of cosmic rays; nonthermal radio sources; physics of neutron stars, pulsars, and black holes; cosmic X-ray sources and gamma-ray sources. Prer., APAS 560.

APAS 700-4 to 6. Master's Thesis.

APAS 750-variable credit. Reading and Research in Astrophysical, Planetary, and Atmospheric Sciences.

APAS 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog.

APAS 920-variable credit. Independent Study. Instructor consent required.

APAS 940-variable credit. Independent Study. Instructor consent required.

BIBLIOGRAPHY

Bib. 301-2. Methods of Library Research. *Fall, Spring.* Development of library research methods for the undergraduate to achieve proficiency in the use of libraries.

BIOLOGICAL SCIENCES

Students may not receive credit for both MCDB 105-106 and EPOB 121-123-122-124, or Natural Science 123 and 124.

Biology—Environmental, Population, and Organismic

EPOB 100-3. Background in Biological Sciences. This is a 3-credit course designed to provide a background in biology. The course will serve as a general introduction to biological methods and principles.

EPOB 107-4. Introduction to Biology I. Three lect., two rec. per wk. An introductory survey for students educationally disadvantaged in biology and other sciences (i.e., students with inadequate or no high school science course). Includes molecular, cellular, developmental, and organismic biology. Emphasis placed on fundamental principles, concepts, facts, and questions. Fulfills one semester of natural science if followed by EPOB 108.

EPOB 108-4. Introduction to Biology II. Three lect., 2 rec. per wk. Continuation of introductory survey provided in EPOB 107. For students educationally disadvantaged in biology and other sciences. Includes introduction to organisms, homeostasis, behavior, ecology, and evolutionary biology. Emphasis on fundamental principles, concepts, facts, and questions. Together with EPOB 107, fulfills one year of natural science.

EPOB 121-3. General Biology I. *Fall.* A concentrated introduction to molecular, cellular, genetic, and evolutionary biology. Emphasis on fundamental principles, concepts, facts, and questions which underlie more detailed consideration later in the core curriculum. Students with a score of 2 on the Advanced Placement Test in biology consult course office; those with scores of 3, 4, or 5, or at 66th percentile or higher on the CLEP test, receive 6 hrs. credit and are exempt from the course. Consult Course Office for schedule of the CLEP test. Students who transfer credit in biology must consult departmental advisor. Coreq., EPOB 123 for students taking advanced EPOB courses.

EPOB 122-3. General Biology II. *Spring.* Lect. A concentrated introduction to organisms, homeostasis, development, behavior, and ecology. Emphasis on fundamental principles, concepts, facts, and questions which underlie later, more detailed consideration in the core curriculum. See description of EPOB 121 for information on proficiency tests. Prer., EPOB 121; coreq., EPOB 123 for students taking advanced EPOB courses.

EPOB 123-1. General Biology Laboratory I. One 3-hr lab per week. Consists of experiments and exercises to provide an extension of basic concepts and scientific approaches presented in the general biology lect. course (EPOB 121). Coreq., EPOB 121. R.C. Eaton.

EPOB 124-1. General Biology Laboratory II. Focuses upon diversity, physiology, and ecology of whole organisms. Provides direct experience with experimental procedures, identification of organisms, and report preparation. Prer., EPOB 123; coreq., EPOB 122. J. H. Bushnell.

EPOB 302-3. Principles of Ecology. Principles relating to ecosystem structure and function; properties and interactions of populations; adaptations and environmental influences; organization and development of terrestrial and aquatic ecosystems. Prer., EPOB 121-124.

EPOB 303-3. Introduction to Biological Statistics. Lect. and discussion. Introduction to statistical methods for the design and analysis of biological research. Includes such topics as development and testing of hypotheses, field research vs. the controlled experiment, and when to use parametric vs. distribution-free statistics. Prer., EPOB 121-124 and Math. 110 or equivalent. S. Bernstein.

EPOB 310-3. Plants and People. *Spring.* Lect., demonstrations. Introduces botanical studies and emphasizes the role of plants in human affairs. Covers the major uses of plants for foods, fibers; shelter, fuels, medicines, and industrial raw materials as well as some less fundamental uses such as flavorings, perfumes, poisons, dyes, stimulants, and ornamentals. Prer., EPOB 121-124, or equivalent. R. Bye.

EPOB 316-3. Paleo-Ecology. History of modern biotic communities; background of climatic history as setting for contemporary studies of evolution, genetics, and ecology; the myth of stable tropical biotas; ecotonal instability in North America; extinction of large mammals; why environmental planning ignores historical perspective. Field trips required. H. Nichols.

EPOB 317-3. Arctic and Alpine Ecology. *Spring.* Deals with the biology of arctic and alpine environments, the limiting physical factors (such as geomorphology and climatic history), and the human interaction with cold stressed environments, especially the arctic. Field trips are required. Prer., introductory biology, geology, or geography. H. Nichols.

EPOB 320-3. Genetics. Lect., rec. Mendel's Laws, gene action, linkage, chromosomal aberrations, mutation, genetic fine structure, chemical basis of heredity, quantitative and population genetics. For emphasis on molecular, biochemical, and developmental genetics, MCDB 384 recommended. Prer., EPOB 121-124, or equivalent.

EPOB 325-3. Introduction to Evolution. Designed to introduce both science and nonscience majors to modern concepts of organic evolution. Traces the historical development of evolutionary thought, which is central to modern life science, and surveys the kinds of substantiating evidence. Prer., EPOB 121-124. J. Bock

EPOB 340-4. Microbiology. A survey of distinguishing characteristics of microorganisms based on structural-functional relationships, taxonomy, growth, physical-chemical agents of control including antibiotics, metabolism, and genetics. Students will receive an introduction to applied microbiology with emphasis on infectious diseases, basic concepts of immunology and microbial ecology. Prer., EPOB 121-124 and college chemistry. Organic chemistry recommended.

EPOB 342-5. Introduction to Human Anatomy. Lect., lab. An introduction to the basics of human anatomy. Not for medical technology or premedical students without special permission. Prer., EPOB 121-124. Students may not receive credit for both EPOB 342 and P.E. 279.

EPOB 343-5. Human Physiology. Three lect., one 3-hr. lab. and rec. per wk. An introduction to human physiology primarily for students in pharmacy and allied health programs. May be counted towards EPOB major. Prer., EPOB 121-124, and one year of college chemistry. Students may not receive credit for both EPOB 343 and P.E. 280.

EPOB 345-3. The Biology of Human Reproduction. Anatomy and physiology of human reproduction, including sex determination, embryology, puberty, menstrual cycle, pregnancy, lactation, menopause, sexual behavior, sexual abnormalities, and contraception. Prer., EPOB 121-124 or equivalent. R. Jones.

EPOB 346-3. The Biology of Nutrition. A functional approach to human nutrition with emphasis on the roles of nutrients under normal conditions in the biochemistry and activities of the body and its constituent cells, on the physiology of digestion, and on the chemistry, sources, and functions of macro- and micro-nutrients. Nutritional balance, interactions, and the problems and controversies in nutrition are discussed, the experimental bases for science of nutrition are explored. Prer., general biology (one year), college chemistry including 102, 104 or 331 (an introduction to organic or biochemistry). P. Winston.

EPOB 350-4. Plant Kingdom. A survey of plant types with an emphasis on the diagnostic features of plants in general and major taxa in specific. Emphasis is placed on the identity, morphology, anatomy, reproduction, ecology, geography, evolution, fossil record, and economic use of taxon. Prer., EPOB 121-124. S. Shushan and P. Webber.

EPOB 351-4. Plant Anatomy and Development. An introduction to the structures of seed plants, especially angiosperms, and the developmental history of these structures. Cell types will be learned, and their location and function in plant tissues and organs will be studied. The laboratory will provide an opportunity to examine plant tissues and to prepare tissues for examination by the light microscope. The role of plant structures in the living plant will be stressed. Prer., EPOB 121-124 or equivalent. J. Bock.

EPOB 352-4. Flowering Plant Systematics. Introduction to orders and families of angiosperms and consideration of evolutionary relationships. Synopsis of current research areas in modern biosystematics placed in an historical framework. Field and laboratory identification of higher plants with introduction to local and regional flora. Prer., 121-124. R. Bye, M. Lane.

EPOB 353-4. Essentials of Plant Physiology. Lect., lab. Water relations, photosynthesis, respiration, germination, growth, and movements of plants. Prer., EPOB 121-122 and 123-124 or college botany and college chemistry. E. Bonde.

EPOB 354-3. Fall Plants of Colorado. Lect., lab., field trips. A systematic survey of Colorado plants including algae, fungi, lichens, mosses, gymnosperms, and flowering plants. Plant collections will be required. Prer., EPOB 121-124 or consent of instructor. E. Bonde and S. Shushan.

EPOB 361-4. Insect Biology. An introduction to evolution, ecology, physiology, and behavior of insects. Emphasis on how insects have solved problems, such as maintaining water balance or finding food, that are shared by all animals but for which there may be unique solutions among the insects. Agricultural and human health problems relative to entomology are discussed. Prer., EPOB 121-124, or equivalent zoology course. M. Breed.

EPOB 363-3. Parasitology. Lect., lab. A survey of animal parasites, including life histories; emphasis on parasites of man. Prer., EPOB 121-122 and 123-124, or college zoology. J. Bushnell.

EPOB 372-5. Principles of Comparative Vertebrate Anatomy. Lect. and lab. An introduction to the major components of the vertebrate body and how they are organized into a whole organism, emphasizing function, evolution, and diversity of these basic features. Laboratories

involve dissection of representative groups and demonstrations. Prer., EPOB 121-124. J. Hanken.

EPOB 374-3. Embryology. Lectures will emphasize the experimental analysis of embryonic development in animals. Topics to be covered include gametogenesis, fertilization, cleavage, gastrulation, cytodifferentiation, morphogenesis, and organogenesis. Prer., one year college biology. Concurrent enrollment in EPOB 375 required. Students may not receive credit for both EPOB 374 and MCDB 465. A. Bekoff.

EPOB 375-2. Developmental Biology Laboratory. *Spring.* Lab. for EPOB 374 and MCDB 465. Studies of live eggs and embryos from sea urchins, nematodes, fruit flies, frogs, chickens, and mice, plus cultured cells, sponges, and slime molds, provide experience with experimental design and interpretation of data. Prepared slides illustrate details of descriptive embryology. Concurrent enrollment in EPOB 374 or MCDB 465 required. Bekoff, Biroc, Ham, Hirsh.

EPOB 380-3. Global Ecology. (Same as Nat. Sci., 330.) Involves the study of ecological principles and problems at the biosphere level. Presents a world-wide approach to populations, biotic resources, ecologic interactions, land use, deforestation, desertification, species extinctions, pollution, environmental quality and restoration, and environmental ethics. Prer., one year of college biology or consent of instructor. C.H. Southwick.

EPOB 385-5. Comparative Animal Physiology. Lect., lab., rec. Introduction to principles of animal physiology and responses to environmental change. Prer., one year of college chemistry and EPOB 121-122 and 123-124. Comparative vertebrate anatomy (EPOB 372) is recommended.

EPOB 395-4. Behavioral Biology and Social Ecology. Topics considered in this introductory course include basic concepts and history, methods of study, neurobiology and behavior, the development of behavior, predator-prey relationships, communication, aggression and dominance, mating systems, and parental care. Where possible, life-history strategies, the evolution of behavior and behavorial ecology are stressed. Prer., EPOB 121-124 or equivalent, or consent of instructor. M. Bekoff.

EPOB 400/500-3. Teaching of Modern High School Biology. Lect., lab. The context in which modern biology should be taught to either high school or college and university students. Recommended for biological science-education majors. Closed to freshmen and sophomores. Prer., EPOB 121-122 and 123-124, or equivalent, and consent of instructor. M. Kennedy.

EPOB 401-2. Teaching Biology. Offers students a one-time opportunity to assist in teaching of specific laboratory section in EPO biology under direct faculty supervision. The student must make arrangements with the faculty person responsible for the course in which he plans to assist. A student may take this course for credit only once. No student can receive independent study credit through this program. Prer., consent of instructor.

EPOB 402/502-3. Stream Biology. Geological, physical, chemical, and biological study of flowing water with special reference to streams and rivers as ecosystems. A laboratory course is offered (see EPOB 415-419/515-519). Prer., EPOB 302. Windell.

EPOB 403/503-3. Limnology. Ecology of inland waters, including a detailed consideration of physical, chemical, and biological properties of freshwater ecosystems: origins and major characteristics of lakes and streams, survey of chemical and nutrient cycles in freshwater habitats, survey of biotic composition of freshwater environments. Important themes in modern freshwater ecology are considered, including energy flow, trophic structure, eutrophication, and management of freshwater ecosystems. Prer., 121-124. W. Lewis.

EPOB 404-3. Wildlife Impact Assessment. Topics in this course include prediction, detection, evaluation, communication, and mitigation of effects of human activities on wildlife populations and habitats. Many of the concepts and methods apply more broadly to environmental impact assessment. Prer., EPOB 121-124, 302. D. W. Crumpacker.

EPOB 407/507-3. Geographical Ecology. Discussion of ecological and faunistic distribution of animals on a world basis. How the number and kinds of species vary from region to region and how we can account for this variation. This course seeks to explain patterns of distribution of animals in terms of historical geological, evolutionary, and ecological processes that have caused them. Emphasis is placed on ecological aspects. Prer., EPOB 302 or equivalent. A. Cruz.

EPOB 408/508-4. Physiological Plant Adaptation. Lect. lab. Examines adaptive aspects of plant structure and function in natural environments. Some of the subjects considered are a cost-income approach to resource allocation, leaf energy budgets and the adaptive significance of leaf size and shape, environmental and biological control of photosynthesis, and adaptive aspects of plant water relations. Prer., EPOB 302 and 350 or equivalent. R. Monson.

EPOB 409/509-4. Biometry. A demanding, problems-oriented methods course in statistical inference procedures, assumptions, limitations, and applications with emphasis on techniques appropriate to realistic biological problems. Includes data file management using interactive computing techniques. Prer., general biology and Math. 110 or equivalent. M. Grant.

EPOB 410-414/510-514 (2-4). Advanced Ecology. Specific aspects of ecology. Emphases are specialties of faculty. One or more courses are offered each semester. Topics which have been taught are listed here and others may be given: dynamics of mountain ecosystems, tundra ecology, ethnoecology, population dynamics, tropical and insular biology, ecology of fishes, quantitative plant ecology, arctic and alpine environments. Prer., EPOB 302. Some courses have additional prer. Staff. See *Schedule of Courses.*

EPOB 415-419/515-519 (1-2). Techniques in Ecology. Courses emphasizing application of modern ecological techniques. One course offered each semester in topics such as stream biology, aquatic biology, environmental measurement and control, techniques in geoecology. Prer., EPOB 302. Some courses have additional prer. Staff. See *Schedule of Courses.*

EPOB 420-2. Laboratory in Eukaryotic Genetics. Laboratory genetics will provide working experience with genetic mappings of *Drosophila* chromosomes, segregation of mutants of *Arabidopsis*, electrophoresis of proteins, preparation of human and *Drosophila* chromosomes, and identification of mitochondrial DNA phenotypes. Prer., EPOB 320. J. Mitton.

EPOB 426/526-4. Evolutionary Ecology of Plants. Ecology and evolution of plant populations: Population dynamics, geographic variation, adaptive strategies, and plant-animal co-evolution. Prer., genetics, ecology, evolution. Y. Linhart.

EPOB 428, 429/528, 529-2 to 4. Advanced Topics in Evolution. Specialized aspects of organic evolution. Courses offered on an irregular basis include origin and dispersal of flowering plants, reproductive biology of flowering plants, evolution, and speciation. Prer., EPOB 320/325.

EPOB 430, 431/530, 531-2 to 4. Advanced Genetics. Courses offered at irregular intervals dealing with specialized topics in genetics. Prer., EPOB 320.

EPOB 432, 433/532, 533-1 to 2. Techniques in Genetics. Courses offered occasionally involving specific procedures and their applications in solving genetic research problems. Prer., see *Schedule of Courses.*

EPOB 434/534-3. Evolutionary Morphology of Vertebrates. An advanced course in vertebrate structure and evolution, with emphasis on current controversies and methods in the study of morphology. Material will be drawn from a number of fields, including comparative anatomy, paleontology, biomechanics, and developmental biology. Prer., EPOB 372 or instructor's consent. J. Hanken.

EPOB 435, 436/535, 536-2 to 4. Biological Field Studies. Courses offered during the summer session and occasionally during the academic year, stressing broad areas of biology and employing field approaches. Prer., see *Schedule of Courses.*

EPOB 437 to 439-2. Biological Seminar. Designed primarily for seniors seeking Honors in EPO Biology. Separate sections may be available for other seniors especially those interested in graduate studies. Sample topics include history of biological concepts, impact of biology on modern thought, biology and the crises of the modern world. Prer., consent of instructor. See *Schedule of Courses.*

EPOB 442/542-3. Microbial Approach to Environmental Problems. Microbial approaches and solutions to environmental problem areas

in which microorganisms play favorable or unfavorable roles: in biodeterioration control in soil, water and waste management, current pollution problems, resource recovery, energy production, ecological control of pests, and biotechnology. Field trips, lab. group projects. Prer., EPOB 340 or consent of instructor. W. Segal.

EPOB 446, 447/546, 547-2 to 4. Advanced Microbiology. Courses dealing with specialized topics related to microbiology such as microbial ecology, microbial physiology, and applied microbiology. Prer., see *Schedule of Courses.*

EPOB 448, 449/548, 549-1 to 2. Advanced Microbiology Laboratory. Special techniques related to specific areas of microbial research; microbial ecology laboratory, microbial physiology laboratory. Prer., see *Schedule of Courses.*

EPOB 451/551-4. Plant Ecology. Lect., lab., and field work. Discussion of the ecosystem concept. Survey of the characteristics of Colorado ecosystems in detail and of North America in general; adaptation; ecological classification of plants. Prer., EPOB 121-124 or consent of instructor.

EPOB 453-4. Morphology of Nonvascular Plants. Lect., lab. Algae, fungi, and bryophytes. Prer., EPOB 121-124 or college botany. S. Shushan.

EPOB 454-4. Morphology of Vascular Plants. Lect., lab. Tracheophytes. Prer., EPOB 121-124 or college botany. S. Shushan.

EPOB 455-458/555-558 2 to 4. Advanced Botany. Special areas of botany offered each year including courses in algology, mycology, lichenology, palynology, evolution and ecology of domesticated plants, advanced classification of flowering plants, plants of Colorado, developmental plant anatomy, Cenozoic paleobotany. Prer., see *Schedule of Courses.*

EPOB 459, 460/559, 560-2 to 4. Advanced Plant Physiology. Functional aspects of botany including advanced general plant physiology, ecological plant physiology, plant growth and development in sterile culture. Prer., see *Schedule of Courses.*

EPOB 463/563-2 to 4. Field Techniques in Environmental Science. A field and laboratory course in assessing the abiotic and biotic environment. Emphasis will be on field techniques in climatology, surveying soils, hydrology, geomorphology, plant and animal ecology, and environmental law. Evaluation will be by written module reports and maps. Prer., two semesters general biology or two semesters of physical geography or equivalent, and enrollment in EPOB 435/535.

EPOB 464/564-2 to 4. Plant Field Studies. Field-oriented courses offered at irregular intervals or during summer sessions. Example: field botany, plants of Colorado. Prer., see *Schedule of Courses.* Staff.

EPOB 465/565-5. Invertebrate Zoology. *Alternate years.* Lect., lab. Morphology, physiology, ecology, and phylogeny of invertebrates; emphasis on types not included in EPOB 361 or 363. Prer., EPOB 121-124 or college zoology. J. Bushnell.

EPOB 467, 468/567, 568-2 to 4. Advanced Invertebrate Biology. Courses dealing with specific taxa and/or special aspects of in vertebrate biology. Topics offered include insect taxonomy, aquatic invertebrate zoology, biology of social insects, benthic and Aufuchs ecology. Prer., see *Schedule of Courses.*

EPOB 469, 470/569, 570-1 to 2. Advanced Invertebrate Biology Laboratory. Laboratory courses dealing with special taxa and/or special aspects of invertebrate biology. Prer., see *Schedule of Courses.*

EPOB 472/572-5. Vertebrate Histology. Lect., lab. Analysis of vertebrate histology and preparation of vertebrate tissues for light microscopic examination. Especially useful to students of vertebrate anatomy, development, and physiology. Prer., EPOB 121-124 and one of the following: comparative vertebrate anatomy, comparative animal physiology, or vertebrate embryology.

EPOB 474/574-3. Biology of Amphibians and Reptiles. Comparative morphology, taxonomy, ecology, and geographic distribution of amphibians and reptiles. For lab. see EPOB 479, 480/579, 580. Prer., EPOB 121-124 or equivalent.

EPOB 475/575-3. Ornithology. Lect., lab., field trips. Origin, evolution, ecology, physical and behavioral characteristics, and taxonomy of orders and families of birds of North America; field work with local species emphasizing avian ecology. Prer., EPOB 121-122, 302, or consent of instructor. C. Bock.

EPOB 476/576-4. Mammalogy. Discussion, lab., and field studies. Origin, evolution and adaptation, geographic distribution, ecology, and taxonomy of mammals; field and laboratory study of Colorado species. Prer., EPOB 302. D. Armstrong.

EPOB 477, 478/577, 578-2 to 4. Advanced Vertebrate Biology. Special aspects of vertebrate biology such as ichthyology, experimental embryology, biology of freshwater fishes, vertebrate natural history. Prer., see *Schedule of Courses.*

EPOB 479, 480/579, 580-1 to 2. Advanced Vertebrate Biology Laboratory. Laboratory courses dealing with special taxa and/or special aspects of vertebrate biology. Prer., see *Schedule of Courses.*

EPOB 481, 482/581, 582-2 to 4. Animal Field Studies. Field-oriented courses in animal biology. Courses are typically taught at locations other than the Boulder campus. Prer., see *Schedule of Courses.*

EPOB 484/584-3. Comparative Biology of Locomotion. Investigates the physiological consequences of natural animal activities. Covers topics such as metabolic energy production, skeletal muscle function, the metabolism of flying birds and insects, aquatic locomotion, terrestrial locomotion including migration energetics and exercise adaptations in lower vertebrates and man. A blend of physiology, metabolsim, and behavior. Prer., EPOB 121-124 and chemistry. T. Gleeson.

EPOB 486/586-3. Environmental Animal Physiology. A broad consideration of biochemical, physiological, morphological, and behavioral adaptations of animals to various environments and strategies for allocation of energetic expenditures in relation to environmental demands. Prer., EPOB 385. C. Carey.

EPOB 489, 490/589, 590-2 to 4. Advanced Animal Physiology. Specialized areas of physiology including invertebrate physiology, cell physiology, vertebrate reproduction, and others. Prer., see *Schedule of Courses.*

EPOB 491, 492/591, 592-1 to 2. Techniques in Animal Physiology. Laboratory courses dealing with special techniques employed in various aspects of physiological research. Examples: techniques in endocrinology, instrumentation, vertebrate physiology laboratory. Prer., see *Schedule of Courses.*

EPOB 496/596-3. Developmental Neurobiology. An intensive survey of mechanisms involved in the development of neurons and neural circuits in both vertebrates and invertebrates. Prer., EPOB 374, or consent of instructor. A. Bekoff.

EPOB 497/597-3. Introduction to Neurobiology. An introduction to the cellular structure and physiology of neurons, followed by a consideration of integrative mechanisms. Topics include the action potential, synaptic transmission development, sensory systems, motor systems, and the neural basis of behavior. Introduction to structure and physiology of neurons followed by neuroethological analysis of how neurons are organized into assemblies which generate behavior. Emphasis on simple systems in both vertebrates and invertebrates. Prer., one upper division course in physiology or cell biology. R. Eaton.

EPOB 498, 499/598, 599-1 to 4. Advanced Ethology. Special areas of ethology such as sociobiology, animal communication. Prer., see *Schedule of Courses.* Staff.

EPOB 501-1. Seminar: Introduction to Biological Research. In-depth discussions on areas of biological research represented in EPO biology. Required of all first year graduate students in EPO biology. Prer., see *Schedule of Courses.*

EPOB 520-3. Biophysical Ecology. The first half of the course examines aspects of solar radiation, thermal radiation, sensible heat transfer through conduction and convention, wind, and latent heat transfer through evaporation. During the second half, these concepts will be used to discuss biological microenvironments, plant and animal energy budgets, and plant and animal adaptation to microenvironment. Prer., EPOB 302, Phys. 302, or consent of the instructor. R. Monson.

EPOB 527-3. Population Genetics. Theoretical groundwork of population genetics, presenting botanical, zoological, or anthropological examples. Subjects considered: stochastic and deterministic factors influencing gene frequency changes in populations, genetic load and stable equilibria, inbreeding and mixed mating systems, and speciation. For graduate and advanced undergraduate student pursuing careers in genetics, ecology, or evolution. Prer., Genetics (EPOB 320) or MCDB 384. Mitton.

EPOB 587-3. Vertebrate Endocrinology. Lect. Evolutionary analysis of the chemical control and integration of physiology and behavior. Prer., EPOB 343 or 385. D. Norris.

EPOB 610 to 619-2. Seminar in Environmental Biology. Open only to graduate students.

EPOB 620 to 629-2. Seminar in Population Biology. Open only to graduate students.

EPOB 630 to 639-2. Seminar in Organismic Biology. Open only to graudate students.

Note: No student may receive independent study credit for assisting in the operation and/or teaching of any laboratory section.

EPOB 920-1 to 3. Independent Study. (Freshmen or sophomores.) Consent of instructor required.

EPOB 940-1 to 3. Independent Research (Undergraduate). Consent of instructor required.

EPOB 941-1 to 3. Independent Study (Undergraduate). Consent of instructor required.

EPOB 950-1 to 3. Independent Study. Consent of instructor required.

EPOB 960-1 to 3. Independent Research in Environmental Biology. Consent of instructor required.

EPOB 961-1 to 3. Independent Research in Population Biology. Consent of instructor required.

EPOB 962-1 to 3. Independent Research in Organismic Biology. Consent of instructor required.

Biology—Molecular, Cellular, and Developmental

MCDB 105-4, 106-4. Introduction to Molecular, Cellular, and Developmental Biology. *Fall, Spring.* Three lect., one 2-hr. lab. per wk. Designed to prepare MCDB majors and other science majors for upper division MCDB courses. Nonscience majors who seek to understand modern biology and its implications for the future of humankind are encouraged to enroll as long as they have the necessary prerequisites. Origin and evolution of life; structure of biological macromolecules and molecular associations; structure and function of cells; sources of energy and materials for life; reproduction; molecular and Mendelian genetics; growth, development, and death; multicellularity; organismal physiology; communities of organisms. Lab. sections stress carrying out actual experiments, and provide time for questions and discussion of lect. material. Prer., high school chemistry and algebra. Majors with AP or CLEP credit in biology should consult with a departmental advisor before enrolling. MCDB 105 prer. for 106. Bever, Gold.

MCDB 311-3. Cell Biology. *Fall.* Same as MCDB 312 except no lab., two lect./wk. This course does not carry credit toward the MCDB major or the distributed studies major with MCDB as the primary subject. Such majors must take MCDB 312. Prer., MCDB 106 or EPOB 123. Staehelin, Klymkowsky, McIntosh.

MCDB 312-4. Cell Biology. *Fall.* Two lect. and one lab. per wk. Major emphasis is on the details of cellular organization and molecular basis of cellular function. The lab. provides firsthand experience with modern techniques. Required for MCDB and distributed studies majors with MCDB as the primary subject. Recommended for students planning careers in biological research and/or the health sciences. Prer., MCDB 106 or EPOB 122-124. Klymkowsky, Staehelin, Biroc.

MCDB 313-4. Histophysiology; Structure and Function of Vertebrate Organ Systems. *Fall.* Three lect., and one lab. per wk. Function and microscopic anatomy of major vertebrate organ systems. Emphasis on correlations between structure and function, particularly at cellular and tissue levels. Topics presented include integumentary, digestive, urinary, respiratory, circulatory, endocrine, reproductive, and immune systems. Prer., MCDB 312 or equivalent. Bonneville.

MCDB 315-2. Biology of the Cancer Cell. *Fall.* Cellular basis of cancer. Includes kinds of cancer and range of occurrence among animals and humans; cell reproduction; loss of control of cell reproduction in cancer; chemicals, viruses, and radiation as causes of cancer; environmental cuases of cancer; cancer and diet; cancer epidemiology; genetic basis of cancer, and prevention of cancer. Prer., MCDB 105. Prescott.

MCDB 384-4. Molecular Genetics. *Spring.* Concepts of phage genetics, bacterial conjugation, transduction, transformation, recombination, mutation, and chromosome structure presented at molecular level. Gene expression through transcription and translation with emphasis on genetic approaches used to study these processes. Brief review of diploid cell genetics, population genetics, *in vitro* somatic cell genetics, and application to eukaryotic cells of concepts derived from bacterial molecular genetics. Prer., general chemistry and MCDB 105-106. Kuempel, McConkey.

MCDB 401-V, 402-V. Teaching MCD Biology. *Fall, Spring.* Practice teaching in college-level courses in MCD Biology. Students will experience laboratory teaching; participate in holding discussion sections, review sessions, and office hours; and carry out special projects. Prer., instructor consent.

MCDB 412/512-3. Biological Membranes. *Spring.* Introduction to chemical, physical-chemical, and structural aspects of membrane molecules and membrane models; examines selected bacterial, animal, and plant membrane systems to gain insights into the principles governing structure, function, and biosynthesis of biological membranes. Prer., MCDB 312. Staehelin.

MCDB 418/518-3. Introduction to Neurobiology. *Fall.* An introduction to the cellular structure and physiology of neurons, followed by a consideration of integrative mechanisms. Topics include the action potential, synaptic transmission, development, sensory systems, motor systems and the neural basis of behavior. Same as EPOB 497/597. Prer., one upper division course in physiology or cell biology. Bekoff, Dubin, Eaton.

MCDB 420/520-2. Topics in Plant Cell Biology, Ultrastructure, and Morphogenesis. *Spring.* Instructor and possibly students present lectures, seminars, and papers on selected contemporary problems in morphogenesis, sexuality, physiology, and cell division among higher and lower plants. Instructor consent for nonbiology majors. Pickett-Heaps.

MCDB 422/522-3. The Plant Cell—Diversity of Form and Function. *Fall.* Three lect. per wk. Structure and ultrastructure of a wide variety of plant cells including algae and lower plants examined and compared. The correlation of structure with possible function always emphasized; the variation and diversity in both form and role of cell organelles and the cells themselves demonstrated. Instructor consent for nonbiology majors. Pickett-Heaps.

MCDB 423/523-1. The Plant Cell Laboratory. One meeting per week; time and place to be arranged to avoid conflicts. Limited to those taking (or who have taken) MCDB 422/522. Various algae and lower plants will be studied in conjunction with the detailed work covered in MCDB 422/522. Pickett-Heaps.

MCDB 465-3. Developmental Biology. *Spring.* Analysis of development with emphasis on cellular and molecular mechanisms. Topics covered include descriptive embryology, control of gene expression in eukaryotic cells, mechanisms of differentiation, and morphogenesis. Primary attention is given to vertebrate development, but other systems are also discussed where appropriate. Prer., MCDB 312, 384, MCDB 466 must be taken concurrently. Ham, Hirsh.

MCDB 466-2. Developmental Biology Laboratory. *Spring.* Lab. for MCDB 465 and EPOB 374. Studies of live eggs and embryos from sea urchins, nematodoes, fruit flies, frogs, chickens, and mice, plus cultured cells, sponges, and slime molds, provide experience with experimental design and interpretation of data. Prepared slides

illustrate details of descriptive embryology. Concurrent enrollment in EPOB 374 or MCDB 465 required. Bekoff, Biroc, Ham, Hirsh.

MCDB 468/568-3. Mechanisms of Aging. *Fall.* Aging studied as a developmental process with emphasis on the cellular and molecular mechanisms involved. Prer., MCDB 312, 384. Ham.

MCDB 472/572-3. Molecular Biology of Cellular Membranes and Organelles. *Spring.* Examines the functional, biosynthetic, and metabolic interrelationships between cellular organelles. Topics will include organelle biochemistry, intracellular energy flow, organelle biogenesis and turnover, and cellular evolution. Prer., MCDB 311 or 312, Chem. 481. Poyton.

MCDB 475-2. Animal Virology. *Spring, odd-numbered years.* Two hours of lect./wk. This basic course encompasses the structure, replication, and interactions with the host of both lytic and transforming animal viruses. The diversity of naturally occurring geonomic structures and the resulting strategies of infection are emphasized. Prer., MCDB 384, Chem. 482, or instructor consent. Danna.

MCDB 484-3. Seminar: Recombinant DNA and Cloning. *Spring.* A small, intensive course, in seminar format, accompanied by a few lectures. Every student will read, speak, and comment on original scientific literature in the field of genetic engineering. Goal is articulate, independent, critical understanding of a section of biology. Prer., excellent understanding of the material of MCDB 105, MCDB 384 will be helpful but is not required. Because of the course design, enrollment may be limited. Yarus.

MCDB 489-3. Human Biochemical Genetics. *Fall.* The human organism as a genetic system. Effect of mutation on protein structure and function; biochemical basis of human genetic disease; immunogenetics; polymorphic gene loci; gene mapping; impact of human genetics on medicine and society. Prer., MCDB 384. McConkey, Kuempel.

MCDB 490/590-4. Workshop in Electron Microscopy. *Spring.* This laboratory course allows the student to obtain experience in the preparation of specimens for electron microscopy, instruction in the operation of the transmission electron microscope, and limited experience with the use of the scanning electron microscope. Instruction in photographic techniques and experience in interpretation of micrographs are also included. Prer., MCDB 312 and consent of instructor. Bonneville.

MCDB 491/591-V. Advanced Workshop in Electron Microscopy. *Fall.* This course allows students to undertake research projects in which electron microscopy is the primary technique. Students will be able to exploit and extend their mastery of techniques acquired by previous training in electron microscopy. Prer., MCDB 490/590 and/or consent of instructor. Bonneville.

MCDB 505-3, 506-3, 507-3, 508-3. Core Courses in Molecular, Cellular, and Developmental Biology I-IV. *Fall, Spring.* Classes meet six hrs. per wk. throughout fall and spring semesters. One course lasts seven weeks. The four courses are tightly integrated to provide an advanced overview of life processes at the molecular, cellular, and developmental level, as well as an introduction to current research in these areas of biology. Emphasis is placed on correlating information derived from pro- and eukaryotic cells. The courses are divided into segments, team-taught by two to four faculty. Topics include structural and functional organization of bacterial, animal, and plant cells; energy metabolism; enzymes; structure, function, and assembly of membranes, microtubules, microfilaments; photosynthesis; chromosomes; genes as units of molecular memory; DNA replication, recombination, transcription; mutation and genetic mapping; translation and posttranslational control; host-virus interactions; evolution of patterns of gene expression; hormones; morphogenesis of complex viruses and subcellular structures; inheritance of cytoplasmic and cortical structures; developmental fields in morphogenesis and regeneration; cell lineage patterns in development; cytoplasmic determinants versus morphogenetic gradients. A detailed outline of each course can be obtained from the department.

MCDB 513-2. Advanced Topics in Electron Microscopy. *Spring, even-numbered years.* Two lect. per wk. with occasional demonstrations or lab. sessions. Basic mechanisms beyond introductory stage and recent developments of current interest in advanced biological research. Elements of electron optics, image optimization, image formation and recording, resolution, radiation damage, various modes of ultramicroscopy (including CTEM, SEM, STEM, HVEM), stereoscopy of cells and tissues, image processing, specimen quantitation, microanalysis, autoradiography, applications to molecular biology, elements of electron diffraction. Specimen preparation treated only incidentally. Some familiarity with electron microscopy desirable. Prer., introductory biology or MCDB 501-590 or Phys. 112, 301, 302 or instructor consent. Fotino.

MCDB 545-3. Special Topics in Tumor Virology. *Spring, even-numbered years.* This course encompasses the structure, replication, and transforming ability of both DNA and RNA tumor viruses. The course will consist of lectures, student presentations (debates), and discussions aimed at critical analysis of current literature. The origins and status of contemporary tumor virus research will be examined. Prer., MCDB 312, MCDB 384, Chem. 482, or consent of instructor. Danna.

MCDB 547-3. Molecular Biology of Stem Cells. *Spring.* Biology and molecular biology of stem cell differentiation with special emphasis on mammalian development and neoplasia. Part I: in vivo and in vitro differentiation of stem cells; discussions on major stem-cell systems (germ line cells, hematocytes, intestinal epithelia, adipose cells, lens cells, mammary epithelial cells, neuroblasts, hepatocytes, and T/t loci). Part II: molecular biology of stem-cell differentiation—critical discussions on coordinate regulation (repressor vs activator), chromatin states, repetitive sequences, RNA processing, DNA rearrangement, and techniques (transformation, micro-injection and cell fusion). Prer., biochemistry and genetics. Advanced seniors are welcome. Sueoka.

MCDB 570-2. Molecular and Cellular Immunology. *Spring, odd-numbered years.* An introduction to modern cellular and molecular immunology, including the implications of recent advances in these fields for cellular and developmental biology, understanding of immune-related pathologies and cancers. Prer., introductory biology and molecular genetics. Health Sciences Center Staff.

MCDB 575-3. Animal Virology. *Spring, odd-numbered years.* Same as MCDB 475, with one additional meeting per week for the purpose of further discussion and a critical review of the literature. Prer., MCDB 384, Chem. 482, or consent of instructor. Danna.

MCDB 578-2. Cell Membranes and Photosynthesis. *Fall, Spring.* Consists of discussions and reports on research advances in biological membranes; plant cell secretion systems; and bacterial, algal, and plant photosynthesis. May be repeated. Instructor consent. Staehelin.

MCDB 580-2. Aspects of Prokaryotic and Eukaryotic Development. Consists of seminar presentations on current research and research literature in bacteriophage molecular genetics, with emphasis on macromolecular assembly processes, and in nematode development, with emphasis on molecular and cellular aspects. May be repeated. Instructor consent required. Wood.

MCDB 582-2. Seminar on Nematode Development. This seminar consists of presentations on current research and research literature in nematode physiology and development, with emphasis on molecular, cellular, and genetic aspects. May be repeated. Instructor consent required. Hirsh, Wood.

MCDB 583-1. Seminar on Genetics and Biology of Drosophila. *Fall, Spring, Summer.* Consists of presentations on selected topics in Drosophila development, molecular biology, and developmental genetics. Covers both classic literature and current research papers. May be repeated. Prer., instructor consent. Fuller, Scott.

MCDB 592-1, variable credit. Special Topics. These course numbers are reserved for special courses such as those offered to present visiting lecturers or for courses offered one time only.

MCDB 596-2, 597-2, 598-2. Current Literature Seminar: Molecular Biology, Cellular Biology, Developmental Biology. This series of courses is designed to prepare graduate students in oral presentation and critical reading of the literature. Each section meets 2 hrs. per wk. Students speak on current topics from the literature in each of the areas, respectively.

MCDB 599-2. Seminar Practicum. Designed for graduate students to practice oral presentation of their own research, fielding questions and responding to critique. Staff.

MCDB 601, 602-variable credit. Graduate Seminar. *Fall, Spring.*

MCDB 700-variable credit. Master's Thesis. Students seeking a master's degree should consult a departmental advisor. Plan I or Plan II is offered.

MCDB 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in requirements for Doctoral Degree.

MCDB 930-1 to 6, 935-1 to 6, 940-1 to 6. Undergraduate Independent Study in Molecular Biology, Cellular Biology, and Developmental Biology Respectively. Instructor consent required.

MCDB 960-1 to 6, 965-1 to 6, 970-1 to 6. Graduate Independent Study in Molecular Biology, Cellular Biology, and Developmental Biology Respectively. Instructor consent required.

BLACK STUDIES

Bl.St. 203-3. Behavior Analysis I. *Fall.* A psychology course which deals with the interrelationships between the black individual and his social environment. Social influences upon motivation, perception, and behavior. Development and change of attitudes and opinions in the ghetto.

Bl.St. 204-3. Behavior Analysis II. *Spring.* Psychological analysis of small groups, social stratification, and mass phenomena, e.g., riots. Continuation of Bl.St. 203.

Bl.St. 215-3. Afro-American History I. *Fall.* Survey of the history of Afro-Americans. Study, interpretation, and analysis of major problems, issues, and trends affecting the black man from preslavery to the present.

Bl.St. 216-3. Afro-American History II. *Spring.* Continuation of Bl.St. 215.

Bl.St. 220-3. Black Social Movements. *Fall.* Examination of selected case studies of black collective behavior in an historical context. Emphasis on an in-depth investigation of the continuing black struggle for social/democratic rights.

Bl.St. 221-3. Black Social and Political Thought. *Spring.* General introductory course designed to acquaint the student with the thinking, writings, and speeches of black people, historical and contemporary.

Bl.St. 232-3. Survey of Afro-American Literature I. (Engl. 272.) *Fall.* Chronological study of Afro-American literature beginning with the 18th century. The Harlem Renaissance, the depression writers, and writers from the 1940s to the present.

Bl.St. 233-3. Survey of Afro-American Literature II. (Engl. 273.) *Spring.* Continuation of Bl.St. 232.

Bl.St. 235-1, 236-1, 237-1. Mini Courses in Black Studies. *Fall.* Three five-week courses in black studies with each bearing 1 hr. of credit. Topics will vary in accordance with student/faculty interest and availability. One, two, or three of the courses may be taken.

Bl.St. 240-2. Afro-American Dance I. *Fall.* An exploration of various Caribbean and African dance forms, both traditional and choreographed works. Other cultural arts will be studied to accompany and enhance the dance as a total cultural experience. This will include some rituals, musical accompaniment, singing and chanting, and descriptive background data of a particular dance.

Bl.St. 241-2. Afro-American Dance II. *Spring.* A continuation of Afro-American Dance I, but may be taken separately by permission of instructor. Emphasizes the growth of American Black dance from the roots of African dance. Technique, movement exploration, and improvisation includes plantation dance, Afro-American heritage dances, blues, and jazz.

Bl.St. 260-3. Introduction to African Literature. (Engl. 270.) *Fall, Spring.* Survey of African literature from its beginnings to the present; the oral tradition, the pioneer writers, market literature, the Negritude movement, and some major contemporary writers like Achebe, Laye, Ngugi, and Soyinka. Also, some theoretical questions concerning second-language literatures.

Bl.St. 302-3. Selected Topics in Black Studies. *Spring.* Intensive examination of a particular topic, theme, issue, or problem concerning the black presence as chosen by the instructor. Sample offerings could include the black family institution.

Bl.St. 400-3. Seminar in Afro-American, African, and Caribbean Literature. Seeks to explore the nature of the literary impulse in African, Afro-American, and Caribbean literature.

Bl.St. 418-3. History of Southern Africa Since 1900. *Fall.* An examination of the history and development within southern Africa of Angola, Zaire, Lesotho, and South Africa, with special emphasis on the latter. The decline of white rule and the strategic importance of the various regions will be studied in detail.

Bl.St. 450-3. Research Methods in Black Studies I. *Fall.* Preparation for empirical inquiry in black studies. Emphasis on philosophy of science concerns and skill acquisition. Students submit rigorous, executable research design for the investigation of a specific problem, topic, or issue germane to black people for credit.

Bl.St. 451-3. Research Practicum in Black Studies. *Spring.* Research apprenticeship with emphasis on skill development. Students execute in library, field, or laboratory the research design developed in Bl.St. 450. Prer., Bl.St. 450 or consent of instructor.

Bl.St. 476-3. Contemporary Afro-American Literature I. (Engl. 472.) *Fall.* An advanced in-depth study of the works of prominent Afro-American novelists and poets of the traditional school, e.g., Wright, Gaines, Ellison, and Morrison. Their works will be studied in terms of their literary, intellectual, and political values.

Bl.St. 477-3. Contemporary Afro-American Literature II. (Engl. 473.) *Spring.* A nontraditional and experimental examination of the literature of the black arts movement of the 1960s and 1970s. Students will examine the works of such authors as Baraka (LeRoi Jones), Don L. Lee, William Melvin Kelly, and Ishmael Reed.

Bl.St. 480-3. The African Novel. (Engl. 474.) *Fall.* In addition to a detailed study of works by distinguished African novelists, examines such areas as the indigenous and foreign antecedents of African Fiction and possibilities of the novel as a reflector of changing moods and attitudes.

Bl.St. 910-variable credit. Independent Study. Arranged with consent of instructor.

Bl.St. 940-variable credit. Independent Study. Arranged with consent of instructor.

Bl.St. 949-variable credit. Independent Study. Arranged with consent of instructor.

CHEMISTRY

Chem. 100-3. Preparatory Chemistry. *Fall, Spring.* Lect. and rec. For students with no high school chemistry or a very poor chemistry background; designed especially to prepare students for entrance to Chem. 103. Students whose academic plans require Chem. 101-104 should not take this course. (Chem. 100 does not count toward fulfillment natural science requirement.) Prer., one year of high school algebra or concurrent registration in Math 110. Students must perform satisfactorily in this course to go on to Chem. 103.

Chem. 101-4. Introduction to Chemistry. *Fall.* Lect. and lab. First course in principles of chemistry. Chem. 101-104 satisfies half the natural science requirement of the College of Arts and Sciences and meets the chemistry requirement for nursing and physical therapy. Prer., high school algebra.

Chem. 103-5. General Chemistry. *Fall, Spring.* Lect., rec., and lab. An introduction college-level chemistry course for students who have taken high school chemistry and whose academic plans require advanced work in chemistry or wish to satisfy the natural science requirement at a more advanced level than Chem. 101-104. Prer., one year of high school chemistry or satisfactory performance in Chem. 100, high school algebra.

Chem. 104-4. Introduction to Organic and Biochemistry. *Fall, Spring.* Lect., rec., and lab. Essential topics in organic and biochemistry. Chem. 101-104 or Chem. 103-104 completes the chemistry requirement for nursing, physical therapy, and physical education

students, and satisfies one year of the natural science requirement. Prer., Chem. 101, 103, or 107. Chem. 104 does not replace Chem. 106 or 108 as a prer. for Chem. 331 or 335.

Chem. 106-5. General Chemistry. *Fall, Spring.* Lect., rec., and lab. A continuation of Chem. 103. For students who intend to take advanced chemistry courses. Subject areas include acids and bases, solubility and complex ion equilibria, transition metal chemistry, chemical kinetics, electrochemistry, and nuclear chemistry. Prer., Chem. 103 or equivalent, with a grade of *C* or higher.

Chem. 107-6. Honors General Chemistry. *Fall.* Lect., rec., and lab. A high level, low enrollment freshman course for well-prepared students who expect to major in chemistry, chemical engineering, physics, molecular biology, or related areas. The principles of chemistry and their illustrations are covered at an honors level. Prer., one year each of high school chemistry and and physics and high score on SAT or ACT mathematics placement examination; four years of high school mathematics recommended.

Chem. 108-6. Honors General Chemistry. *Spring.* Lect., rec., and lab. Continuation of Chem. 107. Prer., Chem. 107 or permission of instructor.

Chem. 331-3. Organic Chemistry I. *Fall, Spring.* Three lect. per wk. For biochemistry option and nonchemistry majors. Topics include structure and reactions of alkanes, alkenes, alkynes, alkyl halides, and aromatic molecules; nomenclature of organic compounds; stereochemistry; reaction mechanisms and dynamics. Prer., Chem. 106, 108 or equivalent with a grade of *C* or higher; coreq., Chem. 333.

Chem. 332-3. Organic Chemistry II. *Fall, Spring.* Three lect. per wk. For biochemistry option and nonchemistry majors. Topics include structure and reactions of alkyl halides, alcohols, ethers, carboxylic acids, aldehydes, ketones, and amines; introduction to the chemistry of heterocycles, carbohydrates, and amino acids; nomenclature of organic compounds; synthesis; and reaction mechanisms. Prer., Chem. 331 and 333 with a grade of *C* or higher; coreq., Chem. 334.

Chem. 333-1. Laboratory in Organic Chemistry I. *Fall, Spring.* One lab. per wk. For biochemistry option and nonchemistry majors. Instruction in the experimental techniques of modern organic chemistry with emphasis on chemical separations and reactions of alkanes, alkenes, and aromatic compounds. Stereochemical modeling and the identification of organic unknowns by spectroscopic and chemical methods will also be introduced. Prer., Chem. 106, 108, or equivalent with a grade of *C* or higher; coreq., Chem. 331.

Chem. 334-1. Laboratory in Organic Chemistry II. *Fall, Spring.* One lab per wk. For biochemistry option and nonchemistry majors. Instruction in the experimental techniques of modern organic chemistry with emphasis on reactions involving alcohols, ketones, carboxylic acids, and their derivatives. Multistep syntheses will also be introduced. Prer., Chem. 331 and 333 with grades of *C* or higher; coreq., Chem. 332.

Chem. 335-3. Organic Chemistry I for Chemistry Majors. *Fall.* Three lect. per wk. Required course for chemistry majors. Topics include structure and reactions of alkanes, alkenes, alkynes, alcohols, ethers, aldehydes, ketones, and alkyl halides; nomenclature of organic compounds; stereochemistry; reaction mechanisms. Prer., Chem. 106 or 108 with a grade of *C* or higher; coreq., Chem. 337.

Chem. 336-3. Organic Chemistry II for Chemistry Majors. *Spring.* Three lect. per wk. Required course for chemistry majors. Topics include structure and reactions of carboxylic acids and derivatives, aromatic compounds, and amines; introduction to the chemistry of heterocycles, carbohydrates, and amino acids; nomenclature of organic compounds; reaction mechanisms. Prer., Chem. 335 and 337 with grades of *C* or higher; coreq., Chem. 338.

Chem. 337-2. Laboratory in Organic Chemistry I for Chemistry Majors. *Fall, Spring.* Two labs per wk. Required course for chemistry majors. Instruction in the experimental techniques of modern organic chemistry with emphasis on chemical separations and reactions of alkanes, alkenes, aromatic compounds, and alkyl halides. Stereochemical modeling and the identification of organic unknowns will also be explored. Prer., Chem. 106 or 108 with a grade of *C* or higher; coreq., Chem. 335.

Chem. 338-2. Laboratory in Organic Chemistry II for Chemistry Majors. *Fall, Spring.* Two labs per wk. Required course for chemistry majors. Instruction in the experimental technqiues of modern organic chemistry with emphasis on reactions involving alcohols, ketones, carboxylic acids, and their derivatives. Multistep syntheses will also be introduced. Prer., Chem. 335 and 337 with grades of *C* or higher; coreq., Chem. 336.

Chem. 401-3. Modern Inorganic Chemistry. *Fall.* Lect. An introduction to modern inorganic chemistry for undergraduates. Includes atomic structure, theoretical basis of the periodic table, structure and bonding in molecules and crystals, reaction mechanisms, and chemistry of selected main group and transition elements. Prer. Chem. 450 or 451 and concurrent Chem. 452.

Chem. 418-4. Instrumental Analysis. *Spring.* Lect. and lab. The theory and practice of instrumental methods of chemical analysis is covered, including atomic and molecular spectroscopy, gas and liquid chromotography, mass spectrometry, and electrochemistry. Lab. provides an opportunity for hands-on experience with common analytical methods. Prer., Chem 450 or 451.

Chem. 440-1. Scientific Glassblowing. *Fall, Spring.* Lab. An introductory course in scientific glassblowing which allows the student an opportunity to develop sufficient skills in glass manipulation to design, fabricate, and repair glass apparatus.

Chem. 450-3. Physical Chemistry. Thermodynamics and related topics with emphasis on macromolecules and biological applications. Includes thermodynamics, chemical and physical equilibria, solution chemistry, transport properties, and multiple-site binding phenomena. Alternative to Chem. 451, designed for biochemistry option and biology majors. Students may not take both 450 and 451. Prer., Phys. 111, Math. 130, 230, and 240, two years of chemistry courses, or consent of instructor. coreq., Phys. 112.

Chem. 451-3, Physical Chemistry. *Fall, Spring.* Lect. Applications of thermodynamics to chemistry. Includes study of the laws of thermodynamics, thermochemistry, solutions, chemical equilibria, and phase equilibria. Prer., Chem. 331 or 335, Phys. 111, and Math. 240. coreq., Phys. 112 and 114.

Chem. 452-3. Physical Chemistry. *Fall, Spring.* Lect. Introduction to quantum chemistry with applications to molecular spectroscopy, the nature of chemical bonding, the electronic structure of conjugated hydrocarbons, and magnetic resonance spectroscopy. Prer., Chem. 331 or 335, Phys. 112, 114, and Math. 240 or equivalent courses. Chem. 451 and 452 may be taken in any order.

Chem. 453-3. Physical Chemistry. *Spring.* Lect. Electrolyte solutions, kinetic theory, chemical kinetics, statistical mechanics, molecular structure and properties (excluding spectroscopy). Prer., Chem. 450 or 451 or Engr. 301 or equivalent course.

Chem. 454-2. Physical Chemistry Laboratory. *Fall, Spring.* One lect. and one 3 hr. lab. per wk. Instruction in the experimental techniques of modern physical chemistry with emphasis on experiments illustrating the fundamental principles of chemical thermodynamics, quantum chemistry, statistical mechanics, and chemical kinetics. Prer., Chem. 450 or 451 or equivalent course in thermodynamics.

Chem. 455-3. Experimental Physical Chemistry. *Fall, Spring.* One lect. and two 3-hr. labs. per wk. Instruction in the experimental techniques of modern physical chemistry with emphasis on experiments illustrating the fundamental principles of chemical thermodynamics, quantum chemistry, statistical mechanics, and chemical kinetics. For chemistry majors. Prer., Chem. 450 or 451 or equivalent course in thermodynamics; coreq., Chem 452 or 453.

Chem. 471-3. Survey of Biochemistry. A one-semester course covering proteins and enzymes, intermediary metabolism, lipids, amino acids, biochemistry of nucleotides and protein biosynthesis, designed for pharmacy students and science majors. Does not serve as a prerequisite for Chem. 482. Biochemistry majors must take Chem. 481-482. Prer., one year organic chemistry or consent of instructor.

Chem. 481-3. General Biochemistry. *Fall, Spring.* Lect. Topics include structure, conformation, and properties of proteins; enzymes: mechanisms and kinetics; intermediary metabolism; Krebs cycle, carbohydrates; energetics and metabolic control; electron transport and oxidative phosphorylation. Prer., one year of organic chemistry.

Chem. 482-3. General Biochemistry. *Fall, Spring.* Lect. Continuation of Chem. 481. Metabolism of lipids, amino acids, and nucleic

acids; photosynthesis; biosynthesis and function of macromolecules including DNA, RNA, and proteins; biochemistry of subcellular systems; and special topics. Prer., Chem. 481.

Chem. 483/583-3. Plant Biochemistry. Lect. Aspects of biochemistry particularly relevant to plants, with emphasis on application of principles of analytical, organic, and physical chemistry, genetics, and cell biology to problems pertaining to agriculture. Prer., Chem. 481 or equivalent.

Chem. 484/584-3. Biochemistry of Complex Carbohydrates. *Fall, odd-numbered years.* Lect. Detailed consideration at the current research level of the chemistry, biosynthesis, and biological functions of the glycoproteins, glycolipids, and polysaccharides or microorganisms, plants, and animals. Prer., Chem. 481 or equivalent.

Chem. 486-4. Biochemistry Laboratory. *Fall, Spring.* Introduction to modern biochemical techniques. Topics include enzymology, spectrophotometry, electrophoresis, affinity chromatography, radioisotopes, membrane structure, immunochemistry, and nucleic acid chemistry. Prer., Chem. 481; coreq., Chem. 450 or 451.

Chem. 501-3. Advanced Inorganic Chemistry I. *Fall.* Lect. Inorganic chemistry based on principles of bonding, structure, reaction mechanisms, and modern synthetic methods. Chemistry and general properties of representative and transition elements and their compounds. Prer., Chem. 452 and graduate standing or Chem. 401.

Chem. 506-3. Advanced Inorganic Chemistry II. *Spring.* Lect. A study of modern coordination chemistry. Includes a description of the bonding and properties of coordination compounds in terms of the ligand field and molecular orbital theories.

Chem. 511-1. Instrumental Methods in Chemistry. *Fall.* Lecture, discussion, and practicum in teaching strategies for undergraduate chemistry courses. Includes applications of Piaget's theories to instruction in chemistry, application of Bloom's taxonomy to questioning skills, ways to tutor, reinforcement theory, and writing instructional objectives, exam, and quiz questions. Required of all chemistry teaching assistants. This course will not count toward a graduate degree.

Chem. 516-3. Analytical Spectroscopy. *Fall.* Lect. Special topics in spectrochemical analysis including atomic and molecular spectroscopy, laser analytical methods, electron spectroscopy, surface analytical methods, and their applications to environmental, atmospheric, and bioanalytical problems. Prer., undergraduate physical chemistry or consent of the instructor.

Chem. 517-3. Electroanalytical Chemistry. *Fall.* Lect. A background for understanding electrochemical systems is established through a review of the relevant thermodynamic, kinetic, and electronic principles. Classical and modern electrochemical methods of analysis are compared. Several special topics are discussed in depth. Prer., undergraduate physical chemistry or consent of instructor.

Chem. 518-2. Chromatography and Analytical Separations. *Spring.* Lect. Analytical separation processes, with special reference to theory and practice of liquid and gas chromatography. Prer., undergraduate physical chemistry or consent of instructor.

Chem. 531-3. Advanced Organic Chemistry I. *Fall.* Lect. Survey of synthetic transformations emphasizing important functional group manipulations, reactions of carbanions, and synthetic applications of pericyclic reactions. Prer., Chem. 451 and one year of organic chemistry.

Chem. 532-3. Advanced Organic Chemistry II. *Spring.* Lect. Modern concepts of physical-organic chemistry and their use in interpreting data in terms of mechanisms of organic reactions and reactivities or organic compounds. Prer., one year of organic chemistry and one year of physical chemistry.

Chem. 533-3. Advanced Organic Chemistry III. *Fall.* Lect. Advanced spectroscopic techniques for structure determination in organic chemistry. Emphasis in ^{1}H and ^{13}C NMR spectroscopy. Prer., Chem. 451 and 452, and 1½ years of organic chemistry.

Chem. 550-3. Chemical Dynamics. *Fall.* Lect. Discussion of mechanism and rate of chemical reactions from a fundamental point of view. The nature of collision is discussed and the concepts of cross section and rate constant developed. Theories of elementary bimolecular and decay processes are critically examined.

Chem. 551-3. Survey of Thermodynamics and Statistical Mechanics. A survey of the basic laws of phenomenological equilibrium thermodynamics and its applications to problems in chemistry. An outline of the concepts of statistical mechanics with special emphasis on the properties of perfect gases, crystals, and liquid models. Prer., a basic knowledge of undergraduate physical chemistry.

Chem. 552-3. Survey of Chemical Kinetics and Quantum Mechanics. An introduction to chemical kinetics, including the phenomenological discussion of rate laws, an outline of the theories of rate constants and a survey of experimental techniques. An introduction to quantum mechanics with applications to problems in chemistry. Prer., a basic knowledge of undergraduate physical chemistry.

Chem. 553-3. Statistical Mechanics. *Spring.* Lect. Fundamental concepts of quantum and classical statistical mechanics. Applications to properties of gases, liquids, solids, spin and polymer systems. Reaction, fluctuation, nucleation and relaxation phenomena. Prer., Chem. 451, 452, or equivalent.

Chem. 556-3. Physical Chemistry of Macromolecules. *Spring.* Lect. Structure and conformation of macromolecules; interaction between macromolecules; binding and cooperative phenomena; transport in solution; light scattering; spectroscopic probes of structure and motion.

Chem. 558-3. Introductory Quantum Chemistry. *Spring.* Lect. Basic principles and techniques of quantum mechanics with applications to questions of chemical interest. Quantum dynamics of atoms, molecules, and spin; electronic structure of atoms and molecules. Prer., Chem. 452.

Chem. 559-3. Advanced Molecular Spectroscopy. *Spring, alternate years.* Rotational, vibrational, and electronic spectra of molecules, and their interpretation in terms of the quantum theory of molecular structure. Prer., Chem. 552 or equivalent course in quantum mechanics.

Chem. 581-3. General Biochemistry. *Fall, Spring.* Same lectures as Chem. 481. Course work includes library studies and preparation of special reports. Not open to undergraduates. Prer., one year organic chemistry.

Chem. 582-3. General Biochemistry. *Fall, Spring.* Lect. Same lectures as Chem. 482. Course work includes library studies and report preparations. Not open to undergraduates. Prer., Chem. 481 or 581.

Chem. 587-3. Advanced General Biochemistry II. *Fall.* Lect. In-depth analysis of several of the following subjects: proteins, enzymes, metabolic regulation, bioenergetics, photosynthesis, lipids, nitrogen metabolism, transcription, protein biosynthesis, topics in molecular biochemistry. Prer., Chem. 482 or comprehensive biochemistry.

Chem. 588-3. Advanced General Biochemistry III. *Spring.* Lect. In-depth analysis of selected topics listed under Chem. 587. For the same academic year different topics will be covered in Chem. 587 and 588. Prer., Chem. 482 or comprehensive biochemistry.

Chem. 600-0. Departmental Research Seminar. *Fall, Spring.* Lectures by visiting scientists and occasionally by staff members and graduate students on topics of current research. Meets once a week and is required for all graduate students in chemistry.

Chem. 601-3. Reactions in Solution, Equilibrium and Kinetics. Prer., consent of instructor.

Chem. 602-1 to 3. Special topics in Inorganic Chemistry. Lect. course on subjects of current interest in inorganic chemistry. Primarily used for graduate level presentations of special topics by visiting and resident faculty. Variable class schedule.

Chem. 610-2. Seminar: Inorganic Solution Chemistry. Informal talks and discussion of current research in areas of solution chemistry: soluble-solvent interactions, metal ion ligation, oxidation-reduction reactions, and bioinorganic systems. Prer., graduate standing and consent of instructor.

Chem. 611-2. Seminar: Synthetic Chemistry of Nonmetal Compounds. Informal talks and discussion of currect research in areas of synthetic and structural nonmetal inorganic chemistry. Prer., graduate standing and consent of instructor.

Chem. 612-2. Seminar: Structural Inorganic Chemistry. Current research in the area of structural inorganic chemistry. The primary

focus concerns topics related to the electronic and molecular structure of transition metal complexes. Prer., consent of instructor.

Chem. 613-2. Seminar: Synthetic Chemistry of Transition Metal Compounds. This course will involve the study of organometallic and coordination compounds with special emphasis on methods of synthesis, characterization techniques, and reactivity studies. Studies will be directed toward the synthesis and mechanistic understanding of homogeneous catalysts. Prer., consent of instructor.

Chem. 620-2. Seminar: Chromatography and Trace Analysis. Student and faculty discussions and reports on research advances in chromatography, trace analysis, and environmental chemistry. Prer., permission of instructor.

Chem. 621-2. Electrochemistry Seminar. Student and faculty discussions and reports on research advances in electrochemistry. Prer., permission of instructor.

Chem. 622-2. Analytical Spectroscopy and Kinetic Measurements Seminar. Student and faculty discussions and reports on research advances in analytical spectroscopy and reaction rate measurements. Prer., permission of instructor.

Chem. 623-1. Seminar: Molecular Spectroscopy in Chemical Analysis. Consists of discussion and presentation of current research in analytical spectroscopy including absorption, fluorescence, and ionization methods. Prer., permission of instructor.

Chem. 625-1. Seminar: Analytical Chemistry. *Fall, Spring.* Student, faculty, and guest presentations and discussions of current research in analytical chemistry. Required of all analytical chemistry graduate students. Credit is deferred until presentation of satisfactory seminar.

Chem. 626-1 to 3. Special Topics in Analytical Chemistry. Lect. course on subjects of current interest in analytical chemistry. Used for graduate level presentations of special topics by visiting and resident faculty. Variable class schedule. Prer., graduate standing.

Chem. 631-3. Organic Synthesis. Selected topics in synthetic organic chemistry, encompassing both methodology and the total synthesis of complex molecules. Prer., Chem. 531.

Chem. 635-1. Seminar: Organic Chemistry. *Fall, Spring.* Discussions principally concerned with recent literature in organic chemistry.

Chem. 641-1 to 3. Special Topics in Physical Organic Chemistry. *Spring.* A course devoted to various topics of current interest in physical organic chemistry. Among the subjects covered in recent years are photochemistry, carbene chemistry, molecular orbital methods, gas phase ion chemistry.

Chem. 642-2. Seminar: Ground-State and Excited-State Organic Reactions. Discussions of certain organic reactions and their mechanisms involving both ground-state and electronically excited-state intermediates. Coreq., Chem. 700, 800, 943, or 963.

Chem. 643-2. Seminar: Physical Organic Chemistry. Current research and literature in physical organic chemistry with emphasis on gas phase ion molecule reactions. Prer., Chem. 532, one year of physical chemistry, consent of instructor.

Chem. 644-1. Seminar: Photochemistry and Free Radical Chemistry. Current research in the areas of organic free radical chemistry, photochemistry, and related topics will be presented and discussed. Prer., consent of instructor.

Chem. 645-1. Seminar: Reactive Intermediates. An application of contemporary ideas of chemical physics to organic molecules. Special attention to the structures and bonding in organic ions and radicals. Prer., organic and physical chemistry.

Chem. 646-1. Seminar: Synthetic Organic Chemistry. A series of seminars on directed total synthesis. Modern synthetic methodology and applications to total synthesis of natural products will be emphasized. Prer., consent of instructor.

Chem. 647-1. Seminar: Topics in Synthetic Chemistry. Discussions of selected topics of current interest, including the total synthesis of complex molecules, development of new synthetic methodology, organosilicon chemistry, chemistry of small-ring molecules, mechanistic problems, and organometallic chemistry. Prer., consent of instuctor.

Chem. 648-1. Seminar: Organometallic Chemistry. Specialized aspects of the synthesis of organometallic reagents and their utility in organic synthesis. Emphasis will be placed on current research results being obtained both at the University of Colorado and from other research groups. Prer., Chem. 331.

Chem. 651-3. Advanced Quantum Mechanics. Topics in time dependent quantum mechanics. Tunneling, energy transfer, curve crossing, photochemical processes. Prer., Chem. 558 or consent of instructor.

Chem. 652-1 to 3. Advanced Topics in Physical Chemistry. Prer., consent of instructor.

Chem. 660-1. Seminar: Biophysical Chemistry. This course will involve discussion of various biochemical molecules, such as DNA, RNA, and proteins, from the viewpoint of their physical properties. Possible topics include the application of thermodynamic, kinetic, and spectroscopic theory and experiment to the study of biophysical systems. Prer., Chem. 450, 451 or consent of instructor.

Chem. 661-1. Seminar: Molecular Spectroscopy. Current research topics in molecular spectroscopy and the properties of molecules in excited electronic states. Prer., consent of instructor.

Chem. 662-2. Seminar: Negative Ion Chemistry. Chemistry of negative ions. Experimental methods and designs. Laser spectroscopy of ions. Theoretical methods. Reactive dynamics of ions in the gas phase. Prer., graduate standing.

Chem. 663-2. Seminar: Theoretical Chemistry. Topics in various aspects of current research; emphasis on student readings and presentations. Prer., consent of instructor.

Chem. 664-2. Research Seminar: Theoretical Chemistry. Study of the theoretical description of molecular dynamics as related to rate processes. Focus is on chemical reactions in liquids, absorption-desorption on surfaces, nucleation reactions and energy flow in molecules. Prer., graduate standing.

Chem. 665-2. Seminar: Reaction Dynamics. Study of experiments and theory in modern reaction dynamics, energy transfer, and photodissociation; experimental techniques, critique of recently published literature, and current work. Prer., Chem. 451, 452, 453, or equivalent.

Chem. 666-2. Seminar: Atmospheric Chemistry. Discussion of current problems and activities in atmospheric chemistry research. Journal articles, conferences, guest workers, and research group progress reports provide resource material. Prer., consent of instructor.

Chem. 667-1. Seminar: Surface Chemistry. Topics in surface chemistry will be discussed, including chemisorption and reactions on metal surfaces, catalysis, and electron spectroscopy for surface analysis. Discussions will be focused on current research and recent literature. Prer., consent of instructor.

Chem. 681-3 to 6, 682-3 to 6. Advanced Topics in Biochemistry. *Fall, Spring.* A detailed study of the current literature relative to one main topic is undertaken each semester. Topics covered on a rotating basis include enzyme kinetics and mechanism; lipids and lipoproteins; chemistry and enzymology of nucleic acids; biochemistry of nucleic acids in eukaryotic cells; and protein chemistry. Presentations include faculty lectures and student reports. Credit for one semester is 3 hours. The course(s) may be taken for a maximum of 12 hours credit. Prer., one year of biochemistry courses and consent of instructor.

Chem. 685-1. Biochemistry Seminar. *Fall, Spring.* Required of all biochemistry graduate students. Credit is deferred until presentation of satisfactory seminar. Prer., consent of instructor.

Chem. 690-2. Seminar: Nucleic Acid Chemistry. Topics in various aspects of current research; emphasis on student readings and presentations. Prer., consent of instructor.

Chem. 691-2. Seminar: Cell Organelle Biochemistry. Topics in various aspects of current research concerning the biochemistry and molecular biology of chloroplasts and mitochondria. Prer., consent of instructor.

Chem. 692-2. Seminar: Regulation of Transcription. Topics in current research; emphasis on literature reading and student presentations. Prer., consent of instructor.

Chem. 693-1. Seminar: Eukaryotic Gene Expression. Discussion of current research, both published and unpublished; student and faculty presentations, occasional guest speakers. Prer., consent of instructor.

Chem. 694-2. Seminar: Plant Biochemistry. Reporting on and critical evaluation of research and research papers. Emphasis on topics in host-pathogen interactions, host-symbiont interactions, and structure and function of complex carbohydrates. Prer., consent of instructor.

Chem. 695-2. Seminar: Biochemistry. Topics in various aspects of current biochemical research; emphasis on student reading and presentations. Prer., consent of instructor.

Chem. 696-1. Seminar: Bioorganic Chemistry. Lectures and class discussion on metabolism, use of isotopes, nutritional biochemistry, and enzyme chemistry. Prer., consent of instructor.

Chem. 697-1. Seminar: Protein and Enzyme Chemistry. Discussion and presentation of topics in protein chemistry and enzymology. Prer., consent of instructor.

Chem. 698-2. Seminar: Structural Biochemistry. An advanced course which covers (1) current theory and techniques of protein crystallography and closely related fields in biophysical chemistry, and (2) a critical examination of current literature in biophysical chemistry. Prer., consent of instructor.

Chem. 700-4 to 6. Master's Thesis.

Chem. 800-30. Doctor's Dissertation. All doctoral students must register for 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Chem. 943-1 to 3. Independent Study in Chemistry. *Fall, Spring.* For undergraduate study. May be repeated; no limit on total credit. Consent of instructor required.

Chem. 963-1 to 3. Special Topics in Chemistry. *Fall, Spring.* Prer., consent of instructor. May be repeated; no limit on total credit.

CHICANO STUDIES

Ch.St.101-3. Introduction to Chicano Studies. The following areas are studied: how social science theory and methodology produce stereotypes, how social problems are attributed to Chicanos, and how Chicanos create culture.

Ch.St. 103-3. Chicano Fine Arts and Humanities. Provides a foundation for study of Chicano literature, music, the plastic arts, theatre, and film. Also introduces aesthetic and critical concepts and their applications in Chicano Studies.

Ch.St. 104-3. Introduction to Chicano Literature. Examines contemporary Mexican-American literature from its early concern with political protest to its present expression of a variety of subjects, themes, and styles.

Ch.St. 127-3. The Contemporary Mexican American. Special attention is given in the following areas of Mexican American life: family life cycle, migration, economic change, discrimination (race and sex), and political status. Prer., Ch.St. 101 or sophomore standing.

Ch.St. 201-3. Chicano History to 1848. An introduction to the historical developments of Chicano society and thought from the pre-Columbian period to 1848.

Ch.St. 202-3. Chicano History 1848 to Present. An introduction to the historical development of Chicano society and thought from 1848 to the present.

Ch.St. 221-3. Barrio Issues and Problems. Includes such problems as dropouts, drugs, discrimination, health care, housing, police, religion, sexual identity, and welfare. Prer., Ch.St. 101 or 127.

Ch.St. 302-3. Field Experience. The objective is to acquaint students with major ethnographic studies in ethnic communities and to teach such qualitative methods as participant observation and depth interviews. Students will be required to do a field study. Prer., Ch.St. 101 or 127.

Ch.St. 313-3. Study of Chicanas (Wm.St. 313.) Through an interdisciplinary study of history, sociology, literary images, and filmic portrayals, this course will provide insight into the present socioeconomic condition of Mexican-American women and the concept of *femenismo.* Prer., Ch.St. 101 or 201 or 202.

Ch.St. 315-3. Folklore, Mysticism, and Power. Cultural conceptions of folk healing, mysticism, and power are examined with special attention given to the practice of folk healing and mysticism in ancient and contemporary society. Prer., Ch.St. 101 or 201 or 202.

Ch.St. 380-3. Chicanos and the Mass Media. The psychological, social, and organizational dynamics of the media industry (i.e., TV, radio, movies, public broadcasting, and news programming) are examined in the context of Chicano experience. Prer., Ch.St. 101 or 127.

Ch.St. 381-3. Chicano Poetry. Beginning with an examination of indigenous pre-Columbian roots and later Mexican influences, the course will move to an exploration of contemporary Chicano poetry. Prer., Ch.St. 103 or 104.

Ch.St. 382-3. Survey in Chicano Prose Fiction. Of particular interest to the student investigating literature from an ethnic minority perspective, this course covers the most important Chicano writers of prose fiction of the past three decades. The progression of Chicano fiction from naturalism, realism, and romanticism to post-Modernism will be considered. Prer., Ch. St. 104.

Ch.St. 400-3. Mexican-American Culture of the Southwest. A lecture course on Mexican-American culture conducted by experts in the different disciplines: geography, anthropology, history, fine arts, comparative literature, political science, sociology, etc.

Ch.St. 420-3. The Culture of Spain. (Span. 420.) See Spanish for the course description.

Ch.St. 427-3. Intellectual History and Social Theory in Chicano Studies. Surveys the various intellectual traditions that influence the nature of contemporary social thought and theory in Chicano Studies. The approach is that of sociology of knowledge. Prer., Ch.St. 201-202 or consent of instructor.

Ch.St. 430-3. The Chicano and the U.S. Social Systems. Special attention is given to the ways U.S. institutions (i.e., legal, economic, educational, governmental and social agencies) affect Chicanos. The following concepts are discussed: internal colonialism, institutional racism, assimilation and acculturation, and identity. Prer., Ch.St. 101 or 127 or 201 or 202 or 221.

Ch.St. 435-3. The Mexican Revolution. The Mexican Revolution will be studied through a multiperspective approach (films, literature, photographs, historical documents, and chronicles) that allows the student to conceptualize a complex event that changed the history and future of Mexico and the United States. Prer., Ch.St. 103 or 104.

Ch.St. 460-3. History of the Chicano in American Labor Movement. Presents a historical and topical analysis of the American labor movement, particularly its ethnic, sexual, racial, and skill divisions. The objective will be to analyze the historical development of the American working class, specifically, its culture, ideology, ethnicity, and union involvement with focus on Chicanos.

Ch.St. 486-3. Special Topics.

Ch.St. 910-variable credit. Independent Study in Chicano Studies. Consent of instructor required.

Ch.St. 940-variable credit. Independent Study in Chicano Studies. Consent of instructor required.

CLASSICS

General Classics

No Greek or Latin Required

Clas. 101-3. The Study of Words. A study of English words of Latin and Greek origin, focusing on etymological meaning by analysis of component parts (prefixes, bases, suffixes) and on the main types of semantic change which the words underwent in their development.

Clas. 105-3. The World of Ancient Greeks. (Hist. 105.) See History for course description.

Clas. 106-3. The Rise and Fall of Ancient Rome. (Hist. 106.) See History for course description.

Clas. 110-3. Greek Mythology. The Greek myths are documents of early man's imagination, the source of Greek culture, and part of the fabric of the Western cultural tradition. Of particular interest to students of literature and the arts, psychology, anthropology, and history.

Clas. 111-3. Masterpieces of Greek Literature in Translation. Survey of Greek authors whose works have most influenced Western thought: Homer, Aeschylus, Sophocles, Euriphides, Aristophanes, Plato.

Clas. 112-3. Masterpieces of Roman Literature in Translation. A study of the literature, ideas, and culture of the Roman era.

Clas. 202-3. Science in the Ancient World. The coherent development of scientific modes of thought, theory, and research from mythological origins (e.g., Hesiod's poetry) through the pre-Socratic philosophers and culminating in the theories and researches of Plato and Aristotle, and beyond them into the time of the Roman Empire, will be presented in lectures and through the reading of original sources in translation.

Clas. 210-3. Women in Antiquity. (Wm.St. 210.) The evidence of art, archaeology, and literature is examined from a contemporary point of view in a study of the status of women in Greek and Roman antiquity (their roles in works of art and literature, attitudes expressed toward them, their daily lives).

Clas. 330-3. Visiting Scholar's Course. Topic to be announced.

Clas. 333-3. Ancient Athletics. An examination of the role of athletics and recreation in Classical Greece, Rome, and the Roman Empire (especially Constantinople) with special emphasis upon religious and political significance (Olympic Games, etc.) and the philosophical speculations on athletics by Plato, Aristotle, etc.

Clas. 361-3. From Paganism to Christianity. (Greco-Roman Paganism and the Rise of Christianity.) (Phil. 361.) Treats the history of Greek and Roman religion from its Bronze Age origins through the rise of Christianity. Recommended prer., Clas. 110.

Clas. 402/502-3. Athens and Greek Democracy. (Hist. 402.) A study of Greek history from 800 B.C. (the rise of the city-state) to 323 B.C. (the death of Alexander the Great). The major emphasis is upon the development of democracy in Athens. The reading is in the primary sources.

Clas. 403/503-3. Alexander and the Hellenistic World. (Hist. 403.) The course focuses first on the careers of Philip of Macedon and his son Alexander and second on the Hellenistic Age, especially its culture, from Alexander's death (323 B.C.) to the defeat of Cleopatra and Antony by Octavian in 31 B.C.

Clas. 404/504-3. Art of the Ancient Near East. (F.A. Hist. 404/504.) Prer., instructor's consent. See Fine Arts History, Fine Arts, for course description.

Clas. 405/505-3. Greek Constitutional History. A study primarily of Athenian constitutional and legal history with some consideration given to other Greek states.

Clas. 407/507-3. History of the Byzantine Empire. (Hist. 407.) See History for course description.

Clas. 408/508-3. The Roman Republic. (Hist. 408.) A study of the Roman Republic from its foundation in 753 B.C. to its conclusion with the career of Augustus. The major emphasis is upon the development of Roman Republican government. The reading is in the primary sources.

Clas. 409/509-3. The Roman Empire. (Hist. 409.) See History for course description.

Clas. 411/511-3. Ancient Epic. Students will read in English such major epics of antiquity as *Gilgamesh, Iliad, Odyssey, Argonautica, Aeneid.* Topics to be discussed may include the nature of ancient epic, its relation to the novel, and its legacy. Prer., junior standing.

Clas. 412/512-3. Greek and Roman Tragedy. An intensive study of selected tragedies of Aeschylus, Sophocles, Euripides, and Senecca in English translation.

Clas. 413/513-3. Greek and Roman Comedy and Satire. A study of Aristophanes, Plautus, Terence, and Roman satire in English translation.

Clas. 416/516-3. Myth in the Arts. Prer., Hum. 101-102, 6 hours classics, or instructor's consent. See Humanities, Interdisciplinary Studies, for course description.

Clas. 420/520-3. Byzantine Art. (F.A. Hist. 407/507.) See Fine Arts History, Fine Arts, for course description.

Clas. 425/525-3. Archaeology of Ancient Egypt. (Anth. 432/532.) See Anthropology for course description.

Clas. 426/526-3. Biblical Archaeology. (Anth. 426/526.) See Anthropology for course description.

Clas. 427/527-3. Pre-Classical Art and Archaeology. (F.A. Hist. 427/527.) Greece and Crete from the Neolithic period to the end of the Mycenaean world.

Clas. 428/528-3. Classical Art and Archaeology. F.A. Hist. 428/528.) Greek art and archaeology from the end of the Mycenaean world through the Hellenistic era.

Clas. 431/531-3. Etruscan Art and Archaeology. (F.A. Hist. 431/531.) Examines the art and architecture of the Etruscans, the first literate urban civilization of central Italy. Development is traced from mysterious prehistoric origins to the absorption of Etruria by Rome in the first century B.C. Prer., junior standing.

Clas. 432/532-3. Roman Art and Archaeology. (F.A. Hist. 432/532.) Covers a millennium of development in Roman art and architecture, from the foundation of Rome (753 B.C.) to Constantine (A.D. 311-337). The geographical scope includes far-flung imperial provinces as well as the Italian homeland. Prer., junior standing.

Clas. 450/550-3. Open Topics. Especially tailored to the needs of present and future teachers of classics, this course covers specialized topics in classical humanities to be specified in the *Schedule of Courses.* Prer., junior standing.

Clas. 461/561-3. The Art of Ancient Egypt. (F.A. Hist. 461/561.) Prer., instructor's consent. See Fine Arts History, Fine Arts, for course description.

Clas. 476/576-3. Rome, the Law-Giver. A study of the constitutional and legal history of ancient Rome with emphasis upon basic legal concepts and comparisons with American law.

Cla. 483/583-3. Egyptian Hieroglyphics I. (Anth. 483/583.) See Anthropology for course description.

Clas. 484/584-2. Egyptian Hieroglyphics II. (Anth. 484/584.) See Anthropology for course description.

Clas. 486/586-3. Archaeology of Ancient Near East. (Anth. 431/531.) See Anthropology for course description.

Clas. 495/595-3. Latin Backgrounds to English Literature: Selected Readings. Key readings from selected Latin authors influential in English literature will be studied using a bilingual text; emphasis will be placed on structure, word placement, diction, and meter in order to cast light on the debts of their successors. Prer., Lat. 593-594 or instructor's consent.

Clas. 521-3. Classical Greek Art. (Anth. 594; F.A. Hist. 509.) Normally offered every other year. Topics selected from architecture, vase painting, sculpture. Prer., Clas. 428/528, or instructor's consent.

Clas. 523-3. Archaic Greek Art. (Anth. 594; F.A. Hist. 509.) Normally offered every other year. Concentrates on the architecture, sculpture, pottery, and minor arts of the period ca. 700-500 B.C. Regional characteristics and development are stressed. Prer., Clas. 428/528 or instructor's consent.

Clas. 524-3. Prehistoric Greek Art and Archaeology. (Anth. 595; F.A. Hist. 510.) Normally offered every other year. Topics selected from architecture, pottery, frescoes, and minor arts of the third millennium B.C. Prer., Clas. 427/527 or instructor's consent.

Clas. 580-3. Philosophy of Plato. (Phil. 580.)

Clas. 581-3. Philosophy of Aristotle. (Phil. 581.)

Clas. 603-3. Readings in Ancient History. (Hist. 603.) Prer., graduate standing. See History for course description.

Clas. 614-3. Seminar in Archaeology of Selected Areas. (Anth. 614.) Areas to be selected in terms of current research interests. See Anthropology for course description.

Clas. 930-1 to 3. Independent Study.

Clas. 950-1 to 3. Graduate Independent Study.

Clas. 999-0. Master's Degree Candidate.

II. Classical Philology

Cl.P. 601-1. Proseminar: Introduction to Research Methods in Classical Studies.

Cl.P. 609-3. Graduate Seminar. Author or topic to be specified in *Schedule of Courses.* May be repeated.

Cl.P. 610-3. Graduate Seminar. Author or topic to be specified in *Schedule of Courses.* May be repeated.

Cl.P. 700-4 to 6. Master's Thesis.

Cl.P. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

III. Greek

Undergraduate students who start the study of Greek in college to satisfy the language requirement must take Greek 101, 102, and 311.

GR. 101-5. Beginning Classical Greek I. *Fall.*

Gr. 102-5. Beginning Classical Greek II. *Spring.* Continuation of Gr. 101. Prer., Gr. 101 or instructor's consent.

Gr. 311-3. Intermediate Classical Greek I. *Fall.* Readings in Plato.

Gr. 312-3. Intermediate Classical Greek II. *Spring.* The reading of two Attic dramas, generally one Euripidean and one Sophoclean. The major emphasis is upon learning to read the dramas with ease and comprehension. Grammar and syntax receive a good deal of attention.

Prerequisites for the following 400-level courses are Greek 311 and 312, or the equivalent.

Gr. 421/521-3. Lyric Poetry. Offered every three to four years.

Gr. 440/540-3. Attic Orators. Offered every three to four years.

Gr. 450/550-3. Herodotus. Offered every three to four years.

Gr. 465-3. Koine and New Testament. Normally offered every three to four years.

Gr. 493/593-3. Accelerated Beginning Classical Greek I. Offered every other year in the fall semester. For advanced undergraduates and graduate students. Grammar survey, intensive reading.

Gr. 494/594-3. Accelerated Beginning Classical Greek II. Continuation of Gr. 493/593. Offered every other year in the spring semester. For advanced undergraduates and graduate students. Prer., Gr. 493/593 or equivalent. Successful completion of Gr. 594 meets the Graduate School foreign language requirement.

Gr. 500-3. Graduate Reading. Author or topic to be specified in *Schedule of Courses* (e.g., Homer, Hesiod, Pindar, Aeschylus, Sophocles, Euripides, Thucydides, Greek Comedy, Plato, Aristotle, Menander). May be repeated.

Gr. 600-1 to 3. Advanced Graduate Reading. Materials to be taken from graduate reading list. May be repeated.

Gr. 930-1 to 3. Independent Study.

Gr. 950-1 to 3. Graduate Independent Study.

IV. Latin

Lat. 101-5. Beginning Latin I. *Fall.*

Lat. 102-5. Beginning Latin II. Continuation of Lat. 101. *Spring.* Prer., Lat. 101 or instructor's consent.

Lat. 103-5. Latin Review. *Fall.* For students who have had two years of high school Latin.

Lat. 211-3. Intermediate Latin. *Fall, Spring.* Prer., Lat. 101 and 102, or two years of high school Latin. Students with three years of high school Latin will be placed in accordance with their level of proficiency.

The following courses are intended for persons with three years of high school Latin or two years of college Latin.

Lat. 311-3. Cicero-Petronius. *Fall.* Intermediate-level readings will be selected from the prose works of Cicero and Petronius. Prer., Lat. 211 or three years of high school Latin.

Lat. 312-3. Catullus-Horace. *Spring.* Readings from the lyric poetry of Catullus and Horace will be selected. Prer., Lat. 211 or three years of high school Latin.

Lat. 321-3. Livy-Pliny. *Fall.* Intermediate-level readings will be selected from the prose works of Livy and Pliny. Prer., Lat. 211 or three years of high school Latin.

Lat. 322-3. Vergil-Ovid. *Spring.* Readings from the epic poetry of Vergil and Ovid will be selected. Prer., Lat. 211 or three years of high school Latin.

Lat. 331. Caesar-Tacitus. *Fall.* Intermediate-level readings will be selected from Caesar, *Gallic War;* Tacitus, *Agricola, Germania.* Prer., Lat. 211 or three years of high school Latin.

Lat. 332-3. Roman Comedy. *Spring.* Readings from the comedies of Plautus and Terence will be selected. Prer., Lat. 211 or three years of high school Latin.

All 400-level courses are intended for those who have completed one 300-level sequence.

Lat. 402/502-3. Latin Prose Composition. Offered every three to four years.

Lat. 424/524-3. Roman Elegy. Offered every three to four years. The poetry of Propertius, Tibullus, Ovid: structure, unity, traditional influences, originality.

Lat. 425/525-3. Horace's Odes and Epodes. Offered every three to four years.

Lat. 432/532-3. Lucretius. Offered every three to four years. The philosophical background to Lucretius' *De Rerum Natura;* tradition and originality in Lucretius' thought and poetry.

Lat. 455/555-3. Tacitus.

Lat. 461/561-3. Cicero's Philosophical Essays. Offered every three to four years.

Lat. 490-3. Teacher Training. Offered fall semester in alternate years, to be taken the semester prior to student teaching. Teach techniques, preparation of materials, professional orientation. Prer., proficiency test in the translation of Caesar, Cicero, Vergil, Ovid.

Lat. 493/593-3. Accelerated Beginning Latin I. *Fall.* For advanced undergraduates and graduate students. Grammar survey, intensive reading.

Lat. 494/594-3. Accelerated Beginning Latin II. Continuation of Lat. 493/593. *Spring.* For advanced undergraduates and graduate students. Reading of advanced texts: Caesar, Cicero, Ovid. Prer., Lat. 493/593 or equivalent. Successful completion of Lat. 594 meets the Graduate School foreign language requirement.

Lat. 500-3. Graduate Reading. Author or topic to be specified in *Schedule of Courses* (e.g., Roman Comedy, Catullus, Cicero's Forensic Oratory, Sallust, Satire: Horace, Juvenal; Vergil, Livy, Seneca's Tragedies, Tacitus). May be repeated.

Lat. 600-1 to 3. Advanced Graduate Reading. Materials to be taken from graduate reading list. May be repeated.

Lat 930-1 to 3. Independent Study.

Lat. 950-1 to 3. Graduate Independent Study.

COMMUNICATION

Comm. 101-3. Introduction to Public Communication. *Fall, Spring.* Introduces concepts that define communication in a variety of contemporary public and mediated contexts. Topics include symbols, myths, and rituals, and the rhetoric of politics, agitation, control, advertising, and entertainment. For communication education majors; for nonmajors.

Comm. 102-3. Introduction to Interpersonal and Small Group Communication. *Fall, Spring.* Presents an introduction to concepts and related skills that define communication in a variety of face-to-face contexts. Topics include models of communication, meaning, content/relationships, formal gathering, intimacy, and group problems. Optional for majors; open to nonmajors.

Comm. 203-3. Interpersonal Communication. *Fall, Spring.* Emphasizes personal aspects of communication. Choice making, choice attribution, risk taking, personal knowledge, creativity, and alternative kinds of interpersonal relationships are central topics. Increased self-awareness, understanding of interpersonal relationships, and improvement of interpersonal skills are dominant goals. Prer., major in communication or completion of Comm. 101 or 102. Required for majors.

Comm. 215-3. Organizational and Small Group Communication. *Fall, Spring.* An introduction to the processes of communication in groups with emphasis on group decision making in organizational settings. Prer., major in communication or completion of Comm. 101 or 102. Required for majors.

Comm. 231-3. Oral Communication—Developing Competency. Designed to explore a variety of contexts, purposes, and styles of communication. Students will make a minimum of five presentations for critique-evaluation and be examined over course content. The primary aim is to find and develop the student's most effective style for different purposes and contexts. Prer., major in communication or completion of Comm. 101 or 102. Alternatives may be negotiated. Optional for majors.

Comm. 250-3. Information Theory: Background of Contemporary Developments. The objective of this course is to develop a basic, nontechnical, understanding of information theory—the mathematical theory of communication—as background or contemporary developments in computers and information systems. Optional for majors; open to nonmajors. Prer., Math. 101 or high school equivalent.

Comm. 320-3. Argumentation. *Fall, Spring.* This class focuses on principles of argument, the process of critical decision making, the uses and limitations of logic and evidence. Contemporary issues (personal, social, political, or philosophical) are analyzed and debated. Prer., Comm. 203 and 215 for majors, and 101, 102, or 250 for nonmajors. Required for majors.

Comm. 335-3. Creative Dramatics. *Fall, Spring.* Study of experiential and creative learning techniques. A special focus is the manner in which creative drama assists in the growth and development of the human being. Junior standing or above.

Comm. 369-1 to 6. Problems in Communication: Internship. *Fall, Spring.* Studies are pursued in community based communication research projects. These research projects are generally investigative in nature and require an internship of 10 hours or more per week in the field. (Six-hr. limit for major.) Prer., consent of supervising instructor.

Comm. 418/518-3. Advanced Interpersonal Communication. Reviews perspectives of interpersonal communication and the key variables and research studies that emerge from each perspective. Special attention is paid to the humanistic or dialogic view of interpersonal communication. Assignments include readings, discussion, and experiential methods. Graduate students will be assigned additional work of a more theoretical nature. Prer., for majors, any two of Comm. 203, 215, 320; for nonmajors, consent of instructor; junior standing or above for all.

Comm. 419-3. Special Topics. Special interest areas of communication research and practice are analyzed in depth. The course format is lecture, discussion, investigative analysis, and practical applications. (Six-hour limit in major.) Prer., instructor consent.

Comm. 420/520-3. Persuasion. *Fall, Spring.* Persuasion is the study of all the dimensions of communication with an emphasis on oral performance. Attitudes, values, beliefs, ethics, notions of credibility, criticism of effects, and elements of oral presentation are analyzed. Advanced level registration involves the examination and synthesis of current theory, research findings, and societal applications of both. Advanced students are expected to meet writing standards appropriate for thesis projects. Prer., for majors: any two of Comm. 203, 215, 320; for nonmajors, consent of instructor; junior level or above for all.

Comm. 421/521-3. Psychology of Communication. *Fall, Spring.* Emphasizes applications to communication of selected areas of psychological theory and research. Topics treated may include person perception, interpersonal attraction, learning, symbolic interaction, attitude change, language and meaning, and information theory. Advanced level registration involves extended reading and analysis. Written efforts at this level are critiqued by standards appropriate to thesis writing. Prer., for majors, any two of Comm. 203, 215, 320; for nonmajors, consent of instructor; junior standing or above for all.

Comm. 423/523-3. Nonverbal Dimensions of Communication. *Spring.* The study of nonverbal communication focuses on how people communicate in everyday life without words and with signals which accompany words. Special topics of analysis include proxemics (spatial relations), kinesics (body movement), facial expression, eye contact, vocal qualities, touch, personal adornment, and environmental cues. Advanced level registration involves the examination and synthesis of current theory, research findings, and applications of both. Prer. for majors, any two of Comm. 203, 215, 320; for nonmajors, consent of instructor; junior standing or above for all.

Comm. 424/524-3. Organizational Communication. *Fall.* Focuses on relationships among such variables as information processing, network analysis, leadership, morale, productivity, decision-making and conflict, and general message construction and delivery. The course format is lecture, discussion, and case studies. Advanced level registration involves the examination and synthesis of current special theories, research findings, and applications of both. Advanced students are expected to meet writing standards appropriate for thesis projects. Prer. for majors; any two of Comm. 203, 215, 320; for nonmajors, consent of instructor; junior standing or above for all.

Comm. 426/526-3. Communication and Conflict. (C.P.S. 426.) Conflict management is studied from a communication perspective on the intrapersonal, interpersonal, and small group levels. Attention is given to managing conflict in informal settings and to the productive management of conflict. Assignments include field observations, analysis of actual conflicts, and experiences in intervention methods. Advanced registration involves reading primary theoretical works in conflict, reading and critiquing recent research in communication and conflict, and writing a major paper. Prer., for majors, any two of Comm. 203, 215, 320; for nonmajors, consent of instructor; junior standing or above, for all.

Comm. 427/527-3. Intercultural Communication. *Fall, Spring.* The processes, problems, and potentials unique to communication across cultural boundaries are the focus of this course. Special topics include comparative studies of communication philosophies and customs in selected countries. Advanced level registration involves the examination and synthesis of current theory, research findings, and applications of both. Prer. for majors, any two of Comm. 203, 215, 320; for nonmajors, consent of instructor; junior standing or above for all.

Comm. 430-3. Teaching of Communication and Theatre. *Fall.* The fundamental educational decisions faced by the teacher of communication and theatre are analyzed. Methods of teaching, unit design, textbooks, and general materials selection are specific problems studied. Prer., consent of instructor.

Comm. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Comm. 930-1 to 6. Undergraduate Independent Study. *Fall, Spring.* Prer., written consent of supervising instructor.

Comm. 950-1 to 6. Master's Independent Study. *Fall, Spring.* Prer., written consent of supervising instructor.

Comm. 960-1 to 6. Doctor's Independent Study. *Fall, Spring.* Prer., written consent of supervising instructor.

Comm. 999-0. Candidate for Degree (Master's).

COMMUNICATION DISORDERS AND SPEECH SCIENCE

CDSS 200-3. Voice and Diction. Elementary course for the improvement of the speaking voice. Group and individual laboratory practice.

CDSS 210-3. Introduction to Communication Disorders. Survey of communication disorders including hearing impairments, learning disabilities, and speech-language disorders, as well as an introduction to basic speech and hearing science.

CDSS 301/401-3. Speech and Language Development in Children. The underlying processes in the development of speech and language, normal and atypical. Laboratory activities required.

CDSS 304-3. General Phonetics. Introduction to principles of speech production, transmission, and reception. Classification of speech sounds and development of an understanding and a limited skill in transcription using International Phonetic Alphabet.

CDSS 305-4. Anatomy and Physiology of the Speech and Hearing Mechanism. A study of structures and function of those portions of the human body important to the reception of sound and the production of speech.

CDSS 308-3. Introduction to Speech and Hearing Sciences. A study of basic processes of speech production, transmission, and perception.

CDSS 370-2. Manual Communication I. An introduction to the various systems of manual communication used by the deaf, with emphasis upon developing receptive and expressive skills in the use of American Sign Language.

CDSS 371-2. Manual Communication II. A continuation of CDSS 370. Examines more closely the academic, linguistic, and research aspects of manual communication, and extends the vocabulary and situational uses of sign.

CDSS 450-4. Speech Disorders I. Survey of the following disorders: articulation, stuttering, and language and learning disabilities. Prer., CDSS 305, 308.

CDSS 451-4. Speech Disorders II. Survey of the following disorders: cleft palate, motor speech, aphasia, and voice. Prer., CDSS 305, 308.

CDSS 469-1. Observation and Cotherapy. Supervised observation and cotherapy with individuals exhibiting speech, language, and hearing problems. Prer., CDSS 450, 451.

CDSS 470-3. Audiology I. Basic principles and techniques of pure tone audiometry, hearing conservation programs in the schools and industry, and psychological aspects of hearing impairment. Required projects in screening and pure tone audiometry. Prer., CDSS 305, 308.

CDSS 471-3. Audiology II. Basic principles and techniques of clinical masking, speech audiometry, pathologies of the auditory system, impedance audiometry, and introduction to rehabilitation of the hearing impaired. Required projects. Prer., CDSS 470.

CDSS 508-2. Experimental Phonetics I. A demonstration and lab. course in the applications of instrumentation to problems in acoustic and physiological phonetics; measurement and analysis of linguistically significant acoustic parameters of speech.

CDSS 509-2. Speech Perception. A survey of research findings and laboratory experience on topics in speech perception including intelligibility of speech, perceptual cues of segmental and suprasegmental linguistic features, dichotic listening and hemispheric specialization, and speech synthesis.

CDSS 510-3. Computer Applications in CDSS. Course is intended to familiarize students with basic concepts of computers and how they are applied in the field. Emphasis is placed on analysis of typical CDSS problems, their computer-based solutions, and skills to utilize programs.

CDSS 520-3. Psycholinguistics and Language Behavior. Presents an introduction to psycholinguistic theories that relate to language comprehension and construction strategies. Psycholinguistic theories are also related to theories of sociolinguistics and cognition that are relevant to the language disordered.

CDSS 525-3. Neural Bases of Communication Disorders. Neuroanatomical and neurophysiological bases for normal and disordered communication.

CDSS 532-3. Language Disorders of Children. Language disorders are viewed from infancy through adolescence. A comparison is made of the cognitive, social, and linguistic development of the language-learning disabled, the mentally retarded, the emotionally disturbed, the autistic, the hearing impaired, and the environmentally deprived.

CDSS 551-2. Articulation Disorders. Provides an overview of normal aspects of phonological acquisition—perception and production. Factors related to articulation disorders are presented. Traditional assessment procedures, phonological process analysis strategies, and critical examination of remediation approaches are the focus. Prer., CDSS 450, 451 or equivalent.

CDSS 552-3. Cleft Palate and Voice Disorders. Anatomical and physiological bases for normal and disordered velopharyngeal and laryngeal function. Acoustic and perceptual analyses of speech produced by individuals with cleft palate and voice disorders. Assessment and management of these individuals. Prer., CDSS 601.

CDSS 554-2. Stuttering: Therapy and Research. Primary emphasis is the treatment of children and adults who stutter. Various stuttering intervention approaches are discussed and evaluated. Discussion is also devoted to counselling parents of young children who stutter. Familiarity with research is a secondary emphasis.

CDSS 556-3. Neurogenic Communication Disorders. Focus on the role of the speech-language pathologist in the assessment and treatment of individuals with aphasia, related language disorders, and motor speech disorders. Prer., 525.

CDSS 567-3. Speech-Language-Learning Appraisal. The appraisal process and techniques are taught in this course. Students learn about test construction and measures of social maturity, intelligence, hearing, speech, oral language, reading, writing, spelling, and mathematics.

CDSS 570-2. Conservation of Hearing in Schools and Industry. Principles of hearing screening in both the pediatric and adult populations; prevention of hearing loss in the educational and industrial settings. Coreq., CDSS 676. Prer., CDSS 470-471.

CDSS 572-3. Residual Hearing and Amplification. Study of the physical components of hearing aids; hearing aid performance and clinical evaluation of hearing aids; hearing aid use in the education and rehabilitation of the hearing impaired.

CDSS 573-2. Medical Backgrounds for Clinical Audiology. Advanced study of hearing disorders and audiologic practice in the medical setting.

CDSS 574-3. Seminar: Assessment of Hearing I. The first in a two-course sequence in advanced hearing measurement including both behavioral and electrophysiologic assessment procedures. Course includes lect. and lab. Prer., 470 and 471 or equivalent or consent of instructor.

CDSS 575-3. Seminar: Assessment of Hearing II. The second in the two-course sequence.

CDSS 580-3. Communication Skills of the Hearing Impaired. A study of the process and teaching of speech reading, the basic features

of auditory training, and the development of speech and language skills for the hearing impaired.

CDSS 584-3. Social and Vocational Adjustment of the Hearing Impaired. Study of the personal, social, and vocational adjustment of the hearing impaired, together with a review of the agencies and organizations which serve them.

CDSS 601-2. Research Methods in Communication Disorders and Speech Science. Intended to familiarize students with basic methodologies and research designs employed in the field. Focuses on critical reading of research papers and design of experiments.

CDSS 608-2. Experimental Phonetics II. A comprehensive survey of topics in physiological and articulatory phonetics with emphasis on motor control of speech production and its theoretical and methodological issues. Lab. experiences and research reports on a selected topic are part of the course requirements.

CDSS 609-1 to 3. Problems in Communication Disorders and Speech Science. Current issues related to theory and management of communication disorders are presented.

CDSS 617-1 to 3. Practicum I: Voice Evaluation. Supervised clinical experience on campus in the evaluation of voice disorders and cleft palate. Prer., CDSS 552.

CDSS 634-2. Methods of Language-Learning Disabilities Intervention. Invervention methods and materials appropriate for children from infancy through adolescence with oral language, reading, and writing disorders are discussed.

CDSS 656-1 to 4. Practicum I: Speech-Language Intervention (Child Language Center). Supervised experience in the management of speech-language disorders in pre-school age children who are enrolled in the clinic's preschool program.

CDSS 657-1 to 3. Practicum I: Speech-Language-Learning Appraisal. Supervised clinical experience on-campus in the appraisal of speech, language, learning disorders after training at the observational level.

CDSS 658-1 to 4. Practicum I: Speech-Language-Learning Intervention. On-campus supervised clinical practice in the management of speech-language disorders in children and adults. Graduate standing and CDSS 469 or equivalent.

CDSS 659-7. Practicum II: Public School Internship. Off-campus supervised experience providing extended and in-depth practice with speech-language handicapped school children.

CDSS 669-7. Practicum II: Speech-Language-Learning Internship. Off-campus experience in a clinical or hospital setting which provides in-depth practice with speech-language handicapped individuals.

CDSS 670-2. Instrumentation in Audiology. Examines instrumentation used by audiologists for signal generation, amplification, measurement and calibration. Also examines microcomputer applications in audiology. Prer., consent of instructor.

CDSS 676-1 to 3. Practicum I: Conservation of Hearing. Supervised clinical experience off campus in the organization and administration of hearing conservation programs in schools and/or industry.

CDSS 677-1 to 3. Practicum I: Audiology Appraisal. Supervised clinical experience on campus in the appraisal of hearing of children and adults.

CDSS 678-1 to 3. Practicum I: Audiology Intervention. Supervised clinical on- and/or off-campus experience in the management of hearing disorders of children and adults.

CDSS 689-4 to 8. Practicum II: Audiology Internship. An off-campus experience in a school, hospital, or clinic setting which provides in-depth appraisal and/or rehabilitation practice with hearing impaired individuals.

CDSS 698-1 to 4. Seminar: Departmental Research.

CDSS 700-1 to 4. Master's Thesis.

CDSS 794-2. Doctoral Practicum.

CDSS 795-2. Practicum III. Clinical Supervision.

CDSS 796-2. Practicum IV: Clinical Administration.

CDSS 797-2. Practicum V: Research Coordination.

CDSS 798-2. Practicum VI: Classroom Instruction.

CDSS 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

CDSS 910-1 to 4. Independent Study, Freshman.

CDSS 920-1 to 4. Independent Study, Sophomore.

CDSS 930-1 to 4. Independent Study, Junior.

CDSS 940-1 to 4. Independent Study, Senior.

CDSS 950-1 to 4. Independent Study: Speech-Language Pathology, Master's.

CDSS 951-1 to 4. Independent Study: Audiology, Master's.

CDSS 952-1 to 4. Independent Study: Language-Learning Disabilities, Master's.

CDSS 953-1 to 4. Independent Study: Speech Science, Master's.

CDSS 960-1 to 4. Independent Study: Speech-Language Pathology, Doctoral.

CDSS 961-1 to 4. Independent Study: Audiology, Doctoral.

CDSS 962-1 to 4. Independent Study: Language-Learning Disabilities, Doctoral.

CDSS 963-1 to 4. Independent Study: Speech Science, Doctoral.

CDSS 999-0. Candidate for Degree.

COMPARATIVE LITERATURE

C.L. 421/521-3. Literary Genres.

C.L. 435/535-3. Studies in the Novel.

C.L. 436/536-3. Studies in Drama.

C.L. 437/537-3. Studies in Poetry.

C.L. 442/542-3. Medieval Literature.

C.L. 443/543-3. Renaissance Literature.

C.L. 444/544-3. Baroque Literature.

C.L. 445/545-3. Literature of the Enlightenment (English, French, German).

C.L. 446/546-3. Nineteenth- and Early 20th-Century Literature.

C.L. 447/547-3. Modern Literature.

C.L. 448/548-3. Contemporary Literature.

C.L. 461/561-3. Comparative Morphology of Literary Form.

C.L. 462/562-3. Poetry and Poetics.

C.L. 463/563-3. Theory and History of Literary Criticism.

C.L. 464/564-3. International Literary Relations.

C.L. 465/565-3. Influence and Literary Fortune.

C.L. 466/566-3. Themes, Motifs, and Characters.

C.L. 483/583-3. Literature and History.

C.L. 484/584-3. Philosophy and Literature.

C.L. 485/585-3. Literature and the Social Sciences.

C.L. 500-3. Proseminar I.

C.L. 501-3. Proseminar II.

C.L. 510-3. The Classical Tradition.

C.L. 511-3. The Medieval Tradition.

C.L. 560-3. Art of Translation.

C.L. 580-3. General Aesthetics I.

C.L. 581-3. General Aesthetics II.

C.L. 601-3. Seminar: Major Figures.

C.L. 602-3. Seminar: Period.

C.L. 603-3. Seminar: Genre.

C.L. 604-3. Seminar: A Selected Topic.

C.L. 700-4. Master's Thesis.

C.L. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

C.L. 950-1 to 3. Independent Study in Comparative Literature.

C.L. 951-1 to 3. Tutorials in Classical Letters.

C.L. 952-1 to 3. Tutorials in Medieval Studies.

C.L. 953-1 to 3. Tutorials in Renaissance Letters.

C.L. 954-1 to 3. Tutorials in 18th-Century Studies.

C.L. 955-1 to 3. Tutorials in 19th-Century Studies.

C.L. 956-1 to 3. Tutorials in Modern and Contemporary Literature.

C.L. 957-1 to 3. Tutorials in Theory and Criticism.

C.L. 958-1 to 3. Tutorials in Literature and the Arts.

C.L. 959-1 to 3. Tutorials in Literature and the History of Ideas.

C.L. 960-1 to 3. Advanced Study in Comparative Literature.

C.L. 961-1 to 3. Advanced Study in Classical Arts and Letters.

C.L. 962-1 to 3. Advanced Study in Medieval Arts and Letters.

C.L. 963-1 to 3. Advanced Study in Renaissance Arts and Letters.

C.L. 964-1 to 3. Advanced Study in 18th-Century Arts and Letters.

C.L. 965-1 to 3. Advanced Study in 19th-Century Arts and Letters.

C.L. 966-1 to 3. Advanced Study in 20th-Century Arts and Letters.

C.L. 967-1 to 3. Advanced Study in Theory and Criticism.

C.L. 968-1 to 3. Advanced Study in Language and Literature.

C.L. 969-1 to 3. Advanced Study in Ancillary Disciplines.

C.L. 999-0. Candidate for Degree.

ECONOMICS

Econ. 152-3. Economic History of the U.S. A survey of the economic aspects of U.S. history from the colonial period to the present.

Econ. 153-3. Current Economic Problems. An introduction to the major concepts of economics and how they are applied to such problems as population, poverty, and urban economic and social choices that face the American people in the light of limited resources.

Econ. 201-4. Principles of Macroeconomics. An overview of the economy by examining the flow of income and GNP, the factors determining the level of employment, income, money, credit, and prices.

Econ. 202-4. Principles of Microeconomics. The operation of the price system as a major organizer of the economy. Elementary theory, problems, and public policy of competition, monopoly, distribution of income, and international economic relations.

Econ. 232, 233, 234, 235, 236, 237. Mini-Courses in Selected Economic Topics. This is a series of mini-courses, each carrying 1 hr. credit. Specific topics to be given each semester will be announced in the course schedule.

Econ. 353-3. Natural Resource Economics. (For nonmajors). Economic analysis is integrated with life science aspects of natural resource systems to develop social policies for national use of natural resources. The economist's approach to natural resources policy analysis is studied, then applied to energy, forestry, fisheries, mineral, and water systems. Students may not receive credit in Econ. 353 and 453. Prer., Econ. 202.

Econ. 354-3. Environmental Economics. (For nonmajors). Understanding the causes of excessive environmental pollution and the tools for controlling it through economic analysis; values of preservation; and distribution of costs and benefits from environmental protection programs. Students may not receive credit in Econ. 354 and 454. Prer., Econ. 202.

Econ. 381-4. Introduction to Economic Statistics With Computer Application. Introduction to statistical methods and their applications in quantitative economic research. Prer., Math. 107, 108, or equivalent; and Econ. 201 and Econ. 202.

Econ. 401-3. Economic Education. Seminar for qualified undergraduate economics majors interested in being teaching assistants. Students must hold two 50-min. recitations per week for an introductory economics class and attend a weekly seminar with the other undergraduate TAs. (Econ. 401 - TA for Macro.) Prer., Econ. 201-202, 407-408, overall grade point average of 3.5, and consent of faculty teaching seminar and professor teaching principles. Also 3.5 grade point average in economics.

Econ. 402-3. Economic Education. Seminar for qualified undergraduate economics majors interested in being teaching assistants. Students must hold two 50-min. recitations per week for an introductory economics class and attend a weekly seminar with the other undergraduate TAs. (Econ. 402 - TA for Micro.) Prer., Econ. 201-202, 407-408, overall grade point average of 3.5, and consent of faculty teaching seminar and professional teaching principles. Also 3.5 grade point average in economics.

Econ. 407-3. Intermediate Microeconomic Theory. Production, price, and distribution theory. Study of value and distribution theories under conditions of varying market structures, with special reference to the contributions of modern economic theorists. Econ. 407 and 408 may be taken in any order. There is no recommended sequence. Prer., Math. 107, 108, or equivalent.

Econ. 408-3. Intermediate Macroeconomic Theory. National income and employment theory. Primary emphasis placed on determination of the levels of employment and prices. Within the framework of a general equilibrium macroeconomic model, theories of consumption, investment, and money are considered. The problems of unemployment and inflation are analyzed and appropriate monetary and fiscal policies considered. Econ. 407 and 408 may be taken in any order. There is no recommended sequence. Prer., Math. 107, 108, or equivalent.

Econ. 411/511-3. Monetary and Banking Systems. Survey of major monetary and financial institutions, such as commercial banks, Federal Reserve System, and savings institutions, and the structure of debt from the standpoint of how their operation affects the money supply and its circulation.

Econ. 412/512-3. Monetary Theory and Policy. Theories of inflation and deflation and their effects upon economic growth and prosperity. Goals of monetary policy, problems involved in trying to achieve these goals, survey of some recent monetary policies in action. Prer., Econ. 411/511.

Econ. 421/521-3. Public Finance. Taxation, public expenditures, debts, and fiscal policy. Role of public finance in times of peace and war. National, state and local taxation, with some special attention to the State of Colorado.

Econ. 425/525-3. Urban Economics. Analysis of the level, distribution, stability, and growth of income and employment in urban regions. The topics of urban poverty, housing, land use, transportation, and local public services are examined, with special reference to economic efficiency and social progress.

Econ. 432, 433, 434, 435, 436, 437. Mini-Courses in Selected Economic Topics. A series of mini-courses, each carrying 1 hr. credit. Specific topics to be given each semester will be announced in the course schedule.

Econ. 440-3. International Economics and Policy. Designed principally for nonmajors, this course examines national and supranational policies which affect the international economy, with attention to trade barriers, economic nationalism and regionalism, international political economy, exchange market intervention, and international transmission of economic perturbations. Prer., Econ. 201 and 202.

Econ. 441/541-3. International Trade. Theories of interregional and international trade, private and public trade, world population and resources, tariffs and commercial policy, international economic organization. Prer., Econ. 407.

Econ. 442/542-3. International Finance. Foreign exchange, theories of adjustment disequilibria in the international balance of payments, international investment, international monetary and banking organizations. Prer., Econ. 408.

Econ. 450/550-3. Comparative Economic History of Developing Areas. History of trade, commercial policies, banking and financing, throughout colonial and precolonial periods, until the present date. Special attention to the effects of colonialism and other relationships with industrialized countries on economic development. This course serves as background for other courses in area studies and economic development.

Econ. 451/551-3. Economic History of Europe. Evolution of industrial society with emphasis on its growth and development from colonial times to the present.

Econ. 452/552-3. Economic History of the United States. American economic organization and institutions and their development from colonial times to the present.

Econ. 453/553-3. Natural Resource Economics. An analysis of problems associated with socially optimal use of renewable and nonrenewable natural resources over time. Problems of common property resources, irreversible forms of development, and preservation of natural areas. Students may not receive credit for Econ. 353 and 453. Prer., Econ. 407 and Econ. 480/580 or equivalents.

Econ. 454-3. Environmental Economics. Effects of economic growth on the environment; application of economic theory of external diseconomies, cost-benefit analysis, program budgeting, and welfare economics to problems of the physical environment. Students may not receive credit for Econ. 354 and 454. Prer., Econ. 407, 480/580 or equivalents.

Econ. 456/556-3. Agricultural and Rural Economics. Analysis of the rural sector and related problems and policies; economics of agriculture, agribusiness, and rural-urban relations; role of agriculture in economic development.

Econ. 458/558-3. Comparative Agricultural Systems and Development. Organization of agriculture and policies relating to the rural economy in different countries. Examination of such topics as the world food problem, rural population trends, land reform programs, agricultural technology, and rural-urban development strategies.

Econ. 461/561-3. Labor Economics. Determination of wages, hours, and working conditions in the American economy. Includes economic effects of trade unionism and other social institutions that have been developed to promote equality of bargaining power between labor, management, and the public.

Econ. 469/569-3. Government and Business in the Economy. An analysis of the roles of business and government in the economy, in the light of the performance of a theoretical free-market system, departures of real economies from the free-market model, and the economic goals of society.

Econ. 471/571-3. Comparative Economic Systems. Critical study of socialism, capitalism, communism, utopianism, syndicalism, cooperatives, and other proposed economic systems.

Econ. 476/576-3. Economics of the Public Service Industries. Public policy issues in the regulated industries: transportation, communications, electricity, and gas.

Econ. 477/577-3. Economic Development: Theory and Problems. Theoretical and empirical analysis of problems of economic development in both underdeveloped and advanced countries.

Econ. 478/578-3. Policies of Economic Development. Current conditions and policies of national and international economic development with emphasis on accelerating and maintaining economic and social growth.

Econ. 480/580-3. Introduction to Mathematical Economics. Introduction to the use of mathematics in economics research. Prer., Math. 107 and 108; Econ. 201 and 202.

Econ. 481-3. Introduction to Econometrics. Designed to give undergraduate economics majors an introduction to econometric theory. The multiple regression model and problems encountered in its application are developed in lecture and individual applied projects. Prer., Econ. 381.

Econ. 483/583-3. Microcomputer Applications in Economics. The main objective is innovative uses of personal computer (IBM-PC) in economic analysis and model building techniques. Students will acquaint themselves with the nature and properties of economic models by trial and error through individualized, computer generated exercises. Topics include input-output analysis, linear programming, nonlinear approximation, and simulation. Prer., Econ. 480 or Math 130, and Econ. 407.

Econ. 487/587-3. Economic Development of Latin America I. Current problems of economic development in Latin America.

Econ. 489/589-3. The Economics of Africa and the Middle East. Current problems of development faced by African and Middle Eastern economies. Emphasis on case studies, regionalism, planning, and the ramifications of economic change.

Econ. 498-3. Senior Seminar: Research on Contemporary Economic Problems. Prer., Econ. 381, 407, 408, 480, or consent of instructor.

Econ. 498-3. Economics Honors Thesis. Open only to seniors in the economics honors program. For information consult the department's director of honors.

Econ. 507-3. Applied Economic Theory. Course develops competence in techniques of applied micro/macro theory for those going directly into policy and problem solving jobs. Topics include estimating demand, cost, and production functions; operational models of production, processes from industry/agriculture, capital theory with resource applications, benefit-cost analysis. Prer., Econ. 407, 408, 480, or equivalent.

Econ. 535-3. Calculus for Economists. Partial derivatives and their applications to economics; optimization, both unconstrained and constrained; matrices and determinants. Course is offered through the Economic Institute. Prer., Econ. 480 or equivalent, plus consent of director of Economics Institute.

Econ. 536-3. Econometrics. The single equation regression model with two or more variables, least squares estimators and their properties, problems in single equation regression estimation, and the simultaneous equation model. Course is offered through the Economics Institute. Prer., Econ. 381 or equivalent, plus consent of director of Economics Institute.

Econ. 537-3. Advanced Intermediate Microeconomic Theory. Production and cost theory, theory of monopoly, monopolistic competition and oligopoly, distribution theory, and general equilibrium and welfare economics. Course is offered through the Economics Institute. Prer., Econ. 407 and Econ. 535 or equivalents, plus consent of director of Economics Institute.

Econ. 538-3. Advanced Intermediate Macroeconomic Theory. A brief review of intermediate theory and advanced theory of modern inflation. Course is offered through the Economics Institute. Prer., Econ. 408 and Econ. 535 or equivalents, plus consent of the director of the Economics Institute. Econ. 535 may be taken concurrently.

Econ. 581-3. Econometric Methods and Applications. Designed to introduce first-year graduate students to basic econometric theory and applications. An attempt will be made to integrate this course with the other core courses required of economics graduate students. For example, empirical examples will be drawn from the economics literature they will be reading for other classes. Prer., Econ. 381 or equivalent.

Econ. 600-3. History of Economic Thought. Advances the student's cultural appreciation of the technical apparatus of current economic concepts. Students read in the original texts of certain great economic writers from the industrial revolution to the 1920s. Secondary sources will be used in some instances.

Econ. 601-3. Microeconomic Theory I. Recent and contemporary literature on fundamentals of economic theory. Consideration of value theory with particular emphasis on methodology, theory of demand, theory of the firm, and theory of distribution.

Econ. 602-3. Macroeconomic Theory I. Considers the theory of aggregative analysis and accompanying policy implications. A general equilibrium model is constructed and applied to the problems of unemployment, inflation, and growth. Particular emphasis is given to theories of consumption, investment, and the supply of and demand for money.

Econ. 603-3. Microeconomic Theory II. Continuation of Econ. 601.

Econ. 604-3. Macroeconomic Theory II. Continuation of Econ. 602.

Econ. 607-3. Mathematical Economics—Statics. Mathematical foundations of theories of consumption, production, and general equilibrium. Topics in linear, nonlinear programming, input-output analysis, game theory, and welfare economics. Prer., consent of instructor.

Econ. 608-3. Mathematical Economics—Dynamics. Mathematical exposition of contemporary macro- and microdynamics. Neoclassical and linear models. Topics in efficient and optimal growth, growth and fluctuations, stabilization and control policies. Prer., consent of instructor.

Econ. 610-3. Alternative Economic Paradigms. This seminar explores nontraditional economic paradigms and considers how these approaches compare with the dominant neo-classical view. Emphasis will be placed on the paradigms associated with the Austrian and Cambridge schools. Prer., Econ. 600, 601, and 602 or approval of instructor.

Econ. 611-3. Money and Central Banking. Monetary and financial institutions with focus on relationships among domestic monetary policy, international credit, and balance of payments. Prer., Econ. 511; prer. or coreq., Econ. 507 or 602.

Econ. 612-3. Advanced Monetary Theory. Major contributions to monetary and banking theory up to the present day.

Econ. 613-3. Contemporary Monetary Theory and Policy. Continuation of Econ. 612. Modern-day monetary thinking and policy.

Econ. 621-3. Seminar: Public Finance. Advanced study of theory and problems of public expenditures, revenues, budgets, and debt, including a detailed examination of the economic effects of taxation on resource allocation, production, and distribution.

Econ. 622-3. Seminar: Fiscal Policy. Continuation of Econ. 621. A critical analysis of fiscal policy with emphasis on problems of economic stability, growth, and employment. Either course may be taken independently for credit.

Econ. 625-3. Urban and Regional Economics: Theory and Methods. Course covers basic theories in spatial location of economic activity and land use and survey techniques developed to analyze, measure, and predict regional and urban structure and growth, such as economic base studies, regional social accounts, input-output analysis. Prer., Econ. 425/525 or consent of instructor.

Econ. 635-2. Mathematics for Economists: Special Topics. Development of selected topics and applications in mathematics for economists and especially linear algebra and/or differential equations. Course is offered through the Economics Institute. Prer., Econ. 480/580 or equivalent, plus consent of director of the Economics Institute.

Econ. 636-2. Statistics for Economists: Special Topics. Development of selected topics in statistics and their applications to economic research. Course is offered through the Economics Institute. Prer., Econ. 381 or equivalent, plus consent of director of Economics Institute.

Econ. 637-2. Microeconomic Theory: Special Topics. Development of selected topics in microeconomic theory and their applications to economic policy. Research paper required of all participants. Course is offered through the Economics Institute. Prer., Econ. 407 or equivalent, plus consent of director of Economics Institute.

Econ. 638-2. Macroeconomic Theory: Special Topics. Development of selected topics in macroeconomic theory and their applications to economic policy. Research paper required of all participants. Course is offered through the Economics Institute. Prer., Econ. 408/508 or equivalent, plus consent of director of Economics Institute.

Econ. 641-3. Seminar: International Trade Theory. Contemporary and classical literature on theories of international trade. Prer., 441/541.

Econ. 642-3. International Finance Seminar. Foreign exchange markets, past and current international monetary mechanisms, and the processes of adjustment. Plans for international monetary reform. International monetary and banking institutions. Prer., Econ. 441/541 and 442/542.

Econ. 653-3. Seminar: Natural Resources Economics. *Offered every third semester.* An analysis of problems associated with socially optimal use of renewable and nonrenewable natural resources over time. Problems of common property resources, irreversible forms of development, and preservation of natural areas. Prer., Econ. 407, 408, and 480/580 or consent of instructor.

Econ. 654-3. Seminar: Environmental Economics. *Offered every third semester.* Theory of externalities: alternative policies for environmental management, taxes, subsidies, standards, pollution rights; industry models, regional models; macroimpacts of environmental policies; transboundary problems; preservation/development. Prer., Econ. 480/580, 507, or 601, or consent of instructor.

Econ. 656-3. Economics of Agriculture and Agribusiness. Analysis of agricultural supply and marketing processes and their interrelations with farming enterprises in industrial and developing economies; the management of farm and farm-related enterprises; commodity markets; government and agriculture.

Econ. 658-3. World Agriculture. World food and raw material needs and production capabilities; comparative agricultural systems and policies in relation to economic development; international trade in primary products.

Econ. 667-3. Seminar: Labor Market Policies. *Offered every third semester.* Economic analysis of wage determination and labor market operation. Detailed study of the supply and demand for labor under competitive and noncompetitive conditions; concentration on level and structure of wage rates, bargaining theory, discrimination, unions, labor mobility and migration, unemployment, and inflation.

Econ. 671-3. Topics in Urban and Regional Economics. Investigates various theoretical topics in urban and regional economics and focuses on policy issues. Course format will involve student research and presentations throughout the terms. Prer., Econ. 625.

Econ. 675-3. Seminar: Industrial Organization and Control. *Offered every third semester.* The large firm in relation to its rivals, suppliers, and customers (theory and industry studies); social control of business through antitrust and other government regulation.

Econ. 677-3. Economic Planning and Development. Deals with role of planning in economic development with particular reference to investigation of planning problems in Southeast Asia and the Middle East.

Econ. 678-3. Economic Development: Problems. Seminar in theory and practice of economic development. Topics include international poverty and inequality, dualistic development, employment mobilizing and allocating resources, human-resource development, sectoral development, planning and policymaking. Prer., Econ. 407, 408; prer. or coreq., Econ. 478-578.

Econ. 679-3. The Economics of Energy and Development. A general survey seminar which covers the economics dominating the field of energy, investigating alternative sources with the economic ramifications of each, and the economics of the logistical and ecological problems involved, related to the role of energy in economic growth of both developed and developing countries and the issues of scarcity, conservation, and imports.

Econ. 681-3. Intermediate Econometrics. Application of statistical inference to economic research. Principal topics are probability theory, statistical inference, and regression analysis. Prer., Econ. 481/581 or equivalent.

Econ. 683-3. Seminar: Econometrics. Theory, construction, and testing of generalized, linear, single-equation, and simultaneous equations models.

Econ. 684-3. Seminar: Mathematical Economics and Econometrics. Advanced topics in econometrics and mathematical economics.

Econ. 691-3. Seminar: Water Resources Development and Management. *Offered every other year.* An examination of the economic principles governing water planning and development. Application of benefit-cost analysis and optimization techniques of design of water systems. Relationship to national planning and growth. Prer., Econ. 407 and facility in calculus and linear algebra.

Econ. 700-1-4. Master's Thesis.

Econ. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Econ. 910-variable credit. Independent Study. Consent of instructor and department required.

Econ. 920-variable credit. Independent Study. Consent of instructor and department required.

Econ. 930-variable credit. Independent Study. Consent of instructor and department required.

Econ. 940-variable credit. Independent Study. Consent of instructor and department required.

Econ. 950-variable credit. Independent Study. Consent of instructor and department required.

Econ. 960-variable credit. Independent Study. Consent of instructor and department required.

ENGLISH

For freshman-level composition courses, see Arts and Sciences, College Expository Writing Program (CEWP).

Engl. 119-3. Introduction to Creative Writing. The student will be introduced to the techniques of fiction and poetry. Student work will be scrutinized by the instructor and discussed in a workshop atmosphere by other students.

Engl. 120-3. Introduction to Fiction. Reading and analysis of short stories and novels.

Engl. 126-3. Introduction to Women's Literature. (WM ST 126) This course will serve as an introduction to the study of literature by women in England and America. Both poetry and fiction will be read, and varying historical periods will be covered. The course is designed to acquaint the student with the contribution of women writers to the English literary tradition and to investigate the nature of this contribution.

Engl. 130-3. Introduction to Drama. Reading and analysis of plays.

Engl. 140-3. Introduction to Poetry. Reading and analysis of poetry.

Engl. 150-3. Introduction to British Writers. Introduces students to a range of major works of British literature, including at least one play of Shakespeare, a pre-20th-century English novel, and works by Chaucer and/or Milton. Closed to those having credit in Engl. 252.

Engl. 160-3. Introduction to American Writers. Introduces students to a range of representative major works of American literature, with emphasis on works written before the 20th century. Closed to those having credit in Engl. 266.

Engl. 190-3. Introduction to Shakespeare. Introduces students to Shakespeare's major works—the histories, comedies, and tragedies—and may include the nondramatic poetry as well.

Engl. 200-3. Writing About Literature. Practical criticism of novels, poems, and plays, with emphasis on written work. Introduction to and practice in using various critical approaches to works of literature.

Engl. 202-3. Introductory Poetry Workshop. An introductory course in poetry writing. Prer., permission of the instructor after submitting a manuscript (five-seven poems). May be taken up to three times for credit.

Engl. 205-3. Introductory Fiction Workshop. An introductory course in fiction writing. Prer., permission of the instructor after submitting a manuscript (one short story). May be taken up to three times for credit.

Engl. 220-3. Modern Short Story. Close reading of selected short stories.

Engl. 221-3. Science Fiction. Readings in classical and popular science fiction.

Engl. 225-3. Introduction to Film Narrative. A survey of the various types of film narrative, focusing on American and international classics of the sound era.

Engl. 226-3. Images of Women in Literature. (WM ST 226) A survey of images of women in English literature from the Middle Ages to the present.

Engl. 253-3. Modern and Contemporary Literature. Close study of significant 20th-century poetry, drama, and prose works. The readings will range from the 1920s to the present.

Engl. 260-3. Introduction to World Literature I. Close study of literary classics of Western civilization: the *Odyssey* or *Iliad,* Greek drama, and several books of the Bible. Not open to students who have credit in Hum. 101, 102.

Engl. 261-3. Introduction to World Literature II. Close study of literary classics of Western civilization: major Roman and medieval texts. Not open to students who have credit in Hum. 101, 102.

Engl. 270-3. Introduction to African Literature. Survey of African literature from its beginnings to the present; the oral tradition, the pioneer writers, market literature, the Negritude movement, and some major contemporary writers like Achebe, Laye, Ngugi, and Soyinka.

Engl. 272-3. Survey of Afro-American Literature I. Chronological study of Afro-American literature from the 17th century to the Harlem Renaissance.

Engl. 273-3. Survey of Afro-American Literature II. Chronological study of Afro-American literature from the depression writers to the present.

Engl. 281 to 289-3. Studies in Language. Intensive study of special topics in the English language, especially designed for freshmen and sophomores.

Engl. 290 to 298-3. Studies in Literature. A study of a special literary topic or major author, especially designed for freshmen and sophomores.

Engl. 302-3. Intermediate Poetry Workshop. An intermediate course in poetry writing. Consent of instructor based on submission of manuscript (five-seven poems). May be taken up to three times for credit.

Engl. 305-3. Intermediate Fiction Workshop. An intermediate course in fiction writing. Consent of instructor based on submission of manuscript (one short story). May be taken up to three times for credit.

Engl. 315-3. Report Writing. Instruction and practice in various forms of reports, papers, and articles. Style and editing are emphasized.

Engl. 322-3. Folklore I. Emphasizes formal study of folk traditions—including tales, songs, games, customs, beliefs, and crafts—within a theoretical framework, using examples from several cultures. Prer., junior standing.

Engl. 326-3. Women Writers. (Wm. St. 326) An introduction to literature by British and American women.

Engl. 330-3. Backgrounds of English and American Literature. The literary, philosophic, and religious traditions of the Greco-Roman and Judeo-Christian worlds: close analysis of major texts in translation. Comparison of ancient and modern texts will be made where feasible.

Engl. 347-3. History of Literary Theory and Criticism I. With a preliminary look at the relevant texts of Plato, Aristotle, and Longinus, this course will concentrate on medieval, Renaissance, and 18th-century poetics.

Engl. 348-3. History of Literary Theory and Criticism II. A survey of Romantic and Victorian theories of literature and criticism, concluding with an introduction to 20th-century approaches.

Engl. 350-3. Survey of British Literature. Chronological study of the greater figures and forces in English literature from *Beowulf* to 1660.

Engl. 351-3. Survey of British Literature. Continuation of Engl. 350.

Engl. 360-3. The Bible as Literature. Survey of the literary achievements of the Judeo-Christian tradition as represented by the Bible.

Engl. 365-3. Survey of American Literature I. Chronological survey of the literature from Bradford to Whitman.

Engl. 366-3. Survey of American Literature II. Chronological survey of the literature from Whitman to Faulkner. Continuation of Engl. 365.

Engl. 368-3. Twentieth-Century American Literature. Reading course in American novelists, poets, and dramatists of the 20th century. Primarily for nonmajors.

Engl. 380-3. Computer Applications in Language and Literature. Surveys the major successful applications of computer technology to the analysis of literary texts. Actual analysis of selected texts, in the context of a consideration of the most appropriate theories of language and literature and the proper structuring of literary data bases, will be the major component of the course. Prer., junior standing.

Engl. 381 to 384-3. Studies in Language. Intensive study of special topics in the English language, especially designed for juniors and seniors.

Engl. 385, 386, 387-3. New Directions in English Studies. New directions courses are concerned with development in the study of literature which have significantly influenced our conception of the theoretical bases for study and expanded our understanding of appropriate subject matter. Such courses may include, but are not limited to, topics in women's literature and feminist criticism, marxist criticism, the various schools of psychological criticism, structuralism, semiotics, deconstruction, ethnopoetics, film studies, and applications of linguistic theories to literary criticism. Prer., junior standing.

Engl. 390 to 393-3. Studies in Literature. A study of a special literary topic or major author, especially designed for juniors and seniors.

Engl. 394-3. Chaucer: Troilus and the Early Poems. A close reading of Chaucer's work before The *Canterbury Tales,* with special emphasis on *Troilus and Criseyde* and its sources.

Engl. 395-3. Chaucer: The Canterbury Tales. A short introduction to Middle English will precede study of the poetry.

Engl. 397-3. Shakespeare. Shakespeare's works up to 1600.

Engl. 398-3. Shakespeare. Shakespeare's works after 1600.

Engl. 399-3. Milton. Milton's poetry and selected prose.

Engl. 400-3. Literature and Psychology. Critical application of basic concepts of psychology to world literature.

Engl. 402-3. Advanced Poetry Workshop. An advanced course in poetry writing. Consent of instructor based on submission of manuscript (five-seven poems). May be taken up to three times for credit.

Engl. 405-3. Advanced Fiction Workshop. An advanced course in fiction writing. Consent of instructor based on submission of manuscript (one short story). May be taken up to three times for credit.

Engl. 408-3. Playwriting: Short Form.

Engl. 409-3. Playwriting: Long Form.

Engl. 419-3. Advanced Shakespeare. For advanced students only. Close readings of works spanning Shakespeare's career.

Engl. 420-3. Development of the English Novel I. From the beginnings to 1830.

Engl. 421-3. Development of the English Novel II. Continuation of Engl. 420.

Engl. 422-3. Modern British and Irish Novel. A study of major figures and trends in the 20th century.

Engl. 423-3. American Novel I. From the beginnings to 1900.

Engl. 424-3. American Novel II. From 1900 to the present.

Engl. 425-3. Modern Novel. A close study of masterpieces by such novelists as Proust, Joyce, Woolf, Lawrence, Mann, Kafka, and Faulkner.

Engl. 426-3. Contemporary Novel. A study of the major novelists and developments in the genre, with emphasis on novels written since 1945.

Engl. 427-3. Topics in Women's Literature. (Wm.St. 427) An advanced course which focuses on areas of research interest in the study of women's literature, such as selected themes or critical issues. Students will be expected to contribute original research to the topic under consideration. Prer., Engl. 126 or 226 or 326.

Engl. 428-3. Folklore II. Upper level studies of folk groups, events, texts, and contexts as they reflect traditional"knowing"—folk perceptions and teachings about the structure and purpose of the universe. Prer., Engl. 322 or equivalent preparation.

Engl. 430-3. Development of British Drama I. From beginning to the closing of the theatres in 1642.

Engl. 431-3. Development of British Drama II. From 1660 to the present.

Engl. 432-3. Elizabethan and Jacobean Drama. Representative non-Shakespearean plays of the period.

Engl. 434-3. Modern British and Irish Drama. A survey of the English-Irish theatre since 1900.

Engl. 435-3. American Drama. Famous American plays from O'Neill to the present.

Engl. 436-3. Modern Drama. Continental, British, and American drama since Ibsen.

Engl. 445-3. Modern American Poetry. A study of major figures and trends in 20th-century American poetry up to 1945.

Engl. 446-3. Modern Poetry. A selection of the works of British and American poets from 1900 to the present.

Engl. 449-3. Problems in Literary Theory and History. This course investigates a particular topic in depth. Topic varies.

Engl. 450-3. Medieval Literature I. An intensive study of the major literary works of the Middle Ages on the continent.

Engl. 451-3. Medieval Literature II. An intensive study of the major literary works of the Middle Ages in Britain.

Engl. 452-3. The Renaissance in England: 1500-1600. Selected prose and nondramatic poetry from Skelton and More through Shakespeare and his contemporaries.

Engl. 453-3. The Renaissance in England: 1600-1700. Selected prose and poetry by Donne, Jonson, Bacon, and their successors.

Engl. 454-3. The Age of Satire: 1660-1740. Dryden, Defoe, Swift, Pope, Addison, and Steele and their contemporaries.

Engl. 455-3. The Age of Sense and Sensibility: 1740-1800. Gray, Johnson, Goldsmith, Boswell, Cowper, Burns, Blake, and their contemporaries.

Engl. 456-3. The Early Romantics. Major emphasis on Blake, Coleridge, and Wordsworth.

Engl. 457-3. The Later Romantics. Major emphasis on Keats, Shelley, and Byron.

Engl. 458-3. Prose of the English Romantic Period.

Engl. 460-3. The Early Victorians. Main currents of Victorian thought in prose and poetry, 1830-1860.

Engl. 461-3. The Later Victorians. Continuation of Engl. 460. 1860-1900.

Engl. 465-3. Studies in American Literature to 1900. An extensive study of particular periods and movements in American literature.

Engl. 466-3. Studies in American Literature after 1900. An extensive study of particular periods and movements in American literature.

Engl. 470/570-3. Anglo-Saxon. An introduction to Anglo-Saxon (Old English) language and literature. Emphasis is placed on rapidly acquiring a reading knowledge of the language. Prose readings are followed by highlights of the shorter poetry (*Wanderer, Seafarer, Battle of Maldon,* etc.). Prer., junior standing.

Engl. 471/571-3. Beowulf. Students will read and analyze *Beowulf* in the original language, with some attention to additional background readings. Prer., Engl. 470 or equivalent.

Engl. 472-3. Contemporary Afro-American Literature I. An advanced in-depth study of the works of prominent Afro-American novelists and poets.

Engl. 473-3. Contemporary Afro-American Literature II. An advanced in-depth study of the works of prominent Afro-American novelists and poets.

Engl. 474-3. The African Novel. In addition to a detailed study of works by distinguished African novelists, examines such areas as the indigenous and foreign antecedents of African fiction and possibilities of the novel as a reflector of changing moods and attitudes.

Engl. 479/579-3. Law and Literature. (Hum. 482.) Explores the relations between law and literature by studying key works of literature in context i.e., Antigone, Shakespeare's *Measure for Measure,* Racine's *Les Plaideurs,* Dickens' *Bleak House,* Kafka's *The Trial* together with selected readings from law reports, cases, and the like.

Engl. 480-3. Advanced Composition for Secondary School Teachers of English.

Engl. 481-3. Literature for Adolescents.

Engl. 482-3. Methods and Materials in English.

Engl. 484-3. English Grammar and the History of the English Language. An introduction to the grammar and history of the English language.

Engl. 485-3. History of the English Language. Outline of history of the language, including a brief survey of sound changes affecting modern English, of history of grammatical forms, and of the vocabulary. Elementary knowledge of English grammar will be assumed. Not open to students who have taken Engl. 484.

Engl. 489-3. Semantics. Study of meaning in English from both contemporary and historical view.

Engl. 490 to 494-3. Seminar: Topics in English. Study of such topics as satire, comedy, tragedy, American humor, the Mexican-American in American literature; especially designed for senior English majors.

Engl. 495 to 498-3. Seminar: Major Authors. Intensive study of the works of one major British or American author.; especially designed for senior English majors.

Engl. 499-3. Honors Thesis.

Engl. 500-509-3. Studies in Major Authors. Individual British and American authors. (Author for a given semester to be specified in the *Schedule of Courses.*)

Engl. 510-519-3. Studies in Special Topics. Special topics in British and American language and literature.

Engl. 520-3. Studies in the Novel. In-depth analyses of novels that are significant in mainstream traditions or that display major departures.

Engl. 521-2 to 6. Poetry Workshop. Designed to give students practical criticism of their poetry and to develop a sense of critical standards. Admission by submission of manuscript and/or consent of instructor.

Engl. 522-2 to 6. Poetry Workshop. Continuation of Engl. 521.

Engl. 523-2 to 6. Fiction Workshop. Designed to give students practical criticism of their fiction and to develop a sense of critical standards. Admission by submission of manuscript and/or consent of instructor.

Engl. 524-2 to 6. Fiction Workshop. Continuation of Engl. 523.

Engl. 525-3. Nonfiction Workshop. Class meetings will be spent in discussion and practical criticism of student work and in discussion of relevant works of nonfiction. Admission is by submission of a manuscript and consent of the instructor.

Engl. 527-3. Recent Poetry. Covers poetry, mainly American, written since World War II.

Engl. 529-3. Recent Fiction. Covers fiction, mainly American, written since World War II.

Engl. 532-3. Studies in Drama. Major dramatic writers.

Engl. 537-3. Dramatic Structure: Comedy. Representative comedy from Aristophanes to the present. Structure and principles of comedy.

Engl. 538-3. Dramatic Structure: Tragedy. Representative tragedy from Classical Greece to the present. Structure and principles of tragedy.

Engl. 550-3. Medieval Literature. Selections representative of the life and thought of the Middle Ages up to 1500.

Engl. 552-3. Renaissance and 17th-Century Literature.

Engl. 554-3. Restoration and 18th-Century Literature. Explores the poetry, novel, and nonfiction prose of the period, with rotating emphases on genres and topics.

Engl. 555-3. Studies in the 19th Century. Covers principal movements and development.

Engl. 560-3. Studies in British and Irish Literature of the Early 20th Century. An intensive study of a few representative authors.

Engl. 565-3. Readings in American Literature. Extensive reading in the history of American literature as the basis for a graduate major or minor in the field.

Engl. 566-3. Twentieth-Century American Literature.

Engl. 570/470-3. Anglo-Saxon.

Engl. 571/471-3. Beowulf: Advanced Anglo-Saxon.

Engl. 573-3. Chaucer.

Engl. 579/479-3. Law and Literature. Explores the relations between law and literature by studying key works of literature in context—*Antigone,* Shakespeare's *Measure for Measure,* Racine's *Les Plaideurs* (in translation), Dickens' *Bleak House,* Kafka's *The Trial,* and others, together with selected readings from law reports, cases, and the like.

Engl. 583-3. Rhetoric and the Teaching of Composition. Analysis of rhetorical theory with emphasis on practical applications in the classroom. Pedagogical alternatives and evaluation of teaching.

Engl. 591-3. Computer Applications in the Humanities. Use of the computer as a tool in research and instruction: style and content analysis, authorship and influence studies, text collation and edition; creativity; analysis of nontextual data; bibliographies and information banks. Programming not required.

Engl. 594-3. Poetics. An advanced poetics course primarily (though not exclusively) for creative writing students. Instruction in the use of a variety of forms from different eras and traditions in fiction and poetry.

Engl. 597-3 to 6. Directed Reading. Intensive individual instruction for graduate students.

Engl. 600 to 609-3. Studies in Major Authors. Intensive study of works of one major British or American author. (Author for a given semester to be specified in the *Schedule of Courses.*)

Engl. 610 to 619-3. Special Topics. Intensive study of specialized topics in English and American literature. (Topic to be specified in the *Schedule of Courses.*)

Engl. 647-3. Problems in Literary Criticism.

Engl. 648-3. Problems in Literary Theory.

Engl. 682-3. Middle English. Reading of literary selections from Middle English with much detail of English words and sound to account for present usages.

Engl. 700-3 to 6. Master's Thesis.

Engl. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Engl. 910-variable credit. Independent Study, Lower Division.

Engl. 940-variable credit. Independent Study, Upper Division.

Engl. 950-variable credit. Independent Study. Graduate Level I. Independent investigation of topics of specific interest to individual students. Students wishing to enroll in Independent Study must petition the director of graduate studies prior to the beginning of the semester.

Engl. 951-variable credit. Tutorials in Medieval Studies.

Engl. 952-variable credit. Tutorials in Renaissance Studies.

Engl. 953-variable credit. Tutorials in 18th-Century Studies.

Engl. 954-variable credit. Tutorials in 19th-Century Studies.

Engl. 955-variable credit. Tutorials in American Studies.

Engl. 956-variable credit. Tutorials in Modern and Contemporary Literature.

Engl. 957-variable credit. Tutorials in Literary Theory.

Engl. 958-variable credit. Tutorials in Language and Rhetoric.

Engl. 959-variable credit. Tutorials in Creative Writing.

Engl. 960-variable credit. Independent Study, Graduate Level II. See Engl. 950.

Engl. 961-variable credit. Advanced Medieval Studies.

Engl. 962-variable credit. Advanced Renaissance Studies.

Engl. 963-variable credit. Advanced 18th-Century Studies.

Engl. 964-variable credit. Advanced 19th-Century Studies.

Engl. 965-variable credit. Advanced 20th-Century Studies.

Engl. 966-variable credit. Advanced American Studies.

Engl. 967-variable credit. Advanced Critical Theory.

Engl. 968-variable credit. Advanced Study in Language and Rhetoric.

FILM STUDIES

F.S. 300-3. Beginning Filmmaking. Offered to instruct students in making Super-8 films. Instruction covers use of cameras and editing equipment, basic editing and splicing techniques, and analysis of pertinent films. The emphasis may be on making personal experimental films or on making narrative sound films, according to the instructor. There is no lab fee for filmmaking courses, but students are expected to purchase materials and rent the necessary equipment. The Film Studies Program maintains an equipment pool with modest registration and rental fees for students needing equipment.

Hum./F.S. 305-4. Film History I. An intensive introduction to film history and theory, from 1895 to 1935. Topics to be covered include the beginnings of still and motion picture photography, the growth of narrative and structural complexity from Lumiere to Gance, the influence of Griffith, American silent comedy, Soviet theories of montage, German expressionist and street films, an overview of experimental and animated films, the transition to sound, and the beginning of film theory. Lectures, discussions, and research papers supplement complete screenings of such films as *The Birth of a Nation, The Gold Rush, Greed, Bonaparte and the Revolution, Un Chien Andalou, The Man With a Movie Camera, Vampyr,* and *The Road to Glory.*

Hum./F.S. 306-4. Film History II. Starts with the late 1930s and early 1940s films of Renoir and Welles and follows the historical growth and the evolution of film aesthetics to the present. Italian Neo-realist, French New Wave, and recent experimental films are studied, as well as the films of major auteur figures such as Bergman, Kurosawa, Fellini, Hitchcock, Bunuel, Antonioni, and Coppola. Prer., Film Narrative or consent of instructor.

F.S. 307-3. Major Film Movements. Usually the course will be a historical-aesthetic survey dealing with the various national cinemas, to be taught in conjunction with the appropriate language department. Typical offerings are The French Film, The German Film, The Russian Film, and so on. Occasionally the course may offer a more detailed approach to a more restricted subject, i.e., French New Wave, German Expressionist Cinema, Italian Neo-realism. Course may be repeated for credit with department consent.[1]

F.S. 308-3. Major Film Directors. Focuses on the work of a single director or a group of related directors. Course content will vary from semester to semester. Consult the *Schedule of Courses* for specific topics. Course may be repeated for credit with department consent.[1]

F.S. 310-3. Documentary Film. A historical survey of the genre, from the silent film era to contemporary examples. May include autobiographical diary and propaganda films.

F.S. 340-3. Advanced Super 8 Filmmaking. Instruction in shooting and editing Super 8 sound, as well as lab techniques. Students will be required to make completed films, i.e., projects that involve a semester of preparation, shooting, reshooting, editing, and final prints. Prer., F.S. 300 or consent of instructor.

F.S. 350-3. Intermediate Filmmaking, 16mm. A film production class in 16mm (with emphasis on personal experimental films) and in film studies (with a documentary and/or narrative orientation). The class will cover the following: 16mm camera operation, splicing, editing, sound transfer and recording, and dealing with the lab. Each student will be expected to make a film by the end of the semester. Students should expect to spend a few hundred dollars on equipment rental, film stock, and lab costs. Course may be repeated for credit with department consent.[1] Prer. F.S. 300 or consent of instructor.

F.S. 355-3. Film Topics. Varying topics on important individuals, historical developments, groupings of films, film directors, national cinemas, critical and theoretical issues in film. May be repeated for credit as topics change.

F.S. 450-3. Advanced Filmmaking. Advanced training in 16mm camera operation, splicing, editing, sound transfer and recording and conforming. Students will be required to edit on the Steenbeck flatbed and produce a film that contains synch sound shot in double system. Course may be repeated for credit with department consent.[1] Prer., F.S. 350 or consent of instructor.

F.S. 460-3. Colloquium in Film Aesthetics. A seminar for the serious round table discussion and critique of film as a possible art form, with emphasis upon the development of an appropriate verbal and written language for description of film.

F.S. 940-1 to 3. Independent Study

See also:

Engl. 225-3. Introduction to Film Narrative. Hist. 270-3. Japanese History Through Film.

Hum. 401-3. Film Topics: Film and Fiction.

Hum. 402-3. Film Theory.

FINE ARTS

Studio

DRAWING

F.A. 100-2. Basic Drawing. Orientation course including pictorial design, life drawing, still life, and landscape, using varied drawing techniques and media. May not be repeated.

F.A. 101-3. Basic Drawing. Required for B.F.A. majors; recommended for other F.A. majors instead of F.A. 100. May not be repeated.

[1]Courses which may be repeated may be used for partial fulfillment of a college requirement only once.

F.A. 200-3 Drawing. Problems in drawing. Exploration of possibilities in pictoral design, the human figure and composition. Prer., F.A. 100, or 101, plus one more 100-level fine arts course. May be repeated once.

F.A. 300-3. Drawing and Anatomy. Emphasis is placed on the human figure as a vehicle for creative drawing. Course involves lecture, studio work, and outside preparation. Prer., 6 hrs. F.A. 200. May be repeated once.

F.A. 400-3. Advanced Drawing. A creative approach to advanced problems in drawing. Prer., 6 hrs. F.A. 200. May be repeated.

F.A. 500-3. Graduate Drawing.

PHOTOGRAPHY

F.A. 216-3. Beginning Photography I. An introduction to techniques and concepts of photography as art. Emphasis is on photography as a means to formal and expressive ends. Students must have an adjustable camera. Prer., soph. standing. May not be repeated.

F.A. 217-3. Beginning Photography II. Exploration of possibility of relating more sophisticated technical and conceptual possibilities to the creative process, including zone system testing and introduction to nonstandard photographic procedures, processes, and equipment. Prer., F.A. 216. May not be repeated.

F.A. 313-3. Beginning Filmmaking. Investigation of the techniques and aesthetics involved in making 8mm, super 8mm, and 16mm motion pictures. May be repeated.

F.A. 319-3. Intermediate Photography. Continued exploration of the possibility of individual photographic expression. Students will be encouraged to discover and develop a personal position in relation to the medium. Prer. F.A. 216, 217, or equivalent. May be repeated once.

F.A. 417-3. Advanced Photography. Exploration of advanced techniques and concepts of photography as art. Emphasis on photography as a means to formal and expressive ends. Prer., F.A. 216, 217, two semester of 319, or equivalent. May be repeated.

F.A. 418-3. New Directions in Photography. An investigation of the use of the photographic image in new, antique, or nonstandard ways, including non-silver, photo-sculpture, various color processes, photo-language, photo installations, electronic media, performance, film-making, electrostatic art (copy machine), photo books, photo collage, audio/visual art, etc. Prer., F.A. 216 and 217, or equivalent. May be repeated. *Note:* course content changes each semester.

F.A. 419-3. Advanced Photography. (See F.A. 417.)

F.A. 517-3. Graduate Photography.

F.A. 518-3. Graduate New Directions in Photography.

F.A. 519-3. Graduate Photography.

PAINTING

F.A. 120-2. Basic Painting. General introduction to painting. Problems of color and pictorial space, still life, landscape, figure, and abstract painting. May not be repeated.

F.A. 121-3. Basic Painting. Required for B.F.A. majors; recommended for other F.A. majors instead of F.A. 120. May not be repeated.

F.A. 220-3 Painting. Emphasis is on aesthetic problems concerning composition, color, and use of materials in expressing the student's ideas. Prer., F.A. 120 plus one other 100-level F.A. course.

F.A. 221-3. Color. A basic introduction to the relative effects of color as used by the artist. Emphasis is on the practice of color relations including basic characteristics, mixtures, illusions, optical mixture, color intervals and color quantity. May not be repeated.

F.A. 223-3. Life Painting. Course covering oil painting from the model, landscape, and still life, concentrating on direct observation. Class must share expenses for models, materials, and transportation. Prer., F.A. 120, or 121, and 6 hours F.A. 220, and 6 hours 320.

F.A. 320-3. Intermediate Painting. Continuation of F.A. 220. Prer., F.A. 220, 6 hrs. credit. May be repeated once.

F.A. 322-3. Aspects of Painting. A lecture course providing insights into the art of painting. Contemporary painting, as well as that of the past, is examined and discussed in depth.

F.A. 420-3. Advanced Painting. Expressive pictorial problems involving varied subject matter and painting media with an emphasis on individual development. Prer., F.A. 220, 6 hrs. credit, and 320, 6 hrs. credit. May be repeated.

F.A. 520-3. Graduate Painting.

WATERMEDIA PAINTING

F.A. 330-3. Watermedia Painting I. Introduction to transparent and opaque water color media emphasizing problems of motivation, creative expression, and techniques involving varied subject matter. Prer F.A. 100 or 101, and 120, or 121, F.A. 221 is recommended. May not be repeated.

F.A. 331-3. Watermedia Painting II. Transparent and opaque water media experience emphasizing problems of motivation, expression and techniques involving varied subject matter. Prer., F.A. 330 or equivalent. F.A. 221 is recommended. May not be repeated.

F.A. 430-3. Advanced Watermedia Painting. Advanced painting problems using transparent and opaque water color media, with an emphasis on individual development. Prer., F.A. 330 and 331, or equivalent. May be repeated.

F.A. 530-3. Graduate Watermedia Painting.

PRINTMAKING

F.A. 240-3. Beginning Intaglio and Relief. Introduction to intaglio and relief printing and printing media. Prer., F.A. 100, or 101, and 200. May not be repeated.

F.A. 241-3. Beginning Lithography. An introduction to the techniques, including metal plate lithography. Prer., F.A. 100, or 101, and 200. May not be repeated.

F.A. 242-3. Beginning Screen Printing. Exploration in silkscreen techniques. Emphasis on creativity and experimentation with contemporary screen printing processes. Prer., F.A. 100, or 101, plus one more 100-level course. May not be repeated.

F.A. 244-3. Beginning Papermaking. Papermaking is the study of plant fibers and cellulose structure relating to the making of paper pulp as an art medium. Emphasis will be placed on the creative use of the paper pulp as related to two- and three-dimensional form. Prer., F.A. 100, or 101, and 200. May not be repeated.

F.A. 340-3. Intermediate Intaglio and Relief. Continued study and experimentation in intaglio and relief processes in both black and white, color, and possible photo imagery. Prer., one other printmaking course. May be repeated once.

F.A. 341-3. Intermediate Lithography. A continuation of stone and metal plate lithography with an emphasis on individual creative development and further development in color printing processes. Prer., one other printmaking course. May be repeated once.

F.A. 342-3. Intermediate Screen Printing. Refinement of basic techniques with the emphasis on individual development. Prer., one other printmaking course. May be repeated once.

F.A. 344-3. Intermediate Papermaking. Continuation of F.A. 244, with more emphasis on individual creative growth and improvement of one's technical ability. Prer., F.A. 244. May be repeated once.

F.A. 440-3. Advanced Intaglio and Relief. Prer., F.A. 340. May be repeated.

F.A. 441-3. Advanced Lithography. Prer., F.A. 341. May be repeated.

F.A. 442-3. Advanced Screen Printing. Introduction to advanced screen printing technology, with emphasis on individual creativity and the ability to resolve problems of two-dimensional form. Prer., F.A. 342. May be repeated.

F.A. 444-3. Advanced Papermaking. Continuation of F.A. 344, but with more emphasis on individual creative growth and additional improvement of one's technical ability. Prer., F.A. 344. May be repeated.

F.A. 540-3. Graduate Intaglio and Relief.

F.A. 541-3. Graduate Lithography.

F.A. 542-3. Graduate Screen Printing.

F.A. 544-3. Graduate Papermaking.

SCULPTURE

F.A. 150-2. Basic Sculpture. Orientation course involving three-dimensional form and application. Expressive problems based on nonobjective form relationships in various sculptural materials. May not be repeated.

F.A. 151-3. Basic Sculpture. Required for B.F.A. majors; recommended for other F.A. majors instead of F.A. 150. May not be repeated.

F.A. 250-3. Materials and Techniques. The exploration of a variety of materials, methods, and techniques and their application with reference to contemporary sculpture, i.e., moldmaking, welding, casting, vacuforming, photo techniques, woodworking, etc. Prer., F.A. 150 or 151. May not be repeated.

F.A. 251-3. Welding and Metal Casting. Technical and aesthetic studies in welding and casting metal as an expressive idea. Prer., F.A. 150, 151, and 152. May not be repeated.

F.A. 350-3. Experiments in Sculpture I. A further exploration of materials, methods, and techniques done through a series of assignments with an emphasis on individual ideas and their relationship to contemporary aesthetics. Prer., F.A. 250 and 251. May not be repeated.

F.A. 351-3. Experiments in Sculpture II. A further exploration of individual concepts and ideas and their relationship to contemporary issues and aesthetics. This will be accomplished through a series of assignments to be worked out with the instructor based on individual interest. Prer., F.A. 350. May not be repeated.

F.A. 450-3. Advanced Sculpture. Individual studies in selected media. Prer., 6 hours of F.A. 350 or 350 and 351. May be repeated.

F.A. 550-3. Graduate Sculpture.

F.A. 551-3. Graduate Sculpture.

Art Education

Art education majors desiring teaching certification are required to take F.A. 364, 366, 367, 368, and 399, and must consult art education advisors concerning the remainder of the program. Only F.A. 369 may be repeated for credit.

F.A. 363-3. Art for the Elementary Teacher. For majors in elementary education, with emphasis on art in the elementary school.

F.A. 364-2. Art in Elementary Schools. For students wishing to receive certification for teaching art in public elementary schools. Deals with the theoretical and practical problems of teaching art in the elementary school.

F.A. 366-2. Art Materials Workshop. Introduction to and exploration of materials available for use by the art educator in both two- and three-dimensional materials used with various age level groups.

F.A. 367-2. Art Materials Workshop: Weaving. Introduction to and exploration of fiber processes suitable for use in the public school.

F.A. 368-2. Art in the Secondary School. For students wishing to receive certification for teaching art in the public secondary schools. Deals with the theoretical and practical problems of teaching art in the secondary school.

F.A. 369-1. Practicum in Art Teaching. Supervised teaching or observation of children and young people stressing the development of effective planning and presentation of art concepts and materials. Coreq., F.A. 364 and 368.

F.A. 468/568-3. Issues in Art Education. Provides students with a wide base for understanding art education purposes, trends, policies, and art education's potential as a viable discipline. Focuses on categories of general interest in art education.

F.A. 564-variable credit (1 to 3). Seminar in Art Education. Subjects and instructors will vary.

Jewelry

F.A. 377-3. Jewelry Design. Creation of jewelry with metals and non-metals. Emphasis on individual design decisions. May not be repeated.

F.A. 477-3. Advanced Jewelry Design. For description see F.A. 377. Prer., F.A. 377. May be repeated.

F.A. 577-3. Graduate Jewelry Design.

Ceramics

F.A. 287-3. First-Year Handbuilding. An introductory course concentrating on the techniques of hand-built clay forms as they relate to function and nonfunction. Various clay techniques, glazing, and firing procedures will be explored. Emphasis will be on ceramics in a fine arts context. Prer., two basic studio courses. May not be repeated.

F.A. 289-3. First-Year Wheelthrowing. An introductory course concentrating on techniques of wheel-thrown forms as they relate to function and nonfunction. Exploration of various glazing and firing methods. Prer., F.A. 287. May not be repeated.

F.A. 387-3. Intermediate Ceramics. Deals with further exploration of techniques approached in F.A. 287 and 289. Students are encouraged to develop personal concentration in relation to medium. Prer., F.A. 287 and 289. May be repeated once. (Formerly F.A. 390.)

F.A. 488-3. Advanced Ceramics. Lecture, research, and experimentation in clay (wheel and hand construction techniques). Prer., F.A. 390, 6 hrs. credit. May be repeated.

F.A. 489-3. Ceramics Seminar. Designed for students majoring in ceramics. Prer., F.A. 488, and instructor consent. May be repeated, not to exceed 9 hours credit.

F.A. 587-3. Graduate Ceramics.

F.A. 588-3. Graduate Ceramics.

F.A. 589-3. Graduate Ceramics Seminar.

Intermedia/Video

F.A. 290-3. Intermedia. Interdisciplinary studio course encouraging experimentation with media and integration of traditional areas of drawing, painting, photography, and sculpture. Areas to be covered include 2-D and 3-D collage/photo-montage/assemblage, correspondence art, video and audio art. Prer., one basic studio course. May not be repeated. (Formerly F.A. 222.)

F.A. 490/590-3. Video. A course exploring time-based media, that is, an art form which deals with the experience, perception, and implication of time as integral to its form and content in its sequential aspects as well as its immediacy. The course will utilize video as a narrative or documentary tool, in relation to the various expressions of performance work, including work designated as conceptual art, body art, video performance, correspondence art, etc.

Seminars/Special Topics

F.A. 104-3. Basic Art Lecture. The object of this course is to develop the student's awareness of art in its historical context. Topics to be covered include the technical aspects of painting and sculpture, origins and development of photography, theory of art values, art criticism, etc.

F.A. 291/391/491/591-variable credit (2 to 3). Special Topics. This is a course which will be offered from time to time to provide a vehicle for introducing timely subjects in fine arts which cannot be offered on a regular basis. Information concerning the topics offered in any given semester will be available prior to pre-registration from the Fine Arts Department. Prer., see *Schedule of Courses*.

F.A. 292/392/492/592-variable credit (2 to 3). Special Topics. See *Schedule of Courses*.

F.A. 403/503-3. Art of the Last Decade, Trends and Criticism. A selective study of significant areas of visual art of the last decade including major critical opinions. Prer., 20 hours of fine arts.

F.A. 495-2. Studio Seminar. For students intending to pursue graduate work and/or a professional career in art. Emphasis will be on developing a critical overview of their work and interests, and how they relate to the problems of professional activity today. Prer., B.F.A. candidate. *Pass/fail only.*

F.A. 496-2. Art Seminar. For fine arts honor students and advanced undergraduates. Requires a considerable amount of outside reading in the fields of aesthetics and art history. Discussion group will meet one evening each week. Adminssion by consent of instructor only.

F.A. 596-2. Graduate Art Seminar.

Visiting Artist Program

F.A. 497/597-4. Visiting Artist Program. Artists of national and international reputation interacting with graduate and advanced undergraduate students discuss their studio work at seminar meetings and a public lecture, providing continuous input of significant developments and a comprehensive view of contemporary issues in the arts. Prer., portfolio review for undergraduates.

Art History

Double-level (400/500) courses are open to both advanced undergraduate and graduate students. An undergraduate student will register for the 400 level; a graduate student for the 500 level. A higher level of performance and extra work will be expected of the graduate student. Not all art history courses are offered every year. Students should check the current *Schedule of Courses*. Seniors may take 500-level courses only after consultation with the instructor.

F.A.H. 100-3. Experiencing Art-Image, Artist, and Idea. An innovative course intended to provide a broad introduction to the understanding and appreciation of art from all time periods and all parts of the world. Particularly directed to nonmajors.

F.A.H. 270-3, 271-3. African-American Art History. (Bl.St. 270, 271.) See Bl.St. 270, 271.

F.A.H. 280-3. Art of Antiquity. A survey of sculpture, painting, and architecture from the Paleolithic to the accession of Constantine. The geographic scope includes Mesopotamia, Anatolia, North Africa, and the lands of the eastern and western Mediterranean.

F.A.H. 281-3. Art of the Middle Ages. A survey of sculpture, painting, and architecture from 300 to 1500 A.D.—art of the Early Christian, Byzantine, Early Medieval, Romanesque, and Gothic periods.

F.A.H. 282-3. Art of the Renaissance, the Baroque, and the Rococo. A survey of sculpture, painting, and architecture from Giotto through the Rococo.

F.A.H. 283-3. Art of the 19th and 20th Centuries. Survey of sculpture, painting, and architecture from the late 18th century to the present, beginning with Neoclassicism and Romanticism. Impressionism and all the other "isms" of the 19th and 20th centuries will be covered. Prer., F.A.H. 280, 281, or 282.

F.A.H. 284-3. Introduction to Asian Art. Designed for those having no previous experience in the study of Asian art, the course will treat the development of sculpture, painting, architecture, and the other visual arts of South Asia, the Far East, and Southeast Asia, especially as they are connected by the religious themes of Hinduism and Buddhism.

F.A.H. 401/501-3. History of Photography. The history of photography from Daguerre to the present.

F.A.H. 404/504-3. (Cla. 404/504.) Art of the Ancient Near East. A survey of the architecture, sculpture, and painting of the eastern Mediterranean from their beginnings to the end of the Sassanian Empire to include the arts of Anatolia, Mesopotamia, and Persia. Prer., instructor's consent.

F.A.H. 405/505-3. Art of India and Southeast Asia. A survey of the architecture, sculpture, and painting of India and those areas of Southeast Asia influenced by India from the period of Mohenjo Daro and Harappa to recent times. The Himalayan region will be treated, as will Tantric art in general. Prer., F.A.H. 284 recommended.

F.A.H. 406/506-3. Art of Islam. Art and architecture of the Islamic peoples from the death of Muhammed through the 18th century from Spain to India.

F.A.H. 407/507-3. Byzantine Art. (Clas. 420/520.) Art of the East Christian Empire from the accession of Constantine to the conquest of Constantinople with a synopsis of developments from 1453 through the 18th century. Prer., junior standing.

F.A.H. 416/516-3. Modern Sculpture 1870-1970. An extensive examination of outstanding sculptors in Europe and America from Rodin to the present; American sculpture since World War II will receive special emphasis. Prer., F.A.H. 283 or consent of instructor.

F.A.H. 427/527-3. Pre-Classical Art and Archaeology. (Clas. 427/527.) See Clas. 427/527.

F.A.H. 428/528-3. Classical Art and Archaeology. (Clas. 428/528.) See Clas. 428/528.

F.A.H. 431/531-3. Etruscan Art and Archaeology. (Clas. 431/531.) Prer., junior standing.

F.A.H. 432/532-3. Roman Art and Archaeology. (Clas. 432/532.) Prer., junior standing.

F.A.H. 435/535-3. Monuments of the High Renaissance. Begins with first stirring of the High Renaissance in Florentine art and architecture around 1480, continues to 1525 in Rome and Central Italy, and deals with monumental art and architecture in Venice and the Veneto from about 1480 to 1580. *Offered abroad only.*

F.A.H. 436/536-3. The Late Renaissance and Mannerism. Italian painting, sculpture, and architecture from about 1520 to 1580, dealing with Mannerism and the expansion of late Renaissance art in Europe. Prer., F.A.H. 282 or consent of instructor.

F.A.H. 437/537-3. Mannerist Painting and Sculpture. An investigation of Mannerism in Italian art and architecture, beginning with "anti-classicism" in Tuscan painting around 1515, continuing with Mannerist art in Rome until 1527 and in Parma and Mantua until about 1540, and ending with art of the *bella maniera* in Florence. *Offered abroad only.*

F.A.H. 441/541-3. Neoclassicism and Romanticism: 1760 to 1840. A survey of painting and sculpture in England and France from the last quarter of the 18th century through the first half of the 19th century. Prer., F.A.H. 283 or consent of instructor.

F.A.H. 442/542-3. European Art From 1830 to 1886. A survey of the major movements in painting in France and England from the Revolution of 1830 to the Impressionist crisis of 1886. Although the emphasis is on painting, major expressions in sculpture and architecture will also be discussed. Prer., F.A.H. 283 or consent of instructor.

F.A.H. 456/556-3. Perspectives on Art and Criticism. An examination of some traditional and current ideas which have shaped, defined, or influenced the goals, practices, and evaluation of the visual arts. Lectures, readings, discussion. Open to fine arts majors or students with 9 or more hours in art.

F.A.H. 460-3. Undergraduate Seminar: Selected Topics in Art History. A seminar course dealing with selected areas or problems within the history of art. Consult current *Schedule of Courses* for

seminar topic. Prer., any two of the following: F.A.H. 280, 281, 282, 283, 284, or equivalent.

F.A.H. 461/561-3. The Art of Ancient Egypt. (Clas. 461/561.) A survey of the development of Egyptian architecture, sculpture, painting, and the minor arts from their beginnings until the establishment of Christianity. Prer., instructor's consent.

F.A.H. 465/565-3. Roots of the Italian Renaissance. Begins with art of the so-called proto-Renaissance in the later 13th and early 14th centuries, with visits to major monuments in Tuscany and the Veneto. Continues with Tuscan art and architecture until about 1440 in Florence. *Offered abroad only.*

F.A.H. 466/566-3. Italian Gothic Art. Developments in Italian painting, sculpture, and architecture from about 1200 to 1400 A.D., including interactions with northern Europe and the so-called Proto-Renaissance. Prer., F.A.H. 281, 282, or consent of instructor.

F.A.H. 467/567-3. Quattrocento Art in Florence and Central Italy. Commences with monuments of the so-called Second Renaissance Style about 1440 around Florence. Deals with the later Ghiberti and Donatello, the work of Leonbattista Alberti, and the painting of Castagno, Piero della Francesca, Botticelli, Filippino Lippi, and others, ending in the late Quattrocento. *Offered abroad only.*

F.A.H. 470/570-3. Art of Africa and Oceania. Native arts of non-Western peoples of Africa and Oceania. Sculpture, architecture, and minor arts for both archaeological and ethnological cultures. Emphasis upon the function of art in society as well as aesthetic analysis.

F.A.H. 471/571-3. Pre-Columbian Art. Architecture, sculpture, and painting of the high cultures of Meso-American and Andean areas before the Spanish Conquest.

F.A.H. 472/572-3. North American Indian Art. Survey of art of North American Indian cultures, including Northwest Coast, Southwest, Southeast, Northeast, and Plains, covering architecture, sculpture, and minor arts for both archaeological and ethnological cultures. Prer., consent of instructor.

F.A.H. 473/573-3. Latin American Art Since 1492. The arts of the colonies of Spain and Portugal in the Western Hemisphere from 1492 to the present. Prer., F.A.H. 282 or equivalent.

F.A.H. 474/574-3. The Arts of Japan. Appreciation and chronological development of the arts of Japan. Emphasis upon the arts of Shintoism and Buddhism as well as the particular Japanese aesthetic from prehistoric times to the present. Prer., F.A.H. 284 recommended.

F.A.H. 475/575-3. The Arts of China. Survey of Chinese painting, sculpture, architecture, and other arts from Neolithic to modern times. Prer., F.A.H. 284 recommended.

F.A.H. 476/576-3. Early Christian and Early Medieval Art. History of European art from Constantine to around the year 1000 with primary emphasis on western Christian, Hiberno-Saxon, Carolingian, Ottonian, and Anglo-Saxon art, but including barbarian and Byzantine contributions. Prer., F.A.H. 281 or consent of instructor.

F.A.H. 477/577-3. Women Artists From the Middle Ages to the Present. (Wm.St. 477.) A survey of women's art in the West with emphasis on painting and sculpture. Prer., a survey of art history or instructor's consent.

F.A.H. 478/578-3. Romanesque Art. History of European art of the 11th and 12th centuries treating architecture, sculpture, fresco painting, and manuscript illumination. Prer., F.A.H. 281 or consent of instructor.

F.A.H. 479/579-3. Gothic Art. History of European art from the mid-12th to the 16th century treating architecture, sculpture, stained glass, and manuscript illumination with special emphasis on developments in France, England, and Germany. Prer., F.A.H. 281 or consent of instructor.

F.A.H. 480/580-3. Italian Renaissance Art I. *Fall.* Italian art and architecture from 1400 to the death of Donatello (1466), with emphasis on the development of Renaissance art in Florence and central Italy. Prer., F.A.H. 282 or consent of instructor.

F.A.H. 481/581-3. Italian Renaissance Art II. *Spring.* Italian art and architecture from about 1470 to 1520, including the diffusion of Renaissance ideas throughout Italy, and the development of the High Renaissance in central Italy and Rome. Prer., F.A.H. 282 or consent of instructor.

F.A.H. 482/582-3. Northern European Painting. *Spring.* History of painting in the Netherlands, France, and Germany in the 15th and 16th centuries. Prer., F.A.H. 282 or consent of instructor.

F.A.H. 483/583-3. Art in France, 1500-1750. *Spring.* Examines the developing French style through the various foreign influences, the impact of classicism, and finally the efflorescence of that uniquely French expression, the Rococo, and its reflections in Germany and Austria. Prer., F.A.H. 282.

F.A H. 484/584-3. Art and Architecture in Italy, 1580-1750. *Fall.* Traces the development of Italian art from the last gasps of Mannerism through the barocchetto style of Tiepolo. Prer., F.A.H. 282.

F.A.H. 485/585-3. Spanish and Netherlandish Painting in the 17th Century. *Spring.* A critical survey of Baroque painting in Spain, Flanders (modern Belgium), and the Dutch Republic. Despite obvious cultural differences among Holland, Catholic Flanders, and Spain, the common thread of Baroque vision will be traced through the three cultures.

F.A.H. 486/586-3. American Art to 1945. A survey of art of the United States from the earliest colonial period to 1945, including minor arts as well as architecture, sculpture, and painting.

F.A.H. 487/587-3. American Art: 1945 to the Present. A survey of American painting and sculpture since World War II. Prer., F.A.H. 283 or consent of instructor.

F.A.H. 491/591-3. Art in the 19th Century. Study of visual arts in Europe from Goya through Post-Impressionism, with principal attention to major movements of Neo-Classicism, Romanticism, Realism, and Impressionism. Primary emphasis on art of painting, but major expressions in sculpture and architecture will also be involved.

F.A.H. 492/592-3. Modern Art. An in-depth study of the fin de siècle, stressing Post-Impressionism, Art Nouveau, and Symbolism. The course closes with Fauvism in France and the expressionist movement in Germany. Prer., F.A.H. 283 or consent of instructor.

F.A.H. 493/593-3. Modern Art. Emphasizing the various "isms" of the 20th century, the course begins with the early Picasso and Cubism, including Analytic and Synthetic Cubism. Also studied are Italian Futurism, de Stijl and the Bauhaus, Dada, and Surrealism. Prer., F.A.H. 283 or consent of instructor.

F.A.H. 495/595-3. Modern Architecture. A survey of world contemporary architecture from its beginnings with Richardson and Wright to the present. Prer., F.A.H. 283 or equivalent.

F.A.H. 508-3. Classical Greek Art. (Anth. 593, Clas. 521.) See Clas. 521. Prer., F.A.H. 428 or consent of instructor.

F.A.H. 509-3. Archaic Greek Art. (Anth. 594, Clas. 523.) Prer., F.A.H. 428 or consent of instructor.

F.A.H. 510-3. Prehistoric Greek Art and Archaeology. (Anth. 595, Clas. 524.) See Clas. 524. Prer., F.A.H. 427 or consent of instructor.

F.A.H. 515-3. Hellenistic Art and Archaeology. (Anth. 592, Clas. 515.) See Clas. 515. Prer., F.A.H. 428 or consent of instructor.

F.A.H. 548-3. Topics in Roman and Etruscan Art and Archaeology. (Anth. 537, Clas. 548.) Consideration of various aspects of Roman and/or Etruscan art and archaeology. Topics to be explored may vary and will be announced in advance. Prer., consent of instructor.

F.A.H. 560-3. Graduate Seminar: Selected Topics in Art History. Subjects and instructors will vary. Prer., consent of instructor.

F.A.H. 562-3. Graduate Seminar: Selected Topics in Art History. Subjects and instructors will vary. Prer., consent of instructor.

F.A.H. 649-3. Seminar: Tools of Research. Required for Master of Arts (art history) candidates. Discussion of problems in art history and theory. Particular emphasis on defining problems for research study and systematically acquiring and presenting written evidence. Study of sources and bibliographical materials pertaining to art. Requirements in oral and written presentation in the seminar, including the preparation and use of visual aids.

Independent Studies

A student may register for independent study in studio or art history. Consult departmental office for policies and procedures relating to registration.

F.A. 930 to 949-variable credit (1 to 3). Undergraduate Independent Study.

F.A. 950 to 969-variable credit (1 to 3). Graduate Independent Study.

F.A.H. 930-variable credit (1 to 3). Undergraduate Independent Study.

F.A.H. 940-variable credit (1 to 3). Undergraduate Independent Study.

F.A.H. 950-variable credit (1 to 3). Graduate Independent Study.

F.A.H. 960-variable credit (1 to 3). Graduate Independent Study.

Thesis

F.A. 700-1 to 4. Master's Thesis (Art Education).

F.A.H. 700-1 to 4. Master's Thesis (Art History).

F.A. 750-1 to 6. Master of Fine Arts Creative Thesis.

Fine Arts Exhibitions

The Department of Fine Arts organizes exhibitions of painting, graphics arts, photography, and sculpture from its own collections and from those of major museums, collectors, artists, and galleries throughout the country. The exhibitions are shown in the Eve Drewelowe Gallery and the other two University of Colorado Art Galleries, which are all located in the Sibell-Wolle Fine Arts Building.

FRENCH AND ITALIAN

French

For comparative literature and linguistics departmental courses and phonetic sciences, see those sections.

Fr. 101-5. Beginning French I. *Fall, Spring.* Open only to students with no previous knowledge of French or upon consultation.

Fr. 102-4. Beginning French II. *Fall, Spring.* Open only to students who have had Fr. 101 at the University of Colorado or upon consultation.

Fr. 105-5. Beginning French Review. *Fall, Spring.* Reserved for students with up to two years of high school French on basis of foreign language placement code.

Fr. 201-4. Second-Year Oral Grammar Review and Conversation I. *Fall, Spring.* Prer., Fr., 102 or 105 or placement. Fulfills undergraduate language requirement.

Fr. 202-3. Second-Year Oral Grammar Review and Conversation II. *Fall, Spring.* Prer., Fr. 201 or 211 or placement (three years of high school French).

Fr. 211-4. Second-Year French Grammar Review and Reading I. *Fall, Spring.* Prer., Fr. 102 or 105 or placement. Fulfills undergraduate language requirement.

Fr. 212-3. Second-Year Grammar Review and Reading II. *Fall, Spring.* Prer., Fr. 201 or 211 or placement/consultation. Fr. 212 fulfills the Graduate School language requirement for the Ph.D.

Fr. 301-3. French Phonetics and Pronunciation. *Fall, Spring.* Prer., Fr. 202 or 212 or equivalent, or upon consultation. Should be taken before or concurrently with any 300-level literature course.

Fr. 302-2. Oral Practice. *Fall, Spring.* Prer., Fr. 301 or upon consultation. Should be taken before or concurrently with any 300-level literature course.

Fr. 303-3. Oral Professional French. *Fall.* Prer., Fr. 202, 212, or equivalent.

Fr. 305-3. French Composition. *Fall, Spring.* Prer., Fr. 212 or equivalent. Should be taken before or concurrently with any 300-level literature course. Must be taken before Fr. 306.

Fr. 306-3. French Composition. *Fall, Spring.* Prer., Fr. 305 or upon consultation.

Fr. 311-3. Main Currents of French Literature. *Fall, Spring.* Prer., Fr. 212 or upon consultation. Fr. 305 is recommended as a prer.

Fr. 312-3. Main Currents of French Literature. *Fall, Spring.* Prer., Fr. 311 or upon consultation.

Fr. 370-3. Scientific and Technical French. Prer., third-year level or equivalent. Emphasis will be on the oral and written translation of scientific and technical data, promotional material, and articles informing on recent French accomplishments in these fields.

All courses at the 400 level or above, unless otherwise indicated, are offered on a three-year cycle. They are not open to freshmen or sophomores.

Fr. 401-2. Advanced Composition. *Fall.* Prer., Fr. 306 or upon consultation. Should be taken before or concurrently with 400-level literature courses.

Fr. 402-2. Advanced Composition. *Spring.* Prer., Fr. 401 or upon consultation. Should be taken before or concurrently with 400-level literature courses.

Fr. 403/503-3. Advanced Oral Practice and Interpreting. *Fall.* Prer., Fr. 302 or Fr. 303, or upon consultation. May be repeated for credit. Frey.

Fr. 405/505-2. French for Business. *Spring.* Prer., Fr. 401 or upon consultation. Frey, Kail.

Fr. 406/506-3. French Phonology and Morphology. *Fall.* No previous knowledge of linguistics is assumed. Prer., Fr. 301 or 501 or upon consultation. Mayer.

Fr. 407/507-3. Syntax of Modern French. *Spring.* Prer., Fr. 406/506 or consultation. Mayer.

Fr. 408-3. History of the French Language. Jensen or Mayer.

Fr. 409/509-3. Contrastive Analysis of French and English. *Spring.* Prer., Fr. 407/507 or consultation. Mayer.

Fr. 410/510-2. Translation. *Spring.* Prer., Fr. 401. Frey.

Prer. for all following courses, French 311-312, graduate standing, or upon consultation.

Fr. 411/511-2 to 3, 412/512-2 to 3. French Special Topics. Different topics will be offered and, in a number of cases, cross-listed with the Department of Comparative Literature or other departments.

Fr. 413/513-3. Medieval Lyric Literature. (Ital. 413/513.) Examination of medieval concept of "courtly love" as both a cultural and literary phenomenon; its theoretical and stylistic evolution from the Provençal to Italian lyric. In English; readings in French for majors. Prer., for French majors, Fr. 311 or 312 or consultation. Zago.

Fr. 420/520-3. Contemporary French Culture and Civilization. *Spring.* Ketchum.

Fr. 421/521-3. French Civilization Through World War I. *Fall.* Ketchum.

Fr. 425/525-3. Medieval and Renaissance Readings. Kail or Zago.

Fr. 431/531-3. Seventeenth-Century French Tragedy and Poetry. Barchilon.

Fr. 432/532-3. Seventeenth-Century French Prose. Barchilon.

Fr. 433/533-3. Molière and 17th-Century French Comedy. Barchilon.

Fr. 435/535-3. French Enlightenment. *Alternate years.*

Fr. 436/536-3. Eighteenth-Century French Novel, Theatre, and Poetry. *Alternate years.*

Fr. 442/542-3. Nineteenth-Century French Theatre and Poetry. *Alternate years.* Frey.

Fr. 443/543-3. Nineteenth-Century French Novel. *Alternate years.* Frey.

Fr. 447/547-3.Twentieth-Century French Theatre and Poetry. *Alternate years.* Ketchum.

Fr. 448/548-3. Twentieth-Century French Novel. *Alternate years.* Ketchum.

Fr. 449/549-3. Women Novelists of the 20th Century in France. Ketchum.

Fr. 451/551-3. French Dramatic Theories. Kail.

Fr. 452/552-3. Italian and French Poetry of the Renaissance. (Ital. 452/552.) Focuses on close reading of major poets of the Renaissance. Special attention will be given to the cultural context of the poems, such as the influence of Petrarchism, the revival of Platonism, and the impact of the Counter-Reformation. In English; readings in major language. Zago.

Fr. 495-3. Methods of Teaching French and Professional Orientation. *Fall.* To be taken one semester prior to or concurrently with student teaching. Tinelli.

Fr. 501-2. Advanced Phonetics. *Alternate years.* Tinelli.

Fr. 557-2. French Literary Criticism.

Fr. 597-2. College Foreign Language Teaching. *Fall.* Required for TAs and graduate part-time instructors. Baker.

Fr. 603-3. History of the French Language to 1300: Grammar, Phonology, History. *Alternate years.* Jensen.

Fr. 604-2. History of the French Language From 1300 to the Present Day: Morphology and History. *Alternate years.* Jensen.

Fr. 605-2. Old Provencal. (Span. 607.) Jensen.

Fr. 611-2. Stylistics of French. Kail.

Fr. 612-2, 613-2. Seminars in French Literature. For use of visiting lecturers and distinguished visiting professors.

Fr. 614-2. Seminar: Special Topics. To be team-taught by French faculty. Upon demand.

Courses listed below are offered on a three-year cycle. One graduate seminar offered per year; centuries, topics and authors vary. Consult *Schedule of Courses.*

Fr. 629-2. Seminar: Moyen Age. Zago or departmental faculty.

Fr. 634-2. Seminar: Renaissance Literature. Kail or departmental faculty.

Fr. 638-2. Seminar: 17e siècle. Barchilon or departmental faculty.

Fr. 655-2. Seminar: 18e siècle. Departmental faculty.

Fr. 671-2. Seminar: 19e siècle. Frey or departmental faculty.

Fr. 672-2. Seminar: 20e siècle. Ketchum or departmental faculty.

Fr. 675-2. Seminar: Advanced Linguistics. Jensen, Mayer, Tinelli, or departmental faculty.

Fr. 700-1 to 4. Master's Thesis.

Fr. 800-30. Doctor's Dissertation. All doctoral students must register for no fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Fr. 940-1 to 3. Independent Study: Language. Upon consultation only.

Fr. 945-1 to 3. Independent Study: Literature. Upon consultation only.

Fr. 950-1 to 3. Independent Study. Upon consultation only.

For courses in comparative literature, linguistics, and phonetic sciences, see those sections.

Italian

Ital. 101-5. Beginning Italian. *Fall, Spring.* Four skills of listening, speaking, reading, and writing are progressively developed in a predominantly oral presentation. Language laboratory work expected.

Ital. 102-5. Beginning Italian. *Fall, Spring.* Prer., Ital. 101.

Ital. 201-2. Second Year Italian Conversation I. *Fall, Spring.* Ital. 201 and 202 are geared to develop oral fluency through a higher-level continuation of the oral work on appropriate subjects. Prer. Ital. 102, its equivalent, or two years of high school Italian, plus concurrent enrollment in Ital. 211, or previous completion of Ital. 211.

Ital. 202-2. Second Year Italian Conversation II. *Fall, Spring.* Prer., Ital. 201, plus concurrent enrollment in Ital. 212 or previous completion of 212.

211-3. Second-Year Italian Reading and Conversation. *Fall, Spring.* Conducted in Italian except for grammar explanations. Designed to provide a thorough grammar review, to improve reading abilities, and to improve writing skills. Prer., grade of *C* or better in Ital. 102 or equivalent.

Ital. 212-3. Second-Year Italian Reading, Grammar, and Composition. *Spring.* Continuation of Ital. 211. Ital. 212 fulfills the Graduate School language requirement for the Ph.D.

Ital. 312-3. Readings in Italian Literature. *Spring.* Study of selected masterpieces of the Middle Ages, the Age of Humanism, the Early and High Renaissance, and the Baroque periods. Conducted in Italian. Prer., Ital. 212 or upon consultation.

Ital. 313-3. Readings in Italian Literature. *Fall.* Study of selected masterpieces from the 18th, 19th, and 20th centuries. Special emphasis on contemporary literature. Conducted in Italian. Prer., Ital. 212 or upon consultation.

Ital. 321-3. Advanced Conversation and Composition. *Fall.* Devoted to assigned translations and compositions with discussion of grammatical and stylistic problems encountered, and to conversation at an advanced level. Prer., Ital. 212 or upon consultation.

Ital. 322-3. Advanced Conversation and Composition. *Spring.* Prer., Ital. 321 or upon consultation.

Ital. 360-3. Workshop in Italian Theatre. Offered in alternate years. Prer., upon consultation.

Most 400 level courses are offered in alternate years.

Ital. 401-2. Problems in Translation, Advanced Grammar, and Stylistics I. Major emphasis will concern practice in translating varying types of prose from Italian into English, with emphasis on literary texts. Prer., Ital. 322 or upon consultation.

Ital. 402-2. Problems in Translation, Advanced Grammar, and Stylistics II.

Ital. 411-3. Dante: *Inferno* and *Purgatorio.* Prer., Ital. 312 or upon consultation.

Ital. 413-3. Medieval Lyric Literature. (Fr. 413/513; C. Lit. 542.) Examination of medieval concept of "courtly love" as both a cultural and literary phenomenon; its theoretical and stylistic evolution from the Provençal and Old-French Romance to Italian lyric. No knowledge of Italian necessary. Prer., for Italian majors, Ital. 312 or 313 or upon consultation.

Ital. 420-3. Italian Culture and Civilization From Origins Through the Renaissance. *Fall.* In English; readings in major language.

Ital. 425-3. History of Italy: 1815 to Present. A survey of the political, social, and intellectual history of Italy from 1815 to present. In English; readings in major language.

Ital. 428-3. Italian Cinema: From 20th-Century Novel to Film. Analyses the transition of Italian 20th-century novels to film with special focus on the changes and re-interpretation of the plot, characters, and themes. Course aim is to broaden students' knowledge of Italian language and culture as well as to give them some of the vocabulary and analytical perspective for these two art forms. In English; Italian majors readings in Italian.

Ital. 451-3. The Culture of the Italian Renaissance. An interdisciplinary course emphasizing the relationship between the fine arts, the civil history and the literature of the Italian Renaissance, and its influence and repercussions in Western Europe. Zago.

Ital. 452-3. Italian and French Poetry of the Renaissance. (Fr. 452/552.) Focuses on close reading of major poets of the Renaissance. Special attention will be given to the cultural context of the poems, such as the influence of Petrarchism, the revival of Platonism, and the impact of the Counter-Reformation. Three-year cycle. In English; readings in major language. Zago.

Ital. 470-3. Dante: *Paradiso, la Vita Nuova*, and Minor Works.

Ital. 492-3. Italian Literature of the 19th Century. Primary focus on the pre-Romantics, Italian Romanticism, Verismo, and Decadentismo literary and cultural movements, particularly in their European context.

Ital. 493-3. Italian Literature of the 20th Century. A study of the Italian novel, theatre, poetry, and short story in the period from World War I to the present.

Romance Linguistics

Rom. 451/551-2. Romance Linguistics I. Outline of the development of Vulgar Latin into the old and modern Romance languages. Detailed study of the historical phonologies of French, Italian, Portuguese, Provençal, Romanian, and Spanish. Prer., consent of instructor. Jensen.

GEOGRAPHY

Geog. 100-3 or 4. Environmental Systems — Climate and Vegetation. A general introduction to the atmospheric environment of the earth: the elements and controls of climate and their implications to hydrology, vegetation, and soils.

Geog. 101-3 or 4. Environmental Systems — Landforms and Soils. An introductory survey primarily concerned with two essential aspects of the natural environment—landforms and soils. Major emphasis is directed to the genesis, distribution, and utility of surface features in a variety of learning situations, including lectures, labs, and field trips. Geog. 101 carries only 2 credits if student has credit in Geol. 101 or 103.

Geog. 198-3. World Regional Geography. Using the interrelated concepts of population, urbanization, trade resources and development as an organizing framework, the world's regions are geographically analyzed and placed in global perspective.

Geog. 199-3. Introduction to Human Geography. A systematic introduction to the broad field of human-environment relationships. Topics vary but may include growth and distribution of populations, locational analysis of economic activities, origin, development, and problems of urban communities; and spatial analysis of cultural, historical, and political phenomena.

Geog. 200-3. World Geographic Problems. Set in several regions, problems include resource-use decision making, locational analysis, Third World poverty and community development, and political and economic urban land use conflict. Small student groups in role-playing simulations leading to human decisions causing geographic change.

Geog. 305-3. Cartography I. This introduction to the science and art of cartography develops skills necessary to create maps and graphs of spatially distributed phenomena. The emphasis is on the use of maps as descriptive and analytical tools, but some attention is given to production and to computer-assisted cartography.

Geog. 306-3. Maps and Mapping. An introduction to maps and their role in society, this course includes the fundamentals of reading and using both reference and special purpose maps as well as the influence of maps on attitudes toward and images of the geographic environment.

Geog. 319-3. Topics in Meteorology. (APAS 319.) Topics vary from year to year and may include weather-map analysis and prediction, weather modification, severe storms, air quality and aviation weather. Nonmathematical. Prer., APAS 115 or Geog. 100, or instructor consent.

Geog. 320-3. Topics in Climatology. (APAS 320.) Topics vary from year to year and may include: climatic change, snow and ice, mountain weather and climate, and applied climatology. Nonmathematical. Prer., APAS 115 or Geog. 100, or instructor consent.

Geog. 325-3. Mountain Geography. A survey of mountain environments and their human use with illustrations from temperate and tropical mountain areas. Prer., Geog. 100, 101, 199.

Geog. 332-3. Geoecology of Alpine and Arctic Regions. Comparisons and contrasts in natural sciences of alpine and artic regions—biogeography, climatology, geomorphology. Examination of concept geoecology as applied to cold-stressed environments. Includes one or two local field trips. Prer., Geog. 100, 101, 199.

Geog. 339-3. Conservation of Natural Resources. This course is an introduction to the nature, distribution, and conservation of natural resources with emphasis on forest, rangeland, and wildlife resources. Resources problems of the western United States are contrasted with those of tropical latitude countries. Prer., Geog. 100 or instructor consent.

Geog. 340-3. Natural Hazards. The impact of extreme geophysical events on human society. Emphasis upon adaptations to extreme events and ways of reducing vulnerability and damage.

Geog. 341-3. Conservation Practice and Resource Management. Inventory, policy, and management of natural resources. Emphasizes practical approaches to the conservation and management of the soil and land, water, and air resources.

Geog. 342-3. Conservation Thought. Historical survey of human consumption of earthly materials; environmental and global considerations of population growth, cultural attitude, and technological development; the diverse goals and philosophy of conservation movements in time and place.

Geog. 381-3. Latin America. National and regional overview of culture, history, resources, population, socioeconomic change, and other contemporary geographic problems.

Geog. 401-3. Introduction to Quantitative Methods in Human Geography. Introduction to the methods and applications of quantitative methods in human geography. Particular emphasis on applications of techniques used in the spatial analysis of human settlement and the distribution of economic activities. Prer., Math. 110 or equivalent.

Geog. 402-3. Statistics for Earth Sciences. (Geol. 477.) See Geology for the course description.

Geog. 404/504-3. Computer-Assisted Cartography. Emphasizes application of geographic information. Attention is directed to mapping both physical and human phenomena. Students will develop their own computer mapping programs. Prer., Geog. 305 and Fortran programming ability.

Geog. 405-3. Cartography II. Advanced cartography with emphasis on independent research and projects. Field trips to leading map publishers and printers arranged.

Geog. 406/506-3. Geographic Interpretation of Aerial Photos. The use of aerial and space photography in geographic research is emphasized. Includes properties and the systematic application of imagery in the photographable portion of the spectrum for the evaluation of

urban, transportation, landform, and vegetation features. Prer., basic courses in geography or equivalent.

Geog. 409/509-3. Remote Sensing of the Environment. Covers the acquisition and interpretation of environmental data by remote sensing. Theory and sensors are discussed as are manual and computerized interpretation methods. The infrared and microwave portions of the spectrum are stressed. Prer., basic courses in geography or equivalent.

Geog. 410/510-3. Geographic Information Systems. Deals with computerized systems for storage and analysis of spatial data. Data structures and problem solving using both statistical and cartographic techniques are considered. Lab assignments allow attention to information concerning both physical and human geographic features. Prer., Geog. 306, 401, or 402 (or equivalent) and Fortran programming ability.

Geog. 416-3. Teaching Geography. Practicum and/or tutorial, by special arrangement only, in the teaching of geography, e.g., serving as small-group leaders or tutors in introductory courses, or developing and/or testing curriculum materials. Prer., consent of instructor.

Geog. 417/517-3. Research Seminar. Development of skills for research with emphasis on primary and secondary sources, on methods of evaluating source materials, and on geographic writing.

Geog. 421-3. Physical Climatology-Principles. A course introducing the physical principles of flows of heat and moisture to and from the earth's surface, the interaction and modeling of such flows, and their distribution in space and time. Prer., Geog. 100 and 320 or equivalent.

Geog. 422-3. Physical Climatology-Applied. Applications of the principles of physical climatology are examined in areas such as water balance, agriculture and forestry, and urban climatology. Prer., Geog. 421 or equivalent.

Geog. 431-4. Principles of Geomorphology. (Geol. 463.) See Geology for the course description.

Geog. 432/532-4. Mountain Geomorphology. (Geol. 460/560.) Field course emphasizing study of landforms produced by weathering and soils, mass movement, erosional processes under all climatic and altitudinal conditions. Prer., a college course in physical geology and consent of instructor. Offered each summer at Mountain Research Station, infrequently during academic year on campus.

Geog. 433/533-4. Mountain Climatology. Survey and analysis of the climatic characteristics of selected mountain environments, their study in the field; emphasis on Rocky Mountains. Prer., a college course in weather and climate and consent of instructor. Offered each summer at Mountain Research Station, infrequently during academic year on campus.

Geog. 435/535-3. Biogeography. Survey and analysis of plant and animal distributions on a world scale from ecological and historical perspectives. Human impact on vegetation is emphasized. Prer., Geog. 100 or consent of instructor.

Geog. 437/537-3. Forest Geography: Principles and Dynamics. Survey of the principles of forest geography and ecology. Both individual tree responses to environmental factors and species interactions within communities are included. Emphasizes forest dynamics and their relation to management problems. Prer., Geog. 100-101, EPOB 121-122, or instructor's consent.

Geog. 438/538-1. Forest Geography Laboratory. Techniques of describing, classifying, and analyzing changes in forest vegetation will be applied in the field to a variety of local forest types. Coreq., Geog. 437/537.

Geog. 443-3. Seminar: Conservation Trends. An advanced upper division seminar to provide environmental conservation and geography majors an undergraduate format for interdisciplinary discussion and research into the current and future directions of conservation. (*Senior majors only.*)

Geog. 450/550-3. Water Resources and Water Management of Western United States. *Offered infrequently.* Interpretation and analysis of hydroclimatic data, surface, and ground-water. Water use is critically evaluated with emphasis on problems associated with geographic maldistribution, appropriations, irrigation, industry, pollution, and regional development.

Geog. 451-3. Surface Hydrology. This course examines hydrologic processes in the surface environment, with emphasis on the environment of the Western U.S. Greatest emphasis is placed on natural processes and their management to augment water resources. Students may not receive credit for this course and Geol. 404/504. Prer., Geog. 100, 101 (or equivalent); Math. 130 or Introductory Statistics.

Geog. 461/561-3. Geography of American Cities. An introduction to the geography of American cities. Includes demographic and ideological context of urban development, emergence of the city system, location theory, and rent models and urban-economic problems.

Geog. 462/562-3. Urban Geography: Social. An analysis of the social, behavioral, political, and demographic factors which influence the development and maintenance of communities in contemporary urban environments, with primary emphasis on U.S. cities.

Geog. 466/566-3. Economic Geography. Several theories of location of economic activity are presented: general theory of land use, agricultural location theory, plant location theory, central place theory, location of systems of cities, and geographical organization of industries. The aggregate geographical structure of regions is studied as the geography of three major markets: labor, product, and capital, including the banking system. The economic growth of regions and policies designed to influence regional growth and welfare. Prer., junior standing.

Geog. 467/567-3. Seminar: World Agriculture. *Offered infrequently.* Analysis of the origins, evolution, and distribution of agricultural systems. Problems of agricultural modernization and development.

Geog. 471/571-3. Political Geography. A systematic study of the relations between geography and politics, especially as a background for better understanding of international affairs. Topics such as frontiers and boundaries, power analysis, electoral geography, resource utilization, and strategic concepts are included.

Geog. 472/572-3. Historical Geography of Europe. *Offered alternate years.* A study of how people have changed the landscape of Europe through time, including an analysis of the past geography of Europe at selected periods of time.

Geog. 473/573-3. Population Geography. The emphasis of this class is on the spatial aspects of population characteristics, including fertility, mortality, migration, distribution, and composition. Includes both theoretical and empirical considerations, and some field work and computer simulations.

Geog. 474/574-3. Environments and Peoples. Diverse environments and peoples are viewed in terms of their systemic relationships in order to understand human adaptability, human modification of environments, the environment as a medium of cultural communication, and the dynamics of human geographic change through space and time.

Geog. 475/575-3. Seminar: Recreational Geography. *Offered alternate years.* An inquiry into the spatial distribution and environmental conditions of recreation. Emphasis will be on outdoor recreation in nonurban settings. The implications of recreational values to resource managers and land use decisions will be included.

Geog. 482/582-3. Historical Geography of Eastern North America. *Offered alternate years.* A study of how people have developed settlements, utilized and changed the landscape of North America east of the Mississippi River through time, including an analysis of the past geography of certain regions of eastern North America at selected periods of time.

Geog. 483/583-3. Historical Geography of Western North America. *Offered alternate years.* A study of how people have developed settlements and utilized and changed the landscape of North America west of the Mississippi River through time, including an analysis of the past geography of certain regions of western North America at selected periods of time.

Geog. 487-3. Geography of Colorado. Location, distribution, evaluation, and utilization of Colorado resources with emphasis on the major problems of resource development and use in the population explosion.

Geog. 488-3. Soviet Union. A systematic and regional survey of features that characterize the physical, economic, and social geography of the U.S.S.R.

Geog. 489-3. Geography of Western Europe. A regional survey of the cultural, economic, social, physical, and political geography of Europe west of the Rhine, emphasizing the distinctive character and problems of each major area.

Geog. 490-3. Geography of Central, Northern, and Southeastern Europe. A regional survey of the cultural, economic, social, physical, and political geography of Europe east of the Rhine, emphasizing the distinctive character and problems of each major area.

Geog. 498/598-1 to 6. Field Problems. Selected geographic problems are investigated through intensive, instructor-directed field work. The instructor and the problem(s) will vary and will be announced. The course may be repeated under different problems with departmental approval. Prer., introduction to human or physical geography.

Geog. 499-3. Internship. Provides an academically supervised opportunity for advanced geography-environmental conservation majors to work in public and private organizations on projects related to students' career goals and to relate classroom theory to practice.

Geog. 521-3. Seminar: Physical Climatology. *Offered alternate years.* A research seminar concerned with problems of mass and energy exchange in the earth-atmosphere system. Topics to be selected from such areas as air quality, bioclimatology, hydrology, climate change, and the climates of urban, agricultural, and natural environments. Prer., Geog. 421 or consent of instructor.

Geog. 522-3. Synoptic and Dynamic Climatology. *Offered alternate years.* Global climates examined from the standpoint of synoptic and dynamic climatology. Prer., Geog. 320 or equivalent and instructor's consent.

Geog. 523-3. Seminar: Climate Change. (APAS 595, Geol. 595.) *Offered alternate years.* A cross-disciplinary survey of the evidence for the theories of climatic change. Prer., consent of instructor.

Geog. 524-3. Topics in Physical Geography. *Offered alternate years.* (precise title specified in *Schedule of Courses.*) Recent research topics which vary from year to year. This course may be taken twice as the topics vary.

Geog. 525-3. Theories of Climate and Climate Variability. (APAS 596.) A critical review of the current theories of climatic variability based on analysis of the different physical processes affecting climate.

Geog. 539-3. Seminar: Biogeography. Detailed consideration of current research themes in biogeography. Intensive reading of current research literature and preparation of research papers. This course may be taken twice, as the topics vary.

Geog. 543-3. Land Utilization. *Offered occasionally.* Examines the theories of land use determination, conflict among various users, and the means of resolving conflict and exercising control over land use. The class involves field work. Prer., consent of instructor.

Geog. 564-3. Seminar: Urban Geography. A survey of current research topics in urban geography. Emphasis on definition of possible student thesis topics. Prer., consent of instructor.

Geog. 599-3. Advanced Internship. Provides an academically supervised opportunity for graduate level geography majors to work in public and private organizations on advanced projects related to geographic theory and to students' career goals.

Geog. 602-3. Data Processing in the Earth Sciences. (Geol. 615.) *Offered occasionally.* See Geology for the course description. Prer., Geog. 402 or Geol. 477, or equivalent, or consent of instructor.

Geog. 615-3. History and Nature of Geography. Covers the development of geographical ideas leading to contemporary methodological issues in the discipline.

Geog. 616-3. Seminar: Geographic Education. *Offered infrequently.* A survey and critique of ideas from education, psychology, philosophy, and geography related to teaching and learning, especially for graduate students in geography who plan careers in college teaching.

Geog. 617-3. Geography Teaching Methods. Individual work under supervision emphasizes the creation of materials for classroom use in geography. Prer., Geog. 616 and instructor consent.

Geog. 618-3. Seminar: Geographic Problems. Application of research methods to selected problems. Instructor and topic will vary and will be announced. Course may be repeated under different topics with advisor's approval.

Geog. 619-1 to 3. Experimental Teaching in Geography. Advanced graduate students in geography experimenting with new course content or structures, instructional objectives, curriculum materials, evaluation devices, communication skills, and the like. Prer., Geog. 616 plus practicum such as teaching assistantship and instructor consent.

Geog. 621-3. Readings in Climatology. *Offered occasionally.* Selected topics in current climatological literature discussed in seminars. Specific themes will vary but may include aspects of microclimatology, paleoclimatic reconstruction, climatic applications of satellite data. Prer., consent of instructor.

Geog. 630-4. The Arctic and Alpine Environments. *Offered alternate years.* Concentration on multidisciplinary aspects of environmental processes and Quaternary history of the arctic-alpine region. This will involve introduction of new and recent faculty research in the Canadian Arctic and in the alpine area of the Rocky Mountains. Local field trips. Prer., consent of instructor.

Geog. 640-3. Seminar: Comparative Environmental Studies. *Offered occasionally.* A critical examination of cross-cultural experience with adjustments to natural hazards and with political management of resource exploitation. Prer., Consent of Instructor.

Geog. 671-3. Seminar: Political Geography. *Offered alternate years.* Detailed consideration of the history and methodology of the field, including an analysis of selected systematic topic such as frontiers and boundaries, international rivers, conflicting claims to territory, electoral geography, etc.

Geog. 672-3. Seminar: Historical Geography. *Offered alternate years.* Discussion of the scope and methodology of historical geography, including consideration of past and current trends, as well as future prospects. Seminar presentations on topics selected for their substantive importance.

Geog. 674-3. Seminar: Cultural Geography. *Offered alternate years.* Exploration of various geographic topics emphasizing the concept of culture. Emergence of several points of view in the development of cultural geography.

Geog. 700-6. Master's Thesis.

Geog. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Geog. 930-1 to 3. Undergraduate Independent Study. By special arrangement with faculty. Only for students presenting strong geography preparation. Prer., consent of instructor and departmental approval.

Geog. 950-1 to 3. Graduate Independent Study. Independent research for graduate students only. Prer., consent of instructor and departmental approval.

GEOLOGICAL SCIENCES

The following courses are not open to majors in geological sciences: Geol. 103, 104, 113, and 114.

Geol. 101-4. Introduction to Geology I. Introductory geology for major and nonmajors. Three lect. and one lab. or field trip per wk. Study of the earth; its materials, its characteristics, and its dynamic processes, and how it relates to people. Geol. 101 carries only 2 credits if student has credit in Geog. 101.

Geol. 102-4. Introduction to Geology II. Introductory geology for majors and nonmajors. Three lect. and one lab. or field trip per wk. Study of the evolutionary history of the earth and life. Prer., Geol. 101 or equivalent.

Geol. 103-3. Introduction to Geology I. Similar in topics to Geol. 101 but closed to geology majors. Three lect. per wk. Geol. 103 carries only 2 credits if student has credit in Geog. 101.

Geol. 104-3. Introduction to Geology II. Similar to topics in Geol. 102 but closed to geology majors. Three lect. per wk. Prer., Geol. 103 or equivalent.

Geol. 113-3. Dynamic Earth I — Introduction. *Fall.* Origin and evolution of the earth as a planet. Altervative energy resources. Composition of the earth, continental drift, and plate tectonics.

Geol. 114-3. Dynamic Earth II — The Solid Earth. *Spring.* Basic concepts of the physics of the solid earth, earthquakes, their causes and prediction. Earth structure, earth's gravity and magnetic fields, paleomagnetism. Students who are especially interested in the solid earth are encouraged to take Geol. 113 (APAS 113) before Geol. 114 (APAS 114).

Geol. 115-3. Dynamic Earth III — Meteorology and Oceanography. *Spring.* Composition and structure of the atmosphere and the oceans. Ocean-current systems, waves, and tides. Air-sea interaction. Weather phenomena. Man's impact on the ocean and atmosphere.

Geol. 153-4. Geological Development of Colorado and the West. Three lect. and one field trip or lab per wk. An outline of the development, through time, of the geology of Colorado. Follow-up for those who have had Geol. 101.

Geol. 301-4. Introduction to Mineralogy. Three lect. and one lab. per wk. Origin, occurrence, identification, classification, and uses of minerals. Applications of mineralogy to economic geology and petrology are emphasized. Prer., Geol. 101-102/153-201, Chem. 106, Math. 130, or consent of instructor. Smyth.

Geol. 302-4. Petrology. The field relations, petrography, petrology, chemistry, and origins of igneous and metamorphic rocks are studied by means of lect., reading, and lab and field experience. Labs include instruction in the fundamentals of optical petrography and the study of rocks in thin section. Prer., Geol. 301. Larson, Stern, Munoz, Smyth.

Geol. 312-4. Structural Geology I. Geometrical techniques for describing and illustrating geological structures. Major topics include graphic methods and geometry of fractures and folds. Prer., Geol. 101-102/153, Math. 110. Braddock.

Geol. 331-3. Introduction to Sedimentology. An introduction to the origin, transport and deposition of sedimentary particles. Emphasizes the physical properties of sediments, fundamentals of fluid flow and sediment transport, sedimentary structures, and facies models. Prer., Geol. 301/302. Kraus.

Geol. 340-4. Evolution of Continental Ecosystems. An enquiry into the evolution of important ecosystems of the past and present. Biological and geological data for reconstructing ecosystems will be discussed in detail and applied to creating scenarios of past ecosystems. Vertebrates and their structure will be emphasized.

Geol. 341-3. Paleobiology. A survey of the evolution and morphology of animal and plant life and the interactions of the biota and the earth. Fossils will be used to solve geological and biological problems. Prer., Geol. 102, one year biology, or consent of instructor. Harris, Kauffman.

Geol. 342-3. Introductory Stratigraphy. Studies of sedimentary rocks and the application of stratigraphic principles are used to interpret ancient environments and geologic history. Field techniques are emphasized. Prer., Geol. 331. Eicher.

Geol. 404/504-3. Geohydrology. Surface and ground waters are examined as a dynamic system within a geological framework. Implications for human management of watercourses, water supplies, and water quality are considered. Prer., physical geology, Math. 130 (or equivalent), introductory physics, or consent of instructor.

Geol. 405/505-3. Introduction to Seismology. Causes and effects of earthquakes, earthquake prediction, seismic waves, record interpretation, parameters of seismic foci, seismo-tectonics of the world. Prer., general physics, calculus. Wyss.

Geol. 410/510-3. Crystal Chemistry. Topics in physics and chemistry of crystals as applied to minerals and rocks will be covered; particularly x-ray, electron, and neutron diffraction phenomena in minerals and principals of chemical substitution and order-disorder reactions. Prer., Chem. 106, Phys. 112. Smyth.

Geol. 411-4. Field Geology. Methods of geologic mapping including plane table surveying, and introduction to photogrammetry. Prer., Geol. 312.

Geol. 412/512-4. Structural Geology II. Mechanics applied to the deformation of rocks. Stress, infinitesimal strain, behavior of elastic and brittle rocks, fault mechanics, mechanical effects of pore fluids, introduction to petrofabrics, and other topics. Lab. included. Prer., Geol. 312, Phys. 111. Braddock.

Geol. 413-4. Geophysics and Tectonics. Students are introduced to fundamental geophysics including seismology, geomagnetism, gravity, radiometric dating, and heat flow. The theory of plate tectonics is reviewed and its geophysical and geological aspects are outlined. The tectonics of orogenic belts such as the North American Cordillera are studied and related to plate tectonic processes. Prer., Geol. 312. Wyss and Kligfield.

Geol. 414/514-3. Techniques in Glacial Geology. Designed to acquaint students with research techniques. Instruction will include analysis of remote sensing imagery and maps, investigation of seismic records, evaluation of sedimentological techniques and approaches, and statistical evaluation of the data. Andrews.

Geol. 415/515-6. Regional Geology of the Central Rocky Mountains. This regional survey of the Central Rocky Mountains will combine lectures, laboratory exercises, and one 2-3 day field trip each week to provide geologists and other scientists with a comprehensive geologic history of this region. Prer., Geol. 101 or 102 or instructor consent.

Geol. 420/520-3. Advanced Mineralogy. Covers topics in the crystal chemistry of major rock forming mineral groups, specifically reactions, transformations, deformations, and geothermometry and geobarometry based on inter- and intra-crystalline element distributions in these major mineral groups. Prer., Geol. 410/510 or consent of instructor.

Geol. 436/536-3. Glacial Geology. Introduction to glaciology, glacial influence on topography, crustal rebound, and sea level, and glacial chronology for nothern North America. Prer., elementary geology or equivalent and consent of instructor. Andrews.

Geol. 447/547-4. Paleontology of the Lower Vertebrates. Evolution of the nonmammalian vertebrates with an emphasis on the evolutionary development of major vertebrate features. Prer., one year beginning biology, one year beginning geology, and Geol. 341.

Geol. 448/548-4. Paleontology of the Higher Vertebrates. Evolution of mammals and birds emphasizing the evolutionary history of modern and prominent fossil orders. Prer., one year beginning biology, one year beginning geology, Geol. 341, or consent of instructor.

Geol. 453-3. Introduction to the Physics of the Solid Earth. A survey of the structure, physical properties of the materials, the environmental conditions, and the processes in the earth's interior. Methods of interpreting geophysical data to determine the state of the interior are emphasized. Prer., Phys. 213, Math. 240. Kissinger, Spetzler.

Geol. 460/560-4. Mountain Geomorphology. (Geog. 432/532.) Field course. Includes Front Range glacial geology and glaciology. Mountain Research Station summer. Must be preceded by Geol. 436/536 and Geol. 463/563 or equivalent, to carry graduate credit in geology. INSTAAR staff.

Geol. 463/563-4. Principles of Geomorphology. (Geog. 431.) Systematic study of weathering, mass-wasting, fluvial, wind, and marine processes and the landforms resulting therefrom. Prer., elementary geology or equivalent, and elementary chemistry, or consent of instructor.

Geol. 477-3. Statistics for Earth Science. (Geog. 402.) Introduction to parametric and distribution-free statistics with emphasis on applications to earth science problems. Prer., algebra and introductory calculus.

Geol. 493-4. Introduction to Geophysical Prospecting. Outlines the principles of geophysical prospecting for oil, other minerals and wa-

ter. Seismic, gravity, magnetic and electrical methods are discussed. A lab is included. Prer., one year of college work in both geology and physics together with mathematics through Math. 130.

Geol. 495-3. Natural Catastrophes and Geologic Hazards. *Not offered every year.* Survey of historic and prehistoric natural disasters, their cause and potential for recurrence. Meteorite impact, earthquakes, volcanic erruptions, tsunamis, landslides, floods, magnetic reversals, and major extinction events. Prer., one year of science; for both majors and non majors. Stern.

Geol. 496-3. Mineral Resources in World Affairs. A nontechnical introduction to the geology, distribution, reserves, uses, and conservation of economic mineral materials, for nongeology majors. Prer., Geol. 101 or instructor's consent. Atkinson.

Geol. 497-1. Mineral Resources in World Affairs Laboratory. Laboratory and field trips for Geol. 496. This provides experience with maps, rocks and on-site inspection of mineral deposits. Prer., Geol. 101.

Geol. 501-0. Journal Club.

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Geol. 503-3. Introduction to Electron Microprobe. Theory and practice of electron microprobe analysis, including EDS and WDS systems. Prer., Geol. 524 and/or consent of instructor. Drexler.

Geol. 507-3. Advanced Sedimentology. Study of fluid flow, particle transport, bedforms, and sedimentary structures. The principles and methods of interpreting vertical sequences of sedimentary structures are emphasized. Prer., Geol. 331 and 342 or equivalents, or permission of instructor. Kraus.

Geol. 511-3. Seismic Stratigraphy. Emphasizes geologic applications of seismic reflection data. The theory of seismic methods, data processing, and conversion of time maps to depth will form the background for utilizing seismic data to derive detailed stratigraphic models. Prer., Math 130, 230; Phys. 111, 112, 114. Edman.

Geol. 516-3. Interpretation of Geological Phase Diagrams. *Alternate years.* Phase diagrams of mineral systems will be explored in terms of the variables temperature, composition, pressure, oxygen fugacity, and water fugacity. The viewpoint will be experimental rather than theoretical, and the unifying theme will be to discover how these diagrams can be related to igneous and metamorphic rocks. Prer., Geol. 527 or 521. Munoz.

Geol. 517-4. Optical Mineralogy. Principles of optical mineralogy and applications to the identification of rock-forming minerals in thin section will be taught. Prer., Geol. 301. Stern.

Geol. 521-4. Igneous Petrology. Systematic analysis of the petrology of igneous rocks. Emphasis is placed on integrating knowledge obtained from theory, experiment, and field studies. Prer., optical mineralogy. Stern.

Geol. 523-4. Mineral Exploration. An introduction to the application of genetic models of mineral deposits to their exploration and discovery. Development of strategies for regional, district, and mine exploration. Prer., Geol. 301. Atkinson.

Geol. 525-4. Introduction to Ore Deposits. A survey of processes of ore formations, with examples drawn from selected districts. Field trips to representative deposits. Prer., Geol. 301 or instructor consent. Atkinson.

Geol. 526-4. Field and Laboratory Study of Mineral Deposits. *Not offered every year.* Field mapping and laboratory studies of ore deposits, with emphasis on petrology, wall-rock alteration, and ore mineralogy. Prer., Geol. 525, 411, or instructor's permission. Atkinson.

Geol. 527-4. Thermodynamics for Petrologists. *Alternate years.* A systematic treatment of the thermodynamic fundamentals required in mineralogy and petrology, with emphasis on heterogeneous equilibria and data retrieval and evaluation. Thermodynamic properties of (1) gases and supercritical fluids, and (2) minerals, will be covered in detail. Prer., mineralogy of silicates, calculus, and graduate standing. Munoz.

Geol. 528-4. Principles of Aqueous Geochemistry. Composition and origin of natural waters. Principles relating to reactions between rock materials and water. Ionic equilibria. Computer methods. Discussion of natural waters. Prer., college chemistry, mineralogy. Previous exposure to computer programming is recommended. Runnells.

Geol. 530-3. Low-Temperature Geochemistry. Discussion of geochemistry of sedimentary and near surface environments. Stability diagrams, ion exchange, weathering, geochemical prospecting, and topics in thermodynamics. Prer., college chemistry and mineralogy. Geol. 527 or 528 recommended. Runnells.

Geol. 531-3. Comparative Sedimentology. Applies studies of modern and other geologically young sediments to the interpretation of Paleozoic depositional systems in central Colorado. Emphasis is put on the origin and diagenetic history of continental and near-shore marine deposits on the east and west flanks of the Ancestral Front Range. The lab includes several ½-day field trips and a 2½-day weekend trip. A term paper is required. Prer., general chemistry, mineralogy, stratigraphy. Walker.

Geol. 532-4. Subsurface Geology. *Not offered every year.* Considers derivation of geological information from borehole measurements, conversion of the data to suitable diagrams, and the geological interpretation of diagrams. Prer. or coreq., stratigraphy and structural geology, or consent of instructor. Curtis.

Geol. 533-3. Planetary Chemistry. *Not offered every year.* Discussion of the chemistry of the solar system, especially the role of stable and radioisotopes and trace elements in interpreting the formation and magmatic evolution of the planets. Prer., Geol. 301 and 302. Stern.

Geol. 534-1. Ore Microscopy. Emphasizes reflected light microscopic methods for the identification of opaque minerals with emphasis on ore minerals and related sulfides. Prer., a course in mineral deposits and optical mineralogy.

Geol. 538-3. Mechanics of Underground Fluids. *Not offered every year.* Occurrence and motion of subsurface waters and petroleum fluids considered in relation to production and disposal of fluids in wells. Prer. or coreq., structural geology, stratigraphy, sedimentation, introductory physics, or instructor's consent.

Geol. 539-3. Rock and Paleomagnetism. *Offered in alternate years.* Study of the origin of magnetic properties of minerals, survey of principal means of rock magnetization and their use in geologic interpretations, and the use and reliability of paleomagnetism. Basic courses in physics, chemistry, mathematics, and geology recommended. Larson.

Geol. 540-4. Quaternary Stratigraphy. Summary of geologic and pedologic methods used to recognize, date, and correlate Quaternary deposits and interpret Quaternary history. Prer., introductory geology and Geol. 463/563, or consent of instructor. Birkeland.

Geol. 541-3. Ancient Sedimentary Environments. Analysis of sedimentary rock sequences, biostratigraphy, sedimentary environments, and stratigraphic synthesis. Prer., Geol. 342. Eicher.

Geol. 543-2. Soil Laboratory Methods. Physical and chemical methods of research in soils. Analysis includes particle size, carbonate, organic matter, iron, aluminum, phosphorous, and clay mineralogy. Prer., Geol. 544 or consent. Birkeland.

Geol. 544-4. Morphology and Genesis of Soils. Effects of climate, vegetation, parent material, topography, and time on the development, classification, and chemistry of soils. Prer., introductory geology and chemistry; Geol. 463/563 recommended. Birkeland.

Geol. 545-3, 546-3. Micropaleontology. *Offered alternate years.* Classification, occurrence, and interpretation of minute fossils, especially Foraminifera. Prer., Geol. 341-342 or consent of instructor. Eicher.

Geol. 549-3. Geochemistry of Hydrothermal Ore Deposits. *Offered alternate years.* Laboratory studies, thermodynamic data, chemical data, fluid inclusions, stable isotopes, and field occurrences are all used to explain the composition, origin, and history of hydrothermal ore deposits. Prer., Geol. 525 or equivalent. Munoz.

Geol. 550-4. Petroleum Geology. Covers the theoretical and applied aspects of petroleum geology and geochemistry. Organic geochemistry, time-temperature models, migration, trapping mechanisms, log analysis, application of facies models in the subsurface and reservoir

geology will be discussed. Prer., structure, stratigraphy/sedimentology, deposits, environment, physics, chemistry. Edman.

Geol. 551-3. Current Problems in Paleobiology. *Offered alternate years.* A series of short field and laboratory projects, utilizing modern research techniques, dealing with current controversies in paleobiology. Prer., Geol. 341. Kauffman and staff.

Geol. 552-3. Marine Paleoecology. *Offered alternate years.* Study of the functional morphology, population structure, niche, and ecological interactions of living and ancient marine organisms. Prer., Geol. 341-342. Kauffman.

Geol. 554-3. Seminar: Chemistry and Ultrastructure of Fossils. *Alternate years.* A survey of the chemistry and ultrastructure of fossils, their functional and ecological significance, with lab., and their use as paleoclocks, in age dating, and in paleoenvironmental interpretation. Prer., Chem. 103 and 106, Geol. 341. Kauffman and Miller.

Geol. 555-3. Paleobotany and Palynology. *Alternate years.* Concepts and methods of paleobotany, focusing on palynology, and its use in diverse fields of geologic, environmental, and biologic interpretation. Prer., Geol. 340 or 341 and one semester of botany. Short and faculty.

Geol. 556-3. Evolution. *Offered alternate years.* Concepts, mechanisms, rates, and patterns of evolution as depicted by living and fossil organisms. Prer., 340 or 341 or introductory biology sequence. Kauffman, VanCouvering.

Geol. 557-1 to 3. Topical Seminar: Paleobiology and Paleoenvironments. A seminar on current topics of exceptional interest built around a series of prominent invited speakers. (Co-listed with G.E. 502 at CSM in 1982.) Prer., Geol. 341 or equivalent in EPO biology. Kauffman and staff, visiting lecturers.

Geol. 558-3. Biostratigraphy and Biogeography. *Offered alternate years.* Concepts and methods of biostratigraphic zonation, correlation, and paleobiogeography in light of biologic, climatic, and physicochemical parameters. Prer., Geol. 341. Kauffman.

Geol. 559-3. Research Techniques in Paleobiology. *Offered alternate years.* Instruction and practice with techniques of physical and chemical preparation of fossils, data analysis and presentation, and illustration. Prer., Geol. 340, 341, or introductory biology or anthropology. Kauffman and staff.

Geol. 561-2. Mammalian Micropaleontology. Studies of mammalian microfossils. Methods of analysis, collection, and use in stratigraphic problems such as correlation, paleoecology, and earth history. Prer., consent of instructor; Geol. 448/548 recommended. Robinson.

Geol. 562-5. Field Problems in Vertebrate Paleontology. *Summer.* Field techniques in study of fossil vertebrates and their host rocks. Four weeks field work, one week faunal analysis. Prer., Geol. 342, 411, 447/448 recommended. Robinson.

Geol. 568-3. Global Tectonics. Geological and geophysical aspects of plate motions along accretionary, transform, subducting, and collisional margins. Relationships of sedimentation, volcanism, metamorphism, and deformation to mountain building with examination of type areas. Prer., Geol. 312, 413, or equivalent. Kligfield and Wyss.

Geol. 570 through 579-variable credit. Geological Topics Seminar. Seminar studies in geological subjects of special current interest are offered primarily for graduate students, as departmental staff and facilities permit.

Geol. 580-4. Structural Geology III. Displacement and strain theory, ductile deformation of rocks. Lab. emphasizes practical techniques of finite strain measurement including computer methods. Prer., Geol. 412/512 or equivalent or consent of instructor. Kligfield.

Geol. 582-3. Geophysical Instrumentation. An introduction to the principles on which the design of instruments for various geophysical observations is based. Emphasis on seismographic and strain/tilt systems, with some discussion of gravimetric and magnetometric instruments. Prer., Phys. 322, 331, A.Math. 236. Kisslinger.

Geol. 593-4. Physical Principles of Seismic Exploration. A survey of the principles of seismic exploration with emphasis on wave propagation and data processing. A lab. is included. Prer., Phys. 214 and Math. 236 or equivalent. Harrison.

Geol. 595-3. Seminar: Climatic Change. (APAS 595, Geog. 523.) A cross-disciplinary survey of the evidence for and theories of climatic change. Prer., consent of instructor. Barry and faculty.

Geol. 596-3. Earth and Planetary Physics I. *Offered alternate years.* Introduction to seismic wave theory. Seismology and the internal structure of the earth, including density distribution and chemical composition. Prer., Phys. 321 and either Math. 443 or A.Math. 236. Kisslinger.

Geol. 597-3. Earth and Planetary Physics II. *Offered alternate years.* The earth's gravity field by surface and satellite techniques. Reduction of gravity observations and isostasy. Potential theory. Tides. Description, analysis, and origin of the earth's magnetic field. Prer., Phys. 321, 331 and either Math. 443 or A.Math. 236. Wahr.

Geol. 598-3. Earth and Planetary Physics III. *Offered alternate years.* The solar system; theories of its origin, meteorites. Distribution of radioactive materials; age dating. Heat flow through continents and the ocean floor; internal temperature distribution in the earth, mantle convection. Origin of the oceans and atmosphere. Prer., basic courses in geology, physics and mathematics recommended.

Geol. 615-3. Data Processing in the Earth Sciences. (Geog. 602.) Advanced statistical analysis, multivariate statistics, time series, classification models. Prer., Geol./Geog. 477 or equivalent or consent of instructor. Andrews.

Geol. 627-3. Thermodynamics for Petrologists II. Advanced topics in thermodynamics with emphasis on (1) properties of electrolyte solutions at low and high temperature; (2) thermodynamics of silicate melts; (3) experimental methods for determining activity coefficients in gaseous, liquid, and crystalline solutions; and (4) linear algebra techniques for manipulation of multicomponent rock compositions. Prer., Geol. 527. Munoz.

Geol. 631-3, 632-3. Sedimentary Petrology. Interpretation of the depositional and diagenetic history of sedimentary rocks as determined from thin-section studies. Prer., Geol. 531 and 517. Walker.

Geol. 653-3. Advanced Geomorphology. Recent research topics. Precise title specified in *Schedule of Courses.* Prer., Geol. 463/563 or consent of instructor. Andrews, Birkeland, Bradley.

Geol. 655-variable credit. Seminar in Geophysics. Advanced seminar studies in geophysical subjects for graduate students. Prer., open on consultation. Kisslinger.

Geol. 678-3. Seismic Wave Theory. (M.E. 678.) Theory of wave motion in continuous media, with emphasis on isotropic, elastic materials. Propagation, reflection, refraction, dispersion, and diffraction of body- and surface-waves in infinite and bounded systems, with applications to seismic waves. Prer., differential equations, complex functions, classical mechanics. Kisslinger.

Geol. 679-3. Advanced Seismology. *Not offered every year.* Wave propagation in the earth; inversion of seismological data to obtain earth structure. Matrix formulation of seismic wave transmission. Theory of seismic wave generation illustrating use of contour integration techniques. Prer., Geol. 678.

Geol. 698-3. Rock Physics. *Not offered every year.* Magnetic, electrical, optical, thermal, and mechanical properties of rocks. Emphasizes basic concepts of solid-state physics and shows the use of these properties in helping to interpret the geologic records. Basic courses in physics, mathematics, and geology recommended. Open on consultation. Spetzler.

Geol. 700-4 to 6. Master's Thesis.

Geol. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Geol. 940 to 949-variable credit. Independent Study in Geology. Time and credit to be arranged. For advanced undergraduates and graduates who have high scholastic standing. Open only upon consultation.

Geol. 950 to 959-variable credit. Independent Study.

Geol. 970-3. Plan 2 Master's Research.

GERMANIC LANGUAGES AND LITERATURES

German

See *Schedule of Courses* for specific course offerings in each semester.

Ger. 101-4. Beginning German I. *Fall, Spring.* For students with no previous training in German.

Ger. 102-4. Beginning German II. *Fall, Spring.* Prer., Ger. 101 or equivalent.

Ger. 201-4. Intermediate German. *Fall, Spring.* A review and continuation of the basic skills begun in the first year: reading, writing, speaking, and oral comprehension. Satisfies Arts and Sciences language requirement. Prer., Ger. 102 or equivalent.

Ger. 202-4. Intermediate German: Reading. *Fall, Spring.* Prer., Ger. 201 or three levels of high school German or equivalent. Satisfies Graduate School language requirement for the Ph.D.

Ger. 205-2. Intermediate German: Conversation. *Fall, Spring.* For students who wish supplementary conversational practice on the third semester level. Does not satisfy the Arts and Sciences foreign language requirement. Students may take this course concurrently with Ger. 201. Prer., Ger. 102 or equivalent.

Ger. 206-4. Intermediate German: Communication Skills. *Fall, Spring.* Prer., Ger. 201 or three levels of high school German. Satisfies Graduate School language requirement for the Ph.D.

Ger. 207-3. Intermediate Conversational German. *Offered during Vacation College only.* Intensive training in speaking and understanding spoken German. Does not satisfy the Arts and Sciences foreign language requirement. Prer., one semester of college-level German or equivalent.

Ger. 222-4. Scientific German. *Fall, Spring.* Prer., Ger. 201 or three levels of high school German, or upon consultation. Satisfies Graduate School language requirement for the Ph.D.

Ger. 301-3. Advanced Conversation and Grammar. *Fall, Spring.* Required for German majors. Prer., Ger. 202 or 206 or 222 or four levels of high school German, or upon consultation.

Ger. 302-3. Advanced Conversation and Composition. *Fall, Spring.* Required for German majors. Prer., Ger. 301 or upon consultation.

Ger. 303-3. Business German. *Fall.* A study of general commercial practices, vocabulary, and terminology applied in business transactions of various kinds with special emphasis on oral and written communications and correspondence; useful in subsequent business careers. Prer., Ger. 202 or 206, or four levels of high school German.

Ger. 309-2. German Pronunciation and Diction. An introduction to phonetics. Prer., Ger. 202 or 206 or 222, or upon consultation.

Ger. 311-3. German Literature I. *Fall.* An examination of selected literary texts from 1910 to the present. Prer., Ger. 202 or 206 or 222, or upon consultation. May be taken either before or after Ger. 312.

Ger. 312-3. German Literature II. *Spring.* An examination of selected literary texts up to 1910. Prer., Ger. 202 or 206 or 222, or upon consultation. May be taken either before or after Ger. 311.

Ger. 401-3. Advanced Composition, Conversation, and Stylistics I. *Fall.* Prer., Ger. 302 or upon consultation. Required for German majors.

Ger. 402-3. Advanced Composition, Conversation, and Stylistics II. *Spring.* Prer., Ger. 401 or upon consultation. Required for German majors.

Ger. 410/510-3. Applied Linguistics. *Fall, alternate years.* Introduction to the study of language and its applications to teaching of German. Analysis of phonology, grammatical structure, and vocabulary of German and English for high school and college teachers of German. Firestone or Lewis.

Ger. 423/523-3. German Civilization I. *Alternate years.* From the beginnings to 1870. Readings and illustrated lectures on the main cultural movements as they are manifested in the various arts and intellectual traditions in the German speaking countries. Prer., Ger. 311 and 312, or upon consultation. Schmidt.

Ger. 424/524-3. German Civilization II. *Alternate years.* From 1870 to the present. Continuation of Ger. 423/523. Prer., Ger. 311 and 312 or upon consultation. Blomster or Hollweck.

Ger. 433-3. The Age of Goethe. *Every third year.* German literature from 1770 to 1830. A close examination of representative texts from the periods of Storm and Stress, classicism, and romanticism. Emphasis on the philosophical and social background. Prer., Ger. 311 and 312. Schmidt or Wessell.

Ger. 434-3. Seminar in German Literature. *Every third year.* Intensive study of a particular literary period, author, or genre, e.g., Brecht, contemporary literature, 19th-century drama. Secondary sources will be utilized. Course content will differ each time. Prer., one previous literature or civilization course on the 400 level.

Ger. 437-3. Introduction to German Literary History I. *Alternate years.* From the beginnings to 1750. An examination of the main currents in German literature, including the Middle Ages, the Renaissance, baroque, and early classicism. Prer., Ger. 311 and 312. Hall.

Ger. 438-3. Introduction to German Literary History II. *Alternate years.* From 1750 to the present. Continuation of 437. The course will cover Weimar Classicism, romanticism, realism, naturalism, and the currents of the last 100 years. Prer., Ger. 311 and 312. Blomster or Wessell.

Ger. 480-3. Seminar: Literature in Cultural Context. Provides a broader basis for the work of literature, viewing it from various cultural perspectives. Specific content of course is defined by the instructor each time it is given. In English translation.

Ger. 495/595-3. Methods of Teaching German. *Fall.* Required of students who desire the recommendation of the department for secondary school teaching positions. For student teaching in German, see T.Ed. 471 under the School of Education.

Note: Prerequisite for all courses above 500 (incl. double-listed courses): graduate standing.

Ger. 501-3. Advanced Language Skills. *Fall, alternate years.* Training in oral and written language arts: speaking to groups, reciting, and lecturing; English to German translations of difficult texts; writing expository prose. Schmidt.

Ger. 514-3. History of the German Language. *Every third year.* Stresses the cultural and political factors which helped to shape the language. The main linguistic aspects dealt with are lexical and semantic changes. Firestone.

Ger. 521-3. Introduction to Middle High German. *Every third year.* A study of classical medieval German, with readings from works by principal Middle High German poets. Firestone or Hall.

Ger. 551-3. The History of German Literature. *Every third year.* An introduction to the systematic study of German literature in its historical development, including the interpretation of representative texts.

Ger. 597-2. College German Teaching. *Fall.* Required of new part-time instructors who have no previous teaching experience.

Ger. 610-3. Practicum Teaching German Literature. Students will register with the permission of a faculty member and will participate in the teaching of a literature course on the 300 or 400 level.

Ger. 700-6. Master's Thesis.

Ger. 710-3. Seminar: German Literature.

Ger. 711-3. Seminar: German Literature.

Ger. 720-3. Seminar: Germanic Linguistics.

Ger. 721-3. Seminar: Germanic Linguistics.

Ger. 730-3. Seminar: Language Instruction.

Ger. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Ger. 910-1 to 3. Independent Study.

Ger. 920-1 to 3. Independent Study.

Ger. 930-1 to 3. Independent Study.

Ger. 940-1 to 3. Independent Study.

Ger. 950-1 to 3. Independent Study.

Scandinavian Languages

Nor. 101-5. Beginning Norwegian. *Fall.*

Nor. 102-5. Beginning Norwegian. *Spring.* Prer., Nor. 101 or upon consultation.

Nor. 211-3. Second-Year Norwegian Reading and Conversation I. *Fall.* Fulfills the Arts and Sciences language requirement for the B.A. and B.F.A. degrees. Prer., Nor. 102 or upon consultation.

Scand. 225-3. Contemporary Sweden and Norway. *Spring.* (Taught in English.) A comprehensive overview of Swedish and Norwegian society with emphasis on economic and political life, institutions and organizations, people and culture, manners and customs.

Scand. 910-1 to 3. Independent Study. Prer., permission of instructor.

Scand. 920-1 to 3. Independent Study. Prer., permission of instructor.

Swed. 101-5. Beginning Swedish. *Fall.*

Swed. 102-5. Beginning Swedish. *Spring.* Prer., Swed. 101 or upon consultation.

Swed. 211-3. Second-Year Swedish Reading and Conversation I. *Fall.* This course fulfills the Arts and Sciences language requirement for the B.A. and B.F.A. degrees. Prer., Swed. 102 or upon consultation.

HISTORY

Hist. 101-3. History of Western Civilization I. Lectures and class discussions on the development of western civilization from its beginnings in the ancient near East to the time of the establishment of the first modern states in the 18th century.

Hist. 102-3. History of Western Civilization II. A survey course dealing with political, economic, social, and intellectual developments in European history from the 17th century to the present. Similarities and contrasts between European states will be underscored, as well as Europe's changing role in world history.

Hist. 103-3. Introduction to Asian History: The Middle East and India. An introductory survey of the history of the Middle East and India. Attention is divided equally between the traditional civilizations of Islam and Hinduism and patterns of modernization and nation-building in the 20th century.

Hist. 104-3. Introduction to Asian History: China and Japan. Introductory survey of the history of China and Japan, covering the main features of the traditional civilizations of these areas as well as more recent phenomena such as modernization, nationalism, and revolution in the 19th and 20th centuries.

Hist. 105-3. The World of the Ancient Greeks. (Clas. 105.) This survey course presents the emergence, major accomplishments, and decline of the world of the ancient Greeks from the Bronze Age civilizations of the Minoans and Mycenaeans to the career of Alexander the Great.

Hist. 106-3. The Rise and Fall of Ancient Rome. (Clas. 106.) A survey of ancient Roman history from the origins of the city to the decline of the Roman Empire in the Western Mediterranean and the emergence of the Byzantine Empire in the Eastern Mediterranean.

Hist. 111-3. Honors: Western Civilization I. A thematic history of the Western world from the ancient Greeks to the beginnings of modern European society. It is designed specifically for freshmen with advanced standing. Focus is on reading and discussion more than lectures. A student receiving credit for Hist. 101 may not receive credit for Hist. 111.

Hist. 112-3. Honors: Western Civilization II. A history of the social, political, and cultural development of the Western world from the beginning of the Enlightenment to the present. It is designed for freshmen with advanced standing. The emphasis will be on reading and discussion. A student receiving credit for Hist. 102 may not receive credit for Hist. 112.

Hist. 141-3. The History of England I. Deals with the period from Roman time to the 17th century. Covered are social, political, and constitutional affairs which contributed to the creation of the English nation.

Hist. 142-3. The History of England II. The period from the 17th century to the present. Political, economic, social, and imperial developments which contributed to the creation of the modern industrial and democratic state are the major issues covered.

Hist. 151-3. The United States to 1865.[1] A survey of American history from the first settlement until the end of the Civil War.

Hist. 152-3. The United States Since 1865.[1] A general survey of the social, economic, political, and cultural development of the United States from the close of the American Civil War to the present.

Hist. 161-3. Honors: The United States to 1865. A survey of American history from the first settlement until the end of the Civil War, taught for students with honors standing. It will emphasize reading and discussion of recent interpretations of the period; willingness to participate in class necessary. A student receiving credit for Hist. 151 may not receive credit for Hist. 161.

Hist. 162-3. Honors: The United States Since 1865. A survey of American history from the Civil War to the present, taught for students with honors standing. It will emphasize the reading and discussion of recent interpretations of the period; willingness to participate in class is necessary. A student receiving credit for Hist. 152 may not receive credit for Hist. 162.

Hist. 181-3. History of Latin America: The Colonial Experience.

Hist. 182-3. History of Latin America: The National Experience.

Hist. 201-3. Chicano History to 1848. (Ch.St. 201.) Introduction to the historical developments of Chicano society and thought from the pre-Columbian period to 1848.

Hist. 202-3. Chicano History: 1848 to Present. (Ch.St. 202.) Introduction to the historical development of Chicano society and thought from 1848 to the present.

Hist. 207-3. History of Christianity I: To the Reformation. A general introduction to the history of Christianity from its beginnings through the first period of the Protestant Reformation. Examines religious life and the church in relation to the social and cultural setting.

Hist. 208-3. History of Christianity II: From the Reformation. A general introduction to the history of Christianity from the Reformation to the present. Examines religious life and the church in relation to the social and cultural setting.

Hist. 211-3. Culture and Institutions of the Middle Ages. Political, institutional, and cultural history of Europe from the 4th to the 12th centuries.

Hist. 212-3. Culture and Institutions of the Middle Ages. Political, institutional, and cultural history of Europe from the 13th to the 15th centuries with particular attention to the disintegration of the medieval order resulting from the national state, the secularization of society, and the decline of the church.

[1] Also available through correspondence study.

Hist. 215-3. Afro-American History I. (Bl. St. 215.) See Black Studies for course description.

Hist. 216-3. Afro-American History II. (Bl. St. 216.) See Black Studies for course description.

Hist. 217-3. Survey of African History to 1800. Will focus on some of the major themes and issues in the history of the African continent from the earliest times to the 19th century. Special attention is given to methodology and the rise of major African states.

Hist. 218-3. Survey of African History, 1800 to the Present. The last 180 years in Africa's history were years of tremendous change. Course will focus on some important events, issues, etc. of this period, including the impact of slave trading on Africa, colonial rule, the imposition of white minority governments in southern Africa, and independence.

Hist. 235-3. Problems in German History: Nazi Germany. Concerned with the origins of German National Socialism, with the rise of the National Socialist movement to power, and with Nazi social and racial policies. Prer., Western Civilization sequence.

Hist. 254-3. Topics in American History. An in-depth exploration of relevant themes in the American experience from the nation's founding to the present.

Hist. 258-3. History of Colorado. Emphasizes the historical variety and ethnic diversity of Colorado. Along with traditional themes in Colorado history, such as the gold rush, attention will be given to Indian and Hispanic activity and culture.

Hist. 270-3. History of Japan Through Cinema. This course uses commercial feature-length films as a vehicle for looking at different chronological periods and understanding life and times. The films of Karosawa, Mizaguchi, Ozu, and other leading directors will be used.

Hist. 271-3. Asian-American History. An introductory level survey of the social history of Asians in America from the 19th century to the present. The primary focus will be on delineating and explaining the changes that Asian Americans, one of the most visible ethnic groups in our society, have undergone since their arrival in the United States.

Hist. 298-3. History of Women in the United States. (Wm.St. 298) An examination of the role of women—social, economic, political—in American history from Colonial times to the present.

For all Selected Readings and Research Seminar courses numbered 301-353, the permission of the instructor is required. Preference will be given to senior history majors.

Hist. 301-3. Selected Readings in Ancient History.

Hist. 302-3. Selected Readings in Medieval History.

Hist. 303-3. Selected Readings in Renaissance and Reformation.

Hist. 304-3. Selected Readings in Early Modern Europe.

Hist. 306-3. Selected Readings in Early English History.

Hist. 308-3. Selected Readings in Comparative European History.

Hist. 309-3. Selected Readings in Modern European History.

Hist. 311-3. Selected Readings in Early American History.

Hist. 312-3. Selected Readings in the American West.

Hist. 314-3. Selected Readings in American Society and Thought.

Hist. 316-3. Selected Readings in American Diplomatic History.

Hist. 318-3. Selected Readings in Japanese History.

Hist. 320-3. Selected Readings in Recent Chinese History.

Hist. 321-3. Selected Readings in Latin American History.

Hist. 323-3. Selected Readings in Russian History.

Hist. 324-3. Selected Readings in Asian and African History.

Hist. 331-3. Research Seminar: Ancient History.

Hist. 335-3. Research Seminar: European Intellectual History.

Hist. 336-3. Research Seminar: Early English History.

Hist. 337-3. Research Seminar: Britain Since 1688.

Hist. 338-3. Research Seminar: Comparative European History.

Hist. 339-3. Research Seminar in Modern European History.

Hist. 342-3. Research Seminar: The American West.

Hist. 344-3. Research Seminar: American Society and Thought.

Hist. 345-3. Research Seminar: Urban American History.

Hist. 346-3. Research Seminar: American Diplomatic History.

Hist. 347-3. Research Seminar: Recent American History.

Hist. 353-3. Research Seminar: Russian History.

Hist. 360-3. The Indian in American History: The Eastern Region. Pre-European social and cultural developments, longevity, and continuity of human history in North America is explored. By examining the ways in which Indian socieities east of the Mississippi River responded to Euro-Americans, the Indian's role in eastern North American history is demonstrated.

Hist. 361-3. The Indian in American History: The Western Region. By discussing pre-European social and cultural developments, the longevity and continuity of human history in North America is explored. By examining the ways in which Indian societies west of the Mississippi River responded to Euro-Americans, the Indian's role in western North American history is demonstrated.

Hist. 398-3. Women in Victorian England. (Wm.St. 398.) Looking at changing roles, status of women in a period of expansion; impact of industrialization on working women, sexuality, family planning, expansion of women in education, politics and the professions, the single women crisis, women's rights.

Hist. 400-3. Women in Asian History. (Wm.St. 410.) A consideration of major issues affecting Asian women throughout history, focusing on aspects of development as they affect women: traditional roles and ideals, the family, colonialism, nationalism, education, the industrial revolution, the impact of technological change and aid programs.

Hist. 401-3. Women and Society in Industrial Europe. (Wm.St. 401.) Examines the impact of industrialization and related social change on women in modern European history. Topics will include work, family, sexuality, and women in movements for social and political change. Prer., Hist. 102 or equivalent and upper division standing.

Hist. 402-3. Athens and Greek Democracy. (Clas. 402.) See Classics for course description.

Hist. 403-3. Alexander and the Hellenistic World. (Clas. 403.) See Classics for course descriptions.

Hist. 407-3. History of the Byzantine Empire. (Clas. 407.) Approaches Byzantium as the heir to the Greco-Roman tradition, paying considerable attention to the lines of continuity with the ancient past but recognizing discontinuity as well. Readings will present a survey of Byzantine history and civilization.

Hist. 408-3. The Roman Republic. (Clas. 408.) See Classics for course description.

Hist. 409-3. The Roman Empire. (Clas. 409.) This intense survey of Imperial Roman history will begin with the Roman Revolution and end with an examination of the passing of centralized political authority in the Western Mediterranean. Emphasis will be on life, letters, and personalities of the empire.

Hist. 411-3. Social Foundations of European Civilization. The study of the social structures of Europe and their relationship to political, religious, and economic institutions A.D. 400-1500.

Hist. 412-3. Intellectual History of Medieval Europe. Changing theories and realities of relationship between religious and secular elements of medieval civilization with particular emphasis on the evolution of the medieval empire and the culture of the universities and schools.

Hist. 413-3. Constitutional and Legal History of England to 1485. The origins and development of the legal and political institutions and concepts of England. Special reference and emphasis is accorded

the implications of those developments to contemporary American and English systems.

Hist. 415-3. History of Science From the Ancients to Sir Issac Newton. A history of science from the Pre-Socratics to Isaac Newton, underscoring major intellectual themes in scientific thought and the historical context in which they developed.

Hist. 418-3. History of Southern Africa Since 1800. Examines the history of Southern Africa. Special emphasis will be placed on the history of South Africa. The course will focus on the decline of white rule and the region's strategic importance.

Hist. 419-3. European Intellectual History, 1750-1870. Treats the major developments in European thought from the Enlightenment to Nietzsche. Special attention given to the individuals whose ideas have had the greatest influence on modern intellectual history, e.g., Rousseau, Hegel, Herder, Marx, Kierkegaard, Baudelaire, Darwin, and others. Prer., upperclass standing or consent of instructor.

Hist. 420-3. European Intellectual History, 1870-Present. Topics which receive particular emphasis: Nietzsche and the youth revolt against middle class society, the literary and artistic avant garde (Impressionism to Existentialism), the psychoanalytic movement, the European Right and Left, Post WW II European thought. Prer., upperclass standing or consent of instructor.

Hist. 423-3. Europe During the Renaissance. Explores the history and culture of Western Europe, ca. 1300-1520. Comprehensive in scope, with analysis of political, economic, social, religious, intellectual, and artistic matters. Discusses the significance of the Renaissance for the origins of modern civilization.

Hist. 425-3. War and the European State, 1618-1793. A study of the development of the European states in response to international power struggles in the 17th and 18th centuries (up to the French Revolution).

Hist. 426-3. The Age of Reason, Montaigne to Voltaire. A study of major European intellectual trends from the late 16th century through the Enlightenment.

Hist. 427-3. History of East-Central Europe to 1815. History of Eastern theocratic empires of Turks and Hapsburgs from the 15th to 19th centuries, the development of political consciousness of various peoples composing these empires, conflicts between Eastern theocracies, and rising secularism of Western Europe, culminating with the Napoleonic Wars.

Hist. 428-3. History of East-Central Europe Since 1815. Problems connected with dissolution of East European empires at the end of WWI, the formation of the nation states, the viability of these states in the 20th century, and the restoration of the imperial order after WWII.

Hist. 432-3. Twentieth-Century Europe. Involved with European political, economic, and social institutions from WWI to the present, with emphasis on 20th-century communism and fascism and developments in the western European democracies.

Hist. 433-3. French Revolution and Napoleon. The causes of the French Revolution are analyzed. Covers in detail the basic political, economic, and social changes and the legacy in Europe and the world of the French revolutionary and Napoleonic eras.

Hist. 434-3. British Colonial America, 1690-1750. This course, the second part of a year-long sequence in early American history, concentrates on the economic, social, cultural, and political processes underway in the British colonies of North America during the period between the Glorious Revolution and the French and Indian War. Hist. 450 is desirable but not a prereq.

Hist. 435-3. German History to 1848. A cultural, political, and social history of Germany up to and including the revolutions of 1848. Particular emphasis will be placed upon the political history of Prussia and upon such cultural phenomena as German romanticism.

Hist. 436-3. German History Since 1849. A cultural, political, and social history of Germany since 1849. Particular emphasis will be placed upon German unification, Bismarckian foreign policy, the rise of neo-Romanticism, Weimar politics, and the rise of National Socialism.

Hist. 443-3. Tudor England. An examination of the Tudors and the developments (constitutional, political, imperial, and artistic) of Renaissance England under this remarkable dynasty.

Hist. 444-3. Stuart England. An examination of England in its age of greatest political crisis and hurried transformation from nearly absolute monarchy to a parliamentary oligarchical form of government.

Hist. 449-3. The Gilded Age. Examines the social and economic changes which transformed American life during the years 1870-1900. Labor violence, agrarian protest, political corruption, and racial and ethnic conflict are some of the consequences of those changes.

Hist. 450-3. British Colonial America, 1492-1689. Story of the exploration, settlement, and early development of the British Colonies in North America from the perspective of the participants themselves, Indian, European, and African.

Hist. 451-3. The American Revolution. A survey of the events leading to the War of Independence and the creation of the United States.

Hist. 452-3. The New Nation: America, 1789-1828. A history of the United States from George Washington's inauguration to the election of Andrew Jackson. The course deals with the political, social, economic, and cultural currents in the life of post-Revolutionary America.

Hist. 453-3. Civil War and Reconstruction. Describes the forces at work in the antebellum period that led to sectional warfare; the social, economic, and political changes effected by the war; the American agony of reconstruction; and the long-range results of that difficult era.

Hist. 457-3. The Early American Frontier. Examination of the westward movement from the colonial period through 1850 in the region east of the Mississippi, with major stress on unique problems of societies on the successive frontiers and their relationship to the determination of national policies.

Hist. 458-3. The Later American Frontier. Deals primarily with the Trans-Mississippi west during the 19th century, the westward advance of various frontiers, and their influence upon national development. Emphasis upon the economic factors and the associated cultural and social growth of the region.

Hist. 459-3. The American Southwest. Focusing on the region's three main peoples (Indian, Hispanic, and Anglo), this course will emphasize the dynamics of inter-ethnic relations. Indian migrations, Spanish conquest and Indian response, Mexican-Indian interaction, and Anglo domination are some of the themes discussed.

Hist. 461-3. Popular Culture in America to 1900. A survey of the cultural predispositions of the people as contrasted with high culture in America. Popular arts, literature, music, folklore, sports, psychology, religion, and science will be covered.

Hist. 462-3. Popular Culture in America: The 20th Century. Continuation of Hist. 461.

Hist. 463-3. American Society and Thought to 1865. Concerned with the American family and community in different social environments. Looking at families of different ethnic, religious, and class backgrounds; observing how they are changed by the passage of time, new economic conditions, or new political institutions.

Hist. 464-3. American Society and Thought Since 1865. Primarily concerned with family roles and community values, and how they are altered by economic, demographic, and intellectual changes. Some of the most important themes will be acculturation, changing occupational opportunity, the idea of success, and popular culture.

Hist. 465-3. U.S. History, 1929-1952: Lecture. A survey of American history, 1929-1952, with attention to domestic and foreign policy issues. Emphasis will be placed upon the Great Depression, WW II, the Cold War, the Korean conflict, and the Truman administration's Fair Deal.

Hist. 466-3. U.S. History, 1948 to the Present: Lecture. Emphasis on the Eisenhower years, the New Frontier, the Great Society of the 1960s, American involvement in Vietnam and popular reaction to that conflict, the Nixon domestic and foreign policies, and the social and economic problems of the 1970s.

Hist. 467-3. Diplomatic History of the U.S. to 1914.[1] Traces the rise of the United States from the status of a weak new nation to that of an imperial world power with interests everywhere.

Hist. 468-3. Diplomatic History of the U.S. Since 1914.[1] Traces the rise of the United States to a position of dominance from 1900 until the present. Not only describes the events of diplomatic history but seeks to explain the economic, social, and intellectual roots of foreign policy.

Hist. 470-3. History of Urban America. Surveys the growth of American cities and urban life styles from the 18th century to the present. Compares the role of cities, their structure and problems, during three stages of growth—commercial, industrial, and modern.

Hist. 472-3. History of Modern Chinese Intellectual Thought. An upper division survey of the major intellectual movements in modern China from Ch'ing Neo-Confucianism, empiricism, nationalism, to Chinese communism.

Hist. 473-3. History of Traditional China. Survey of major traditions in philosophy, art, politics, society, and economy of China during the premodern period.

Hist. 474-3. Rise of Revolutionary China. A survey of political, social, and economic events in China since 1750.

Hist. 475-3. Ancient and Medieval Japanese History. Beginning with the long prehistoric and protohistoric period, continues into the age of the bureaucratic state, then focuses on Japan's exceptionally long feudal experience which brought Japan to the Meiji Restoration of 1868.

Hist. 476-3. Modern Japanese History. Beginning with early modern Japan in the late feudal period, proceeding into the spectacular and rapid modernization of the Meiji era, including Japan's prewar experience of democracy and peaceful diplomacy. Concludes with WW II and postwar reforms.

Hist. 477-3. Modern Japanese Intellectual History. An exploration of salient issues in modern intellectual history in Japan. Examines such themes as the debate over opening Japan, the Meiji Enlightenment, the high tide of liberal democracy, the socialist solution, the rise of feminist consciousness, ultranationalism, Pan-Asianism, existentialism, Japanese Christianity, and Pacifism.

Hist. 478-3. History of Modern India. A survey of the history of modern India. Covers such major themes as Mogul rule, the British Raj, the growth of nationalism, and the independence struggle.

Hist. 480-3. Military History: Lecture. A survey of America's national defense and war efforts from the Spanish American War to the present, with emphasis on the causes and consequences of modern conflicts.

Hist. 481-3. History of Mexico to 1821. Survey of Mexican history beginning with the roots and evolution of Pre-Columbian civilizations and concluding with the gaining of Mexican Independence in 1821. Emphasis on the society and culture of the Aztecs and Mayans, the Spanish conquest of Mexico, and the colonial regime of New Spain.

Hist. 482-3. The Emergence of Modern Mexico. Survey of Mexican history continues with the establishment of independence in 1821, examines the upheavals of the Mexican Revolution, and culminates with recent events in Mexico.

Hist. 488-3. The Medieval Middle East, A.D. 500-1600. An examination of Islam from 600 to the early modern period. Attention is divided equally between (1) Arab, Iranian, and Turkish political and economic history and (2) the arts and sciences characteristic of the civilization of Islam (theology, philosophy, mysticism, etc.)

Hist. 489-3. The Modern Middle East, 1600 to the Present. Primarily from 1800 to the present. Attention is divided equally between (1) political history and international relations in the region and (2) patterns of economic, social, and cultural modernization in the main countries of the region.

Hist. 491-3. The Arab-Israeli Problem. An examination of the clash between modern Jewish and modern Arab nationalism over the area of Palestine/Israel since the late 1800s. The course concludes with a simulation exercise in which the students work through a hypothetical crisis.

Hist. 493-3. History of Russia Through the 17th Century.[1] The establishment and expansion of the Russian state and the development of the political, economic, and social machinery necessary to administer it. From ancient times to the reign of Peter the Great and the proclamation of a Russian empire.

Hist. 494-3. Imperial Russia.[1] A survey of the major cultural, social, and economic changes from the reign of Peter the Great through the first Russian revolution of 1905.

Hist. 495-3. The Russian Revolution and the Soviet Regime.[1] Soviet Russia from the February Revolution of 1917 to the fall of Khruschev. Begins with a description of the early careers and ideas of Lenin, Trotsky, and Stalin, and thereafter covers in detail the significant domestic and international events.

Hist. 498-3. Senior Colloquium.

Hist. 499-3. Honors Thesis. Prer., Hist. 498.

Hist. 500-3. Quantification in History. An introduction to the range of applications of quantification techniques to the study of history. Includes historiography, theory, and practical applications.

Hist. 600-3. Historical Methods: Introduction to the Professional Study of History. The purposes, materials, and techniques of historical scholarship. Theory, practice, and criticism.

Hist. 601-3. Historiography: Introduction to the Professional Study of History. Covers some of the major historiographical schools and concerns that have emerged during the course of the discipline's development in Europe and the United States.

Hist. 603-3. Readings in Ancient History.

Hist. 613-3. Readings in 17th-Century Europe.

Hist. 621-3. Readings in Medieval History.

Hist. 628-3. Readings in History of East-Central Europe.

Hist. 632-3. Readings in Renaissance History.

Hist. 634-3. Readings in European Intellectual History.

Hist. 635-3. Readings in Modern German History.

Hist. 642-3. Readings in English History, 1714.

Hist. 643-3. Readings in Modern European History.

Hist. 647-3. Readings in English History Since 1688.

Hist. 650-3. Readings in American Colonial History.

Hist. 656-3. Readings in Comparative Ethnohistory.

Hist. 658-3. Readings in the American West.

Hist. 660-3. Readings in Feminism and Social Change.

Hist. 661-3. Readings in the History of American Women.

Hist. 663-3. Readings in U.S. Society and Thought.

Hist. 664-3. Readings in the History of the American Family.

Hist. 665-3. Readings in U.S. History, 1929-1952.

Hist. 666-3. Readings in U.S. History, 1948-Present.

Hist. 668-3. Readings in American Diplomatic History.

Hist. 669-3. Readings in U.S. History, 1870-1900.

Hist. 670-3. Readings in the History of Urban America.

Hist. 671-3. Readings in Chinese History.

Hist. 680-3. Readings in Third World History.

Hist. 681-3. Readings in Latin American Colonial History.

Hist. 685-3. Introduction to Historic Preservation. A survey of historic preservation programs and the techniques employed by private and public agencies at the local, state, and national levels to safeguard America's heritage.

Hist. 690-3. Introduction to Archival Management: Lecture. The evolution of archival and manuscript repositories and the methods

[1]Also available through correspondence study.

employed to preserve and make available to researchers public and private records; covers the acquisition, arrangement, and description of records, and techniques for making them available for reference.

Hist. 691-3. Readings in Middle Eastern History.

Hist. 697-3. The Russian Revolutionary Movement.

Hist. 700-4 to 6. Master's Thesis.

Hist. 722-3. Seminar: Medieval History.

Hist. 727-3. Seminar: Early Modern Europe, 16th-18th Centuries.

Hist. 728-3. Seminar: East Central Europe.

Hist. 733-3. Seminar: Reformation Europe.

Hist. 734-3. Seminar: Modern European History.

Hist. 740-3. Seminar: European Intellectual History.

Hist. 745-3. Seminar: English History, 800-1688.

Hist. 746-3. Seminar: English History, 1688-Present.

Hist. 750-3. Seminar: Early American History.

Hist. 758-3. Seminar: History of the American Frontier.

Hist. 760-3. Seminar: History of the American Southwest.

Hist. 763-3. Seminar: American Society and Thought.

Hist. 765-3. Seminar: U.S. History, 1929-1952.

Hist. 766-3. Seminar: U.S. History, 1948-Present.

Hist. 770-3. Seminar: History of Urban America.

Hist. 785-3. Training in Historic Preservation. Training in government agencies in the Denver area to give students opportunities for practical experience in various applications of historic preservation.

Hist. 790-3. Training in Archival and Records Management Procedures. Practical training in archival and records management through on-the-job experience in public and private archival and records management programs operative in the Denver area.

Hist. 794-3. Seminar: Modern Russian History.

Hist. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Hist. 901 through 906-variable credit. Independent Study, Undergraduate Level.

Hist. 910 through 919-variable credit. Independent Study, Undergraduate Level.

Hist. 940 through 949-variable credit. Independent Study, Undergraduate Level.

Hist. 950 through 959-variable credit. Independent Study, Graduate Level I.

Hist. 960 through 969-variable credit. Independent Study, Graduate Level II.

INTERDISCIPLINARY STUDIES, CENTER FOR

Courses listed under CIS carry elective credit. Under some circumstances they may be credited to a specific major. See the *Schedule of Courses* for other current listings.

CIS 480-3. Modes of Thought I. Readings and discussion concerning the modes of thought appropriate to the diverse problems—theoretical, practical, or creative—that man formulates or confronts. Practice in the arts of analytical reading, clear speaking, and precise writing is encouraged. Registration by consent of the instructor.

CIS 481-3. Modes of Thought II. Alternative to CIS 480 with other selected topics.

Humanities

An interdisciplinary major in humanities is offered by the Center for Interdisciplinary Studies. For requirements, see Humanities section. The sequence Hum. 101-102 fulfills the college humanities requirement.

Hum. 101-6. Introduction to the Humanities I. *Fall.* Six meetings a week (three discussion classes, three lect.-demonstrations in art and music). Analytical and comparative study of works in literature, philosophy, music, and the visual arts. From Aegean to Baroque, emphasizing structure, content, and style in specific examples.

Hum. 102-6. Introduction to the Humanities II. *Spring.* Continuation of Hum. 101. From Baroque to contemporary styles. Prer., Hum. 101. Credit cannot be received for both Hum. 101-102 and Engl. 160-161 (formerly 120-121).

Hum. 300-3. Images of the 20th Century. This interdisciplinary course is built around the tension between conflicting attitudes toward the work of art in the 20th century; art for art's sake, or art engagé. In each of four different art forms (literature, film, painting, music), students will study works which assume one or the other, or both, of these polarities. Team-taught.

Hum. 301-3. Twentieth Century: Art, Science, and Society. Focus will be on the relationships among artistic, intellectual, political, and cultural events with selection of particular figures and movements as examples for study.

Hum. 302-3. Narrative in the Arts. Explores the nature of narrative, its forms of presentation in literature, film, dance, art, and music; verbal and nonverbal modes of relating a story with consideration of the importance of fictional and documentary narrative. Prer., Hum. 101-102; recommended, 6 hrs. of literature; consent of instructor.

Hum. 303-3. The Comic Sense. An interdisciplinary approach to comedy, examining art, music, literature, and film from different periods. Comic theory interlaced with the study of particular works.

Hum. 304-3. The Tragic Sense. A study of some of the great tragic works of art, music, and literature from the Greeks to the 20th century. Tragic theory invoked as an aid to interpretation.

Hum./F.S. 305-4. Film History I. Follows film's historical and aesthetic growth by viewing silent and early sound films (half of the films shown are silents). Genres studied include documentaries, experimental films, and classic Russian, German, French, and American films made before 1940.

Hum./F.S. 306-4. Film History II. This course starts with the late 1930s and early 1940s films of Renoir, Welles, Cocteau, and Hitchcock and follows the historical growth and evolution of film esthetics to the present. Neo-realist, French New Wave, and recent experimental films are studied.

Hum. 319-3. Computers and Folklore. Involves a rapid survey of various genres of folklore: ballads, folk song and drama, riddles, similies, limericks, puns, and jokes, as well as nonverbal folklore. Individual and class projects are carried out, making use of established computer-aided methods of analysis.

Hum. 401-3. Film and Fiction. The course explores the similarities and differences between literature and film as narrative arts. Several novels, short stories, and plays and the films made from them are studied. Problems in point of view, manipulation of time, tone, structure, and setting are examined.

Hum. 402-3. Film Theory. Prer., Hum. 305 or consent of instructor.

Hum. 406-3. Period Studies. Prer., Hum. 101-102.

Hum. 407-3. Period Studies. Prer., Hum. 101-102.

Hum. 408-3. Period Studies. Will focus on the literature, art, and music of a particular period or movement. For example, the Romantic Quest; later 19th-century art and literature.

Hum. 409-3. Period Studies. Prer., Hum. 101-102.

Hum. 410-3. Studies in Humanities. Prer., Hum. 101-102 or consent of instructor.

Hum. 411-3. Studies in Humanities. Prer., Hum. 101-102 or consent of instructor.

Hum. 412-3. Studies in Humanities. Prer., Hum. 101-102.

Hum. 413-3. Studies in Humanities. Prer., Hum. 101-102.

Hum. 415-3. The Legacy of Humanism. Examines the traditions of humanism from Erasmus to the present day. The concepts of man shared by Petrarch, Erasmus and More, Shakespeare and Milton, Newman and Whitehead will be examined closely.

Hum. 416-3. Myth in the Arts. A study of representative myths in the art, music, and literature of the ancient and modern worlds. Recommended prer., Hum. 101-102 or Clas. 110.

Hum. 482-3. Law and Literature I. (Engl. 479.) *Fall, alternate years.* Exploration of law as theme and structure from *Antigone* and Utopia to modern fiction, plus readings in legal materials. Prer., Hum. 101-102.

Hum. 483-3. Law and Literature II. *Spring, alternate years.* Continuation of Hum. 482. Seminar investigating problems of censorship, obscenity, etc. Prer., Hum. 482 or consent of instructor.

Hum. 940-1 to 3. Independent Study. Prer., Hum. 101-102. Consent of humanities instructor required.

Natural Science

Nat.Sci. 123-4. Biology—A Human Approach. *Fall.* Principles of biology and their implications. For nonscience majors. Central theme is man and the environment with an emphasis on ecology, natural resource conservation, and the interrelatedness of a growing human population. Lectures, recitations, open laboratories, optional field studies.

Nat.Sci. 124-4. Biology—A Human Approach. *Spring.* A continuation of Nat.Sci. 123 with the emphasis on man as a functioning organism. Organ systems including common malfunctions are studied around the central theme of a constant internal environment.

Nat.Sci. 125-6. Nature and Society. *Fall, Spring.* Selected general themes involving man's relationship to his environment are used to integrate the physical and biological sciences. Such themes include energy and its transformations, humans as knowers and controllers of nature, or humans as agents in the processes of the biosphere.

Nat.Sci. 321-3. History of Science: Ancients to Copernicus. (Phil. 341.) The history of science and natural philosophy from the ancients through the Hellenistic and medieval developments of astronomy, physics, biology, and medicine to the recasting of Ptolemaic astronomy by Copernicus. Taught collaboratively by faculty in the sciences and philosophy. Prer., upper division status or permission.

Nat.Sci. 322-3. History of Science: Copernicus to Newton. (Phil. 342.) The genesis of modern science in the 16th and 17th centuries through the achievements of Bacon, Descartes, Kepler, Galileo, and Harvey, including such strands as the Reformation, Renaissance mysticism, advances in mathematics and instrumentation, and the rise of the atomistic-mechanical philosophy. Prer., upper division status or permission.

Nat.Sci. 323-3. History of Science: Newton to Einstein. (Phil. 343.) The history of physical and biological science, from the epoch-making achievements of Charles Darwin in biology to the dawn of the 20th-century revolutions in physics, chemistry, and genetics. The course deals with the successes of the mechanical philosophy of nature and its eventual problems. Prer., upper division status or permission of instructor.

Nat.Sci. 324-3. Perspectives of 20th-Century Science. (Phil. 344.) A historical study of some of the leading developments of 20th-century science, selected for their scientific or social significance, including quantum theory of atomic structure and the chemical bond, Einstein's relativity theory, nuclear fission, the genetic code, continental drift, concepts of the ecosystem, and other topics. Prer., upper division status or permission.

Nat.Sci. 325-3. History of Biology. *Spring.* Survey of major themes in development of biological theory from ancient times to present, emphasizing complementary roles of observation, experiment, and technical innovation, and influence of general cultural environment on scientific advance. Readings in primary and secondary sources, lectures, discussions. Prer., upper division status or permission.

Nat.Sci. 326-3. The Darwinian Revolution. *Spring.* An examination of the origins, development, and influence of evolutionary theory. Reading, discussion, lectures. A course paper is required. Prer., two semesters of college biology.

Nat.Sci. 330-3. Global Ecology. (EPOB 380.) *Fall.* Involves the study of ecological principles and problems at the biosphere level. Concerns a world-wide approach to life support systems, populations, biotic resources, public health and biomedical problems, ecological interactions, agricultural ecology, environmental deterioration, species diversity and losses, and environmental ethics. Prer., one year of college biology or consent of instructor.

Nat.Sci. 910-1 to 3. Independent Study. *Fall, Spring.* Individual projects, including the opportunity to aid in the teaching activities of the staff. Consent of instructor.

Nat.Sci. 940-1 to 3. Independent Study. *Fall, Spring.* Consent of instructor required.

Social Science

Soc.Sci. 141-3, 142-3. Controversy and Challenge in Modern Social Thought. Designed to acquaint the student with intellectual and cultural developments in the social sciences. Major thinkers, beginning in the 18th century, as well as later challenges to their theories, will be discussed.

Soc.Sci. 440-3. Heritage of American Ideas I. Major concepts in American thought such as democracy, individualism, equality, progress, reform, and freedom, with emphasis on their development and modification, consideration of the contributions of leading figures and movements influential in the shaping of American society.

Soc.Sci. 441-3. Heritage of American Ideas II. Continuation of Soc.Sci. 440.

Soc.Sci. 450-3. American Lives. *Spring.* Analysis of 19th-20th-century American autobiographies from the standpoint of literature, history, anthropology, and psychology. Attention will be given to what it meant to grow up in the United States from the 1850s to the 1970s.

Soc.Sci. 451-3. Social Scientists Make History, 1880-1940. The focus of this course is on an analysis of the formative period of scholarly social thinking and theorizing in America. Social scientists are portrayed as members of cultural, social, and historical environments that influenced the content and development of their theories.

Soc.Sci. 910-1 to 3. Independent Study. For lower division students. Consent of instructor required.

Soc.Sci. 940-1 to 3. Independent Study. Consent of instructor required.

See also individual listings for affiliated programs: American Studies, Asian Studies, Black Studies, Comparative Literature, Conflict and Peace Studies, Women's Studies.

LINGUISTICS

Ling. 100-3. Language. *Offered each semester.* A nontechnical exploration of human language for the general citizen. Emphasis on the basics of how language works, the creative aspects of language, and the languages of America today.

Ling. 150-3. Basic Traditional Grammar. *Offered each semester.* A general course intended to present the fundamentals of grammar in the Western tradition. Emphasis is on making the concepts and uses of grammar (as exemplified in English and closely related foreign languages) understandable to the nonspecialist.

Ling. 200-3. Introduction to Linguistics. *Offered each semester.* An introduction to the study of languages as structural systems. Principles of sound patterns, word formation, meaning, and sentence structure. Some attention to language acquisition, psycholinguistics, language families, dialects, historical change in languages, and different language types.

Ling. 211-3. Writing Systems of the World. *Offered irregularly.* An overview of the structural features of human languages and a review of the different ways these are represented in selected ancient and modern writing systems.

Ling. 330-3. Linguistic Analysis. *Offered yearly.* Intensive practice in the analysis and description of language data. Prer., Ling. 200.

Ling. 343-3. Semantics. *Offered yearly.* Theoretical and practical study of meaning in natural language. Both semantic theories and semantic phenomena from diverse languages are considered. Does not treat techniques for improving the use of language.

Ling. 350-3. Language and the Public Interest. *Offered every third semester.* A study of language in public and private use, with concentration on semantic devices as found in the language of political propaganda, advertising, business, and government, as well as in the everyday use of language between and among people.

Ling. 401/501-3. The Nature of Grammars. *Offered yearly.* Approaches to the description and explanation of language structure. Prer., Ling. 200. Not valid for linguistics Ph.D.

Ling. 424/524-3. Survey of the History of Linguistics. *Offered every third semester.* Historical survey of views on language, and examination of linguistic thought in all historical periods from Panini to de Saussure. This course may not be sustituted for Ling. 724, and it can not be counted toward the Ph.D. in linguistics.

Ling. 440/540-3. Introduction to Transformational-Generative Grammar. *Offered yearly.* This course covers discussion of theoretical and methodological issues in current transformational theory, including conventions of representing sentence structure within the transformational model and justification of abstract structures with emphasis on English syntax. Prer., Ling. 200.

Ling. 460/560-3. English Phonology for Teachers of English to Speakers of Other Languages. *Offered yearly.* Articulatory phonetics of English, English phonological structure, and the relation between the spelling of American English and the pronunciation of the standard dialect. Some consideration of dialects other than the standard dialect. Prer., Ling. 200 or graduate standing.

Ling. 461/561-3. English Structure for Teachers of English to Speakers of Other Languages. *Offered yearly.* Description of the morphological and syntactic categories and structures of English. Prer., Ling. 200 or graduate standing.

Ling. 462/562-3. Methods of Teaching English to Speakers of Other Languages. *Offered yearly.* The theory of second-language teaching together with techniques for teaching and testing. Curriculum design, sequencing topics, drill and examination preparation, and classroom teaching techniques will all be covered. Prer. or coreq., Ling. 460/560 and 461/561.

Ling. 463/563-3. Practicum in TESOL. *Offered yearly.* Professionally supervised practice teaching of English classes for nonnatives. Enrollees will acquire classroom experience in pronunciation, grammar, reading, and writing with students of varying ability, at first under careful supervision but with greater freedom as teaching proficiency is developed. Prer., three of the following: Ling 460/560, 461/561, 462/562.

Ling. 493/593-3. Linguistic Phonetics. *Offered yearly.* Introduction to the practical and theoretical aspects of phonetics. Training in recognition and production of speech sounds, lectures on the fundamentals of articulatory, acoustic, and auditory phonetics. Visits to the sound laboratory. Not valid for linguistics Ph.D.

Ling. 497/597-3. Introduction to Diachronic Linguistics. *Offered every third semester.* A course designed to familiarize the student with the terminology, methods, and theories dealing with phenomena of language change through time. Prer., Ling. 200 and 330 or consent of instructor. Not valid for linguistics Ph.D.

Ling. 498-3. Senior Seminar in Linguistics. *Offered irregularly.* Topics offered in the senior seminar will vary from year to year, depending on interest of faculty and prospective students. Offerings will be at an intermediate level of difficulty. Prer., Ling. 200, 330, 401, 493.

Ling. 499-3. Honor Thesis. *Offered every semester.* This course is required for students who elect departmental honors. Students write an honors thesis based on independent research under the direction of a faculty member.

Ling. 633-3. Phonological Analysis and Theory. *Offered yearly.* Analysis and description of phonological systems using and contrasting various theories. Prer., Ling. 401/501; prer. or coreq., Ling. 493/593.

Ling. 634-3. Methods of Grammatical Analysis. *Offered yearly.* Techniques for analysis and description of grammatical systems. Prer., Ling. 401/501.

Ling. 641-3. Phonological Theory. *Offered every third semester.* Phonetic and (morpho-) phonological representations: distinctive features, segments, prosodic structures, morphological structures. Phonological processes and their interaction. Naturalness conditions. Prer., Ling. 540 and 633, or consent of instructor.

Ling. 642-3. Syntactic Theory. *Offered every third semester.* This course covers various topics in syntactic theory. Prer., Ling. 540 and 634, or consent of instructor.

Ling. 643-3. Semantic Theory. *Offered every third semester.* Current developments in the theory of linguistic semantics. Truth-conditional theories. Generative linguistic theories. Semantic theories of communicative competence. Integration of these theories in the development of a combined theory of semantics and pragmatics. Prer., Ling. 501 and 540; Phil. 244 or equivalent.

Ling. 697-3. Advanced Diachronic Linguistics. *Offered every other year.* Problems dealing with use of the comparative method, internal reconstruction, subgrouping, borrowing, semantic change, interpretation of written records, and the historiographic uses of diachronic linguistics. Prer., Ling. 401/501 and 497/597 or consent of instructor.

Ling. 700-4 to 6. Master's Thesis.

Ling. 717-3. Areal Linguistics. *Offered irregularly.* Study of linguistic features shared by numerous languages or dialects within a given region, usually Africa or North America. The particular area or areas studied, however, will depend on the interests of the instructor and of the students. Prer., consent of instructor.

Ling. 724-3. History of Linguistics. *Offered irregularly.* This course will treat different topics chosen from the four or five historical periods covering the history of linguistics. It is intended to reveal the coherence of linguistic ideas in their historical setting. Prer., consent of instructor.

Ling. 738-3. Seminar: General Dialectology. *Offered irregularly.* Principles of general dialectology with emphasis on problems involving geographical and social factors. Prer., consent of instructor.

Ling. 741-3. Seminar: Advanced Phonology. *Offered irregularly.* Advanced topics in phonological theory. Prer., any two of Ling. 401/501, 493/593, 633, 641.

Ling. 742-3. Seminar: Advanced Syntax. *Offered irregularly.* Deeper analysis of one aspect of the language of an individual student's choice according to a particular theory of grammar. Each student is expected to produce a partial grammar of one linguistic topic in this course. Prer., Ling. 634, 642.

Ling. 743-3. Seminar: Topics in Semantic Theory. *Offered irregularly.* This seminar is devoted to some particular topic in semantic theory such as the place and nature of the lexicon in linguistic theory, a particular semantically-based theory of general linguistics (e.g., Montague Grammar), or some aspect of lexicology (e.g., dictionaries). Prer., Ling. 643 or consent of instructor.

Ling. 750-3. Field Methods. *Offered irregularly.* A course intended to give the student experience in the collection of linguistic data from an informant. Some attention will be given to library research on the topic language. Prer., Ling. 633 or consent of instructor.

Ling. 797-3. Seminar: Diachronic Linguistics. *Offered irregularly.* Advanced topics in the theory of language change or in the reconstruction of language history. Prer., Ling. 697 or consent of instructor.

Ling. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Ling. 920-1 to 3. Independent Study. Prer., consent of instructor.

Ling. 940-1 to 3. Independent Study. Prer., consent of instructor.

Ling. 950-1 to 3. Independent Study. Prer., consent of instructor.

Ling. 960-1 to 3. Independent Study. Prer., consent of instructor.

African Linguistics

Afr. 321-3. Introduction to African Languages. *Offered irregularly.* Genetic classification, language families, typological features of African languages. Sociolinguistic problems in Africa. Prer., junior standing or consent of instructor.

Amerindian Linguistics

Amin. 101-5. Introduction to the Lakhota (Sioux) Language. *Offered irregularly.* Principal attention will be given to learning to speak the language, although reading will also be taught.

Amin. 102-5. Introduction to the Lakhota (Sioux) Language. *Offered irregularly.* Continuation of Amin. 101.

Amin. 201-3. Intermediate Lakhota. *Offered irregularly.* Grammar review, conversation, and reading. Prer., Amin. 101-102 or placement.

Amin. 202-3. Intermediate Lakhota. *Offered irregularly.* Continuation of Amin. 201.

English as a Second Language

ESL 180-3. Spoken English for Foreign Students. *Offered each semester.* Oral drills with the goal of promoting fluency and listening comprehension. Will not fulfill humanities or major requirements. Prer., consent of instructor.

ESL 181-3. Advanced Spoken English for Foreign Students. *Offered each semester.* Continued practice in speaking and listening comprehension, with attention to grammar and pronunciation as well as meaning and appropriateness. Will not fulfill humanities or major requirements. Prer., consent of instructor.

ESL 182-3. Written Composition for Foreign Students. *Offered each semester.* Distinction between spoken and written English with an emphasis on the grammar and vocabulary of the latter. Will not fulfill humanities or major requirements.

ESL 183-3. Advanced Written Composition for Foreign Students. *Offered each semester.* Continued work on grammar and vocabulary but with greater focus on the mechanics of writing and organization of material for longer connected discourse. Will not fulfill humanities or major requirements. Prer., consent of instructor.

Romance Linguistics

For Romance Linguistics, see French and Italian.

Semitic Linguistics

ARABIC

Arab. 101-5. First-Year (Beginning) Arabic. *Fall.*

Arab. 102-5. First-Year (Beginning) Arabic. *Spring.* Prer., Arab. 101.

Arab. 221-3. Second-Year (Intermediate) Arabic. *Fall.* Prer., Arab. 102.

HEBREW

Hebr. 101-5. First-Year (Beginning) Hebrew. *Fall.*

Hebr. 102-5. First-Year (Beginning) Hebrew. *Spring.* Prer., Hebr. 101.

Hebr. 211-3. Second-Year (Intermediate) Hebrew. *Fall.* Prer., Hebr. 102.

MATHEMATICS

Note: A prerequisite course must be completed with a grade of C or better.

Math. 101-3. College Algebra.[1] Simplying algebraic expressions, factoring linear and quadratic equations, inequalities, exponentials, logarithms, functions and graphs, complex numbers, binomial theorem. No credit for students with credit in Math. 110 or A.Math. 120. Prer., one yr. of high school algebra. Math. 101 and 102 are equivalent to Math. 110.

Math. 102-2. College Trigonometry.[1] Trigonometric functions, identities, solutions of triangles, addition and multiple angle formulas, inverse trigonometric functions, laws of sines and cosines. No credit for students with credit in Math. 110 or A.Math. 120. Prer., 1½ yrs. of high school algebra and 1 yr. of plane geometry, or Math. 101. Math. 101 and 102 are equivalent to Math. 110.

Math. 107-3. Mathematics for Social Science and Business. Systems of linear equations; an introduction to matrices, linear programming, and probability. Does not prepare students for Math. 110 or Math. 130. Prer., 1½ years of high school algebra or equivalent.

Math. 108-3. Calculus for Social Science and Business. Differential and integral calculus of algebraic, logarithmic, and exponential functions. Math. 130 carries only 2 hrs. credit, A.Math. 135 carries only 1 hr. credit, if credit in Math. 108. Prer., two years of high school algebra and passing grade in algebra placement test or C or better in college algebra.

Math. 110-5. College Algebra and Trigonometry.[1] Intended primarily for students who plan to take Math. 130. Equivalent to Math. 101 plus Math. 102. See descriptions for those courses. Students with credit in Math. 101 will receive only 2 hrs. credit in Math. 110. Students with credit in Math. 102 will receive only 3 hrs. credit in Math. 110. Prer., 1½ yrs. high school algebra and 1 yr. of plane geometry.

Math. 111-3. The Spirit and Uses of Mathematics 1. *Fall.* For liberal arts students and prospective elementary teachers. Math. 111-112 meets one year of the humanities requirement of the College of Arts and Sciences. Students who have taken Math. 230 may not use Math. 111-112 for the humanities requirement. Includes a study of the nature of mathematics, its methods, its role in our society, and the structure of our number systems. Additional topics will be chosen by the instructor from number theory, elementary calculus, computer science, modern geometry and algebra, logic. Prer., one year of high school algebra and one year of plane geometry.

Math. 112-3. The Spirit and Uses of Mathematics 2. *Spring.* See explanation under Math. 111 above.

Math. 130-5. Analytic Geometry and Calculus 1. Rates of change of functions, limits, derivatives of algebraic functions, applications of derivatives, integration and applications of the definite integral. Students with credit in Math. 108 will receive only 2 hrs. credit in Math. 130. Students with credit in Math. 130 may not receive credit in A.Math. 135 or A.Math. 137. Prer., three years of high school mathematics, including trigonometry, or Math. 110 or Math. 101 and 102. Note: A.Math. 135, 136, 235, and 236 is a sequence designed for engineering students.

[1] Also available through correspondence study.

A.Math. 135-4. Calculus for Engineers 1. Rates of change, limits, derivatives of algebraic functions, applications of derivative, and integration and applications of the definite integral. Students with credit in A.Math. 135 may not receive credit in A.Math. 137 or Math. 130. Only 1 hr. credit for students with credit in Math. 108. Prer., 2 yrs. of high school algebra, 1 yr. of geometry, ½ yr. of trigonometry, and satisfactory math index on green engineering card, or *C* or better in Math. 110.

A.Math. 136-4. Calculus for Engineers 2. Continuation of A.Math. 135. Transcendental functions, methods of integration, plane analytic geometry, polar coordinates, vectors, and parametric equations. Students with credit in A.Math. 136 may not receive credit in A.Math. 138 or Math. 230. Prer., Calculus 1.

A.Math. 137-4. Honors Calculus for Engineers 1. *Offered irregularly.* Differential and integral calculus is covered in more depth than in the standard curriculum, and additional topics are included. Students may not receive credit for this course if they have credit for Math. 130 or A.Math. 135. Prer., two years of high school algebra, one year of geometry, one-half year of trigonometry, one year of calculus, and recommendations by the Office of the Dean of Engineering.

A.Math. 138-4. Honors Calculus for Engineers 2. *Offered irregularly.* Continuation of A.Math. 137. This course covers more advanced topics in the foundations of calculus, plane and solid analytic geometry, differential equations, Taylor's series, and Newtonian dynamics. Students may not receive credit for this course if they have credit in Math. 230 or A.Math. 136. Prer., A.Math. 137.

Math. 230-5. Analytic Geometry and Calculus 2. Continuation of Math. 130. Transcendental functions, methods of integration, plane analytic geometry, polar coordinates, vectors, and parametric equations. Students with credit in Math. 230 may not receive credit in A.Math. 136 or A.Math. 138. Prer., Calculus 1.

A.Math. 235-4. Calculus for Engineers 3. Continuation of A.Math. 136. Completion of required work in differential and integral calculus. Solid analytic geometry. Vector functions and derivatives, partial differentiation, multiple integrals, infinite series. Students with credit in A.Math. 235 may not receive credit in A.Math. 237 or Math. 240. Prer., Calculus 2.

A.Math. 236-3. Introduction to Linear Algebra and Differential Equations. Vector spaces, matrices, determinants, systems of linear equations. Introduction to differential equations. (No credit to students having previous credit in both Math. 313 and Math. 443.) Students with credit in A.Math. 236 may not receive credit in A.Math. 238. Prer., Calculus 3.

A.Math. 237-4. Honors Calculus for Engineers 3. Differential and integral calculus in one and several variables is covered in depth, starting with the theory of infinite series. Topics not in the standard syllabus that are covered include differential equations and the theorems of Green, Gauss, and Stokes in vector analysis. Students may not receive credit in this course if they have credit in Math. 240 or A.Math. 235. Prer., A.Math. 136, A.Math. 138, or Math. 230.

Math. 240-4. Analytic Geometry and Calculus 3. Continuation of Math. 230. Solid analytic geometry, vector functions and derivatives, partial differentiation, multiple integrals, infinite series. Students with credit in Math. 240 may not receive credit in A.Math. 235 or A.Math. 237. Prer., Calculus 2.

Math. 272-3. Introduction to Abstract Mathematics. A course designed to bridge the gap between lower division mathematics courses and the more abstract and theoretical upper division courses. The topics covered vary. Topics often included are informal logic, set theory, relations and functions, axiomatic systems with examples from algebra or geometry, number systems. Prer., Calculus 2 or consent of instructor.

Math. 275-3. Analytical Computations. Designed to introduce students to rigorous mathematical analysis. Emphasizes the logic behind calculations based on topics students are familiar with in elementary calculus and topics growing out of elementary calculus. Topics will vary from term to term. Prer., Calculus 2.

Math. 281-3. Introduction to Statistics. Study of the elementary statistical measures. Introduction to statistical distributions, statistical inference, and hypothesis testing. Prer., two years of high school algebra or Math. 101.

Math. 311-3. Introduction to Theory of Numbers. A careful study of the set of integers: divisibility, congruences, arithmetic functions, sums of squares, quadratic residues and reciprocity, and elementary results on distributions of primes. Prer., Math. 240.

Math. 313-3. Introduction to Linear Algebra. Introduction to basic properties of systems of linear equations, vector spaces, linear independence, dimension, linear transformations, matrices, determinants, eigenvalues and eigenvectors. Students with credit in Math. 313 may not receive credit in Math. 315. Prer., Calculus 3 or consent of instructor.

Math. 314-3. Introduction to Modern Algebra. A careful study of the elementary theory of groups, rings, fields, polynomials, group and ring homomorphisms, isomorphisms. Prer., Math. 272 or 313 or 311.

Math. 315-3. Honors Introduction to Linear Algebra. The subject matter is the same as Math. 313, but the treatment is more thorough, with greater emphasis on theoretical concepts, as opposed to mere computational procedure, although the latter is not neglected. Students with credit in Math. 315 may not receive credit in Math. 313. Prer., Calculus 3 and consent of instructor.

Math. 321-3. Euclidean and Non-Euclidean Geometries. Axiomatic systems. The foundations of Euclidean and Lobachevskian geometries. Prer., Calculus 2.

Math. 352-3. Computable Functions. Turing computers, computable functions, the halting problem and noncomputable functions, Church's thesis, universal machines, Goedel's incompleteness theorem, and undecidable theories. Prer., college algebra or consent of instructor.

Math. 387-3. Probability and Statistics. Discrete and continuous probability laws, random variables. Expectation. Laws of large numbers and Central Limit Theorem. Estimation, testing hypotheses, analysis of variance, regression analysis, nonparametric methods. Emphasis on applications using packaged computer programs. Credit cannot be received in both Math. 281 and 387 or in both Math. 387 and 587. Prer., Calculus 2 and familiarity with the CU computing system.

Math. 413-3. Advanced Finite Mathematics 1. Basic methods and results in combinatorial theory. Enumeration methods, elementary properties of functions and relations, graph theory. Considerable emphasis is placed on applications. Prer., Calculus 3 or consent of instructor.

Math. 414/509-3. Advanced Finite Mathematics 2. More advanced techniques in enumeration theory and graph theory. Finite groups, Polya's theory of counting, digraphs, finite rings and fields. Applications in computer science, switching theory, coding theory, etc. Prer., Math. 413 or consent of instructor.

Math. 422-3. Projective Geometry. *Not offered every year.* An introduction to the study of synthetic projective geometry. The relation of the projective and affine planes. Coordinates in the projective plane. Prer., Math. 313.

Math. 431-3. Advanced Calculus 1. Calculus of one variable. The real number system, continuity, differentiation, sequences and series, convergence, uniform convergence, Taylor's theorem, integration. Prer., Math. 272 and Calculus 3.

Math. 432-3. Advanced Calculus 2. Calculus of several variables. Continuity, differentiation and integration; implicit function theorem; inverse function theorem; Fourier series if time permits. Prer., Math 431, and either Math. 313 or A.Math. 236.

Math. 443/543-3. Ordinary Differential Equations. An elementary systematic introduction to first-order scalar differential equations, *n*th order linear differential equations, and n-dimensional linear systems of first order differential equations. Additional topics are chosen from equations with regular singular points, Laplace transforms, phase plane techniques, basic existence and uniqueness, and numerical solutions. Prer., Calculus 3 and Math. 313 or A.Math. 236.

Math. 445-3. Introduction to Complex Variables. Theory of functions of one complex variable, including integrals, power series, residues, conformal mapping, and special functions. Prer., Calculus 3.

Math. 446/545-3. Applied Topics in Complex Variables. Applications of complex variables with topics chosen from the following: (1)

classical functions (e.g., Legendre, Bessel) defined by differential equations, especially their asymptotic properties and their behavior under changes of variable; (2) Laplace, Fourier and Z-transforms; (3) conformal mapping with applications to solving boundary value problems; (4) other topics as interest and time permit. Prer., Math. 445 or consent of instructor.

Math. 447/549-3. Introduction to Partial Differential Equations 1. Initial and boundary value problems for the wave, heat, and Laplace equations; separation of variables method, eigenvalue problems, Fourier series, orthogonal systems. Prer., A.Math. 236 or Math. 313 or 431, or 443.

Math. 448/550-3. Introduction to Partial Differential Equations 2. Continuation of Math. 447. Boundary value problems, initial value problems, eigenvalue problems in higher dimensions, Sturm-Liouville problems, Fourier and Laplace transforms, approximation methods. Prer., Math 447.

Math. 451-3. Introduction to Mathematical Logic. Sentential logic and first-order logic. Completeness theorems. Prer., two upper division courses in mathematics, or consent of instructor.

Math. 455-3. Set Theory. A careful study of the theory of cardinal and ordinal numbers, definition by recursion, the statement of the continuum hypothesis, simple cardinal arithmetic, and other topics chosen by the instructor. Prer., Math. 272 or Calculus 3.

Math. 465-3, 466-3. Intermediate Numerical Analysis 1, 2. (C.S. 465, 466.) Solution of algebraic and transcendental equations, linear and nonlinear systems of equations. Interpolation, integration, solution of ordinary differential equations, least squares, sources of error and error analysis. Computer implementation of numerical methods. Matrix eigenvalue problems and summation of infinite series. Prer., C.S. 120 and A.Math. 236 or Math. 313; prer. for Math. 446 is Math. 465.

Math. 472/510-3. History of Mathematics. A selection of topics in the history of mathematics from the earliest times to the present, with emphasis on Greek mathematics, the development of the calculus in the 17th century, and the history of algebra, analysis, and geometry in the 19th and 20th centuries. Prer., two upper division courses in mathematics.

Math. 481-3. Introduction to Probability Theory. Axioms, combinatorial analysis, independence and conditional probability, discrete and absolutely continuous distributions, expectation and distribution of functions of random variables, laws of large numbers, central limit theorems, simple Markov chains. Prer., Calculus 3.

Math. 482-3. Introduction to Mathematical Statistics. Point and confidence interval estimation. Principles of maximum likelihood, sufficiency, and completeness; tests of simple and composite hypotheses, linear models, and multiple regression analysis. Analysis of variance distribution-free methods. Prer., Math. 481.

Math. 486-3. Introduction to Stochastic Population Models. *Not offered every year.* A study of mathematical models used in demography, epidemic theory, statistical genetics, and mathematical ecology, and their strengths and limitations. A survey of the mathematical techniques used in these applications. Prer., calculus plus some course in probability and/or statistics.

Note: Undergraduates must have departmental approval to take 500-level mathematics courses; 600-level courses are open *only* to graduate students.

Normally, the courses below are offered every year; courses offered in alternate years or irregularly are indicated by (1).

Math. 501-3, 502-3. Introduction to Topology 1, 2. Elements of general topology, algebraic topology, differentiable manifolds. Prer., Math. 313, 314, 431, and 432.

Math. 505-3. Topics in Combinatorial Analysis.[1] Topics such as finite combinatorial analysis, combinatorial questions entering in topology, infinite permutations and transformations, graph theory. Prer., consent of instructor.

Math. 507-3. Advanced Calculus 3. Same as Math. 433.

Math. 509-3. Advanced Finite Mathematics 2. Same as Math. 414.

Math. 510-3. History of Mathematics. Same as Math. 472.

Math. 511-3. Theory of Numbers 1. Divisibility properties of integers, congruences, diophantine equations, arithmetic functions, quadratic residues, distribution of primes, algebraic number fields. Prer., Math. 314.

Math. 512-3. Theory of Numbers 2. Selected topics in algebraic and analytic number theory. Prer., Math. 511. Math. 513 and 535 are recommended.

Math. 513-3, 514-3. Modern Algebra 1, 2. Groups, rings and ideals, fields, polynomials, Galois theory. Prer., Math. 314.

Math. 515-3. Linear Algebra 1. Vector spaces, linear transformations, eigenvalues and eigenvectors, canonical forms. Prer., Math. 313.

Math. 516-3. Linear Algebra 2.[1] Prer., Math. 515.

Math. 523-3, 524-3. Introduction to Differential Geometry 1, 2.[1] Differential forms in Euclidean 3-space, frame fields, Frenet formulas, calculus of differential forms on surfaces, extrinsic and intrinsic geometry of surfaces, Riemannian geometry of differentiable manifolds, geodesics, curvature, the Gauss-Bonnet theorem. Prer., Math. 313 and 432.

Math. 531-3, 532-3. Introduction to Real Analysis 1, 2. Zorn's lemma, metric and normed linear spaces, completions, continuous functions, Riemann-Stieltjes and Lebesgue integration, measure theory. Prer., Math. 431.

Math. 533-3, 534-3. Partial Differential Equations 1, 2.[1] General theory, first order equations; classification of second order equations: theory and methods of solution of elliptic, parabolic, and hyperbolic types of equations; maximum principles; Green's functions; potential theory. Prer., Math. 431, 432.

Math. 535-3, 536-3. Functions of a Complex Variable 1, 2. Complex numbers and complex plane. Cauchy-Riemann equations, complex integration, Cauchy integral theory, infinite series and products, residue theory, conformal mapping, analytic continuation, singularities, elementary special functions. Prer., Math. 431.

Math. 537-3, 538-3. Topics in Applied Mathematics.[1] Selected topics in mathematical problems arising from various applied fields such as mechanics, electro-magnetic theory, economics, etc. Prer., consent of instructor.

Math. 541-3, 542-3. Calculus of Variations and Control Theory.[1] Classical necessary and sufficient conditions with emphasis on the simplest problems; the problem of Lagrange; Hamiltonian and Lagrangian mechanics. The problem of optimal control; the maximum principle of Pontriagin; controllability, applications. Prer., Math. 432, 443.

Math. 543-3. Ordinary Differential Equations. Same as Math. 443.

Math. 545-3. Applied Topics in Complex Variables. Same as Math. 446.

Math. 549-3. Introduction to Partial Differential Equations 1. Same as Math. 447.

Math. 550-3. Introduction to Partial Differential Equations 2. Same as Math. 448.

Math. 553-3, 554-3. Intermediate Mathematical Physics 1, 2. (Phys. 503, 504.) Survey of classical mathematical physics, starting with complex variable theory and finite dimensional vector spaces. Topics in ordinary and partial differential equations, the special functions, boundary value problems, potential theory, and Fourier analysis. Prer., Math. 431 and 432.

Math. 560-3. Numerical Analysis 1. (C.S. 560.) Solution of linear systems, least squares approximations, nonlinear algebraic equations, interpolation, and quadrature. Prer., calculus, Math. 313; C.S. 120.

Math. 561-3. Numerical Analysis 2. (C.S. 561.) Solution of ordinary and partial differential equations; matrix eigenvalue eigenvector problems. Prer., Math. 560.

[1]Not offered every year.

Math. 562-3. Numerical Solution of Initial Value Problems. (C.S. 562.) Multi-step and single-step methods for ODE. Stability. Stiff equations. Difference schemes for heat and wave equations. Applications. Prer., C.S. 465 or 560, Math. 313, 443, 431, or 435.

Math. 563-3. Numerical Solution of Boundary Value Problems. (C.S. 563.) Finite difference solution of two-point boundary problems and elliptic problems. Methods of SOR, ADI, conjugate gradients. Finite element method. Nonlinear problems. Applications. Prer., Math. 465, Math. 313, 431 or 435, 443.

Math. 565-3. Numerical Methods for Optimization. (C.S. 565.) Linear programming. Unconstrained minimization, one-dimensional search, gradient methods. Nonlinear and quadratic programming. Prer., Math. 465 or 560, Math. 313.

Math. 571-3, 572-3. Mathematical Logic 1, 2. *Alternate years.* First-order logic, completeness theorem, introduction to model theory, ultraproducts, Goedel's incompleteness theorems, theory of recursive functions. Prer., Math. 451 and 455, or consent of instructor.

Math. 573-3, 574-3. Advanced Set Theory 1, 2. *Alternate years.* Cardinal and ordinal arithmetic, generalizations of Ramsey's theorem, independence of the axiom of choice and of the generalized continuum hypothesis. Prer., Math. 455 and 451, or consent of instructor.

Math. 581-3, 582-3. Mathematical Statistics.[1] Mathematical theory of statistics. Topics covered will include distribution theory, estimation and testing of hypotheses, multivariate analysis, nonparametric inference. Prer., Math. 313 and 481, or consent of instructor.

Math. 583-3. Topics in Mathematical Probability.[1] Prer., advanced calculus and Math. 481.

Math. 584-3. Time Series Analysis.[1] Basic properties, linear extrapolation, and filtering of stationary random functions. Spectral and cross-spectral analysis. Estimation of the power spectrum using computers. Nonstationary time series. Comparison of various computer programs. Prer., Math. 481 or consent of instructor.

Math. 585-3. Introduction to Stochastic Processes.[1] A systematic study of Markov chains and some of the simpler Markov processes including renewal theory, limit theorems for Markov chains, branching processes, queueing theory, and birth and death processes. Applications to physical and biological sciences. Prer., Math. 481 and 431 or consent of instructor.

Math. 587-3. Statistical Methods in Research. Design and analysis of experiments, employing t-tests, chi-square tests, analysis of variance and covariance, regression analysis, distribution-free methods, graphical and other quick and approximate procedures with emphasis on applications in the behavioral, biological, and physical sciences. Prer., consent of instructor.

Math. 588-3. Statistical Methods for Data Analysis.[1] A continuation of Math. 587. The method of least squares in fitting linear and nonlinear models to data. Analysis of balanced, unbalanced, and unplanned experiments. Use of packaged computer programs. Practical aspects of applying statistical techniques to the analysis of data. Prer., Math. 587 or consent of instructor.

Math. 603-3, 604-3. Algebraic Topology 1, 2.[1] Homology and cohomology theories, homotopy theory, obstruction theory, and applications. Prer., modern algebra and topology or consent of instructor.

Math. 607-3, 608-3. Differential Topology 1, 2.[1] Differentiable manifolds, tangent bundles, vector fields, differential forms. Frobenius theorem, Riemannian metrics, selected topics. Prer., Math. 501 and 502, 515, 531 and 532.

Math. 611-3, 612-3. Topics in Number Theory 1, 2.[1] May include theory of algebraic numbers, L-series and zeta functions, the zeta functions of an algebraic variety, character sums, multiplicative and additive number theory, diophantine equations and approximations, or other topics chosen by instructor. Prer., Math. 512 or consent of instructor.

Math. 613-3. Theory of Groups 1, 2.[1] Abelian groups, homomorphism, permutation groups, Sylow theorems, solvable groups, group representations and characters. Prer., modern algebra.

Math. 617-3, 618-3. Topics in Algebra.[1] Detailed study of advanced topics not covered in modern algebra or other courses, to be chosen by instructor. Prer., modern algebra. Math. 617 is not required for Math. 618.

Math. 625-3, 626-3. Mathematical Theory of Relativity.[1] Maxwell equations; Lorentz force; Minkowski space-time; Lorentz, Poincaré, and conformal groups; metric manifolds; covariant differentiation; Einstein space-time; cosmologies; unified field theories. Prer., consent of instructor.

Math. 631-3, 632-3. Topics in Real Variables 1, 2.[1] Abstract measure theory, function spaces, and other topics. Prer., Math. 531-532 or consent of instructor.

Math. 633-3, 634-3. Topics in Complex Variables 1, 2.[1] Prer., Math. 535-536.

Math. 635-3, 636-3. Functional Analysis 1, 2. Introduction to such topics as Banach spaces (Hahn-Banach theorem, open mapping theorem, etc.), operator theory (compact operators and integral equations, spectral theorem for bounded self-adjoint operators), Banach algebras (the Gelfand theory). Prer., Math. 531-532.

Math. 637-3, 638-3. Harmonic Analysis.[1] Trigonometric series, periodic functions, diophantine approximation, Fourier series. Bohr and Stepanoff almost periodic functions, positive definite functions, the L^1 and L^2 theory of the Fourier integral. Applications to group theory and differential equations. Prer., Math. 515 and 532.

Math. 639-3, 640-3. Topics in Analysis 1, 2.[1] Selected advanced topics to be chosen by the instructor.

Math. 647-3, 648-3. Theory of Ordinary Differential Equations 1, 2.[1] Prer., Math. 515, 532, and consent of instructor.

Math. 649-3, 650-3. Theory of Partial Differential Equations 1, 2.[1] Differentiation theory, Sobolev theory, *a priori* inequalities, variational methods. Existence and regularity theory for elliptic equations, hyperbolic equations, parabolic equations. Particular equations of mathematical physics. Prer., Math. 531-532.

Math. 653-3, 654-3. Advanced Mathematical Physics 1, 2. (Phys. 603, 604.) Hilbert space, theory of distributions, L^2-spaces, Sobolev spaces, methods of functional analysis, spectral theory of operators, applications to quantum theory, and group theory. Prer., Math. 431 and 432, and Math. 445 or 535.

Math. 655-3, 656-3. Advanced Mathematical Physics 3, 4.[1] Phys. 605, 606.) Further topics in modern mathematical physics with applications. Prer., Math. 653, 654.

Math. 671-3, 672-3. Lattices and General Algebra 1, 2.[1] Modular, distributive, Brouwerian, Boolean lattices. Applications to algebra and topology. Homomorphism, congruence relations, direct factorization, free algebras, varieties. Prer., Math. 455, 513, 514.

Math. 673-3, 674-3. Topics in Logic. Selected advanced topics in logic or foundations to be chosen by the instructor.

Math. 681-3, 682-3. Advanced Probability Theory.[1] Independent random variables, processes with independent increments, martingales, Brownian motion, stochastic integrals, and diffusions. Prer., Math. 531 and 532.

Normally about half of the following seminars are given each year. The same seminar number may be repeated for credit several times.

Math. 688-3. Seminar: Topology.

Math. 689-3. Seminar: Number Theory.

Math. 690-3. Seminar: Algebra.

Math. 691-3. Seminar: Analysis.

Math. 692-3. Seminar: Functional Analysis.

Math. 693-3. Seminar: Differential Equations.

Math. 694-3. Seminar: Applied Mathematics.

Math. 695-3. Seminar: Numerical Analysis.

[1] Not offered every year.

Math. 696-3. Seminar: Logic and Foundations of Mathematics.

Math. 697-3. Seminar: Probability Theory and Statistics.

Math. 698-3. Seminar.

Math. 699-3. Seminar.

Math. 700-4 to 6. Master's Thesis.

Math. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Math. 910-1 to 3. Independent Study.

Math. 940-1 to 3. Independent Study.

Math. 950-1 to 3. Independent Study.

Math. 960-1 to 3. Independent Study.

MUSEUM

Musm. 401-4/501-3. Introduction to Museology. *Fall.* For majors in anthropology, biology, fine arts, geological sciences, history, or other museum-related subjects. Background in history and literature of museums, their objectives and methods; laboratory exercises in curatorship, exhibition theory, and administration. Prer., consent of instructor. Huse.

Musm. 402/502-2. Selected Museum Topics. *Spring.* Provides framework for student projects on varied museum topics, i.e., ethics of collecting, data management, the museum's role in the community. Student projects include case study analysis, interviewing and original presentations. Topics vary each semester. Prer., Introduction to Museology or instructor's consent. Huse.

Musm. 421/521-3. Museum Internship in Anthropology. *Spring.*

Musm. 422/522-3. Museum Internship in Botany.

Musm. 423/523-3. Museum Internship in Geology.

Musm. 425/525-3. Museum Internship in Zoology. Designed to introduce the animal kingdom and basic curatorial techniques and problems of zoological museum operation. All aspects of zoological specimens (except insects) will be studied in depth from relaxing, fixing, positioning, preserving, cataloguing, storing, and shipping.

Musm. 426/526-3. Museum Internship in Entomology. Prer., for all museum internships, Musm. 401 and/or instructor's consent.

Musm. 434/534-3. Museum Internship in Techniques I. Covers the basics of modeling, molding, casting, and restoration of objects related to historical and natural history museums. Research, label writing, and construction of a small loan exhibit will be required. Prer., for all museum internships, Musm. 401 and/or instructor's consent.

Musm. 435/535-3. Museum Internship in Techniques II. Continuation of Musm. 434. More advanced techniques in restoration, molding, casting, and the making of facsimile reproductions. Students have the opportunity to orient their learning more toward their major field. Prer., for all museum internships, Musm. 401 and/or instructor's consent.

Musm. 446/546-3. Museum Field Methods in Anthropology. *Available only in summer.* Archaeological field techniques including excavation, mapping, recording, photography, interpretation, and field laboratory.

Musm. 448/548-3. Museum Field Methods in Geology. *Available only in summer.* Paleontological and paleoecological field techniques including collecting, recording of geographic, stratigraphic, and quarry information; preservation; and interpretation, including applicable readings. Prer., for all field methods courses, instructor's consent.

Musm. 449/549-2. Mammalian Osteology. *Fall, alternate years.* Identification of modern mammal bones, with emphasis on skulls and mandibles (postcrania for 549) of North American terrestrial genera. Specific level identifications will not be taught. Lab only. Prer., instructor's consent.

Musm. 940-variable credit. Independent Study. Prer., consent of instructor.

Musm. 941-variable credit. Independent Study. Prer., consent of instructor.

Musm. 950-variable credit. Independent Study. Prer., consent of instructor.

Musm. 951-variable credit. Independent Study. Prer., consent of instructor.

ORIENTAL LANGUAGES AND LITERATURES

For Arabic and Hebrew, see Linguistics.

Chinese

Chin. 101-5. First-Year (Beginning) Chinese. *Fall.* A thorough introduction to modern Chinese (Mandarin), with emphasis on speaking, as well as reading and writing. Basic fluency in the spoken language will be developed through intensive use and repetition of fundamental sentence patterns and vocabulary. Students learn both traditional full-form characters and the simplified versions now in use on Mainland China.

Chin. 102-5. First-Year (Beginning) Chinese. *Spring.* Continuation of Chin. 101. Prer., Chin. 101 or equivalent.

Chin. 211-5. Second-Year (Intermediate) Chinese. *Fall.* Reading, speaking, and writing modern Chinese, including continued study of both full-form and simplified characters, introduction to dictionaries, principles of character formation and classification, the phonetic writing system (*chu-yin fu-hao*). Prer., Chin. 102 or equivalent.

Chin. 215-5. Second-Year (Intermediate) Chinese. *Spring.* Continuation of Chin. 211 or equivalent.

Chin. 311-3. Third-Year (Advanced) Chinese. *Fall.* A survey of a wide variety of materials written in modern Chinese, including selections from the works of Lu Hsun, newspaper articles from both Taiwan and Mainland China, and readings from the Great Proletarian Cultural Revolution. Students will also view at least one full-length Chinese movie. Equal emphasis is placed on enhanced reading, writing, and oral communication skills. Class is conducted entirely in Chinese. Prer., Chin. 212 or equivalent.

Chin. 312. Third-Year (Advanced) Chinese. *Spring.* Continuation of Chin. 311. Prer., Chin. 311 or equivalent.

Chin. 321-3. Introduction to Classical Chinese. *Fall.* (Formerly Chin. 421.) A systematic introduction to the classical language, based on texts from the pre-Han and Han periods. The course stresses precise knowledge of grammatical principles and exactitude in translation; the basis for all further work in Classical Chinese. Prer., Chin. 212 or permission of instructor.

Chin. 322-3. Readings in Classical Chinese. *Spring.* (Formerly Chin. 422.) A close reading of selected texts of medieval literature (primarily from the T'ang dynasty), both prose and poetry. Emphasis throughout is on a disciplined, philological approach to the texts, with proper attention to diction, tone, and nuance. Prer., Chin. 421 or permission of instructor.

Chin. 411-3. Readings in Modern Chinese Literature I. *Fall.* A survey of a wide variety of literary works by modern Chinese authors, including Lu Hsun, Kuo Mo-jo, Ting Ling, Lao She, and Hao Jan. Special attention is given to analyzing narrative style and character development. Prer., Chin. 312 or equivalent.

Chin. 412-3. Readings in Modern Chinese Literature II. *Spring.* Continuation of Chin. 411. Prer., Chin. 411 or equivalent.

Chin. 499-3. Seminar in Classical Chinese. *Fall, Spring.* Intensive study of selected texts on a particular topic, usually from medieval China. Topic will change each term, and the course may be taken for credit more than once. Prer., Chin. 322.

Chin. 910-940. Independent Study (Undergraduate).

Chin. 950-980. Independent Study (Graduate).

Chinese Courses in English. The following courses require no knowledge of Chinese:

Chin. 481-3. Chinese Poetry in Translation. *Fall.* A study of ancient and medieval Chinese poetry, with special emphasis on the great masters of the T'ang (618-907) dynasty. The course views the poetry in the unique cultural setting of the worlds inhabited and created by the poets — particularly relations with Taoism, Buddhism, natural history, and the astral domains explored and sung of by inspired poetic sky-treaders. Attention is focused not just on *what* a poem says, but on *how* it says it. Lectures and discussion. Prer., junior standing or permission of instructor. P. W. Kroll.

Chin. 482-3. Chinese Fiction in Translation. *Spring, alternate years.* A study of representative samples of Chinese fiction, ranging from medieval short stories and anecdotes written in the classical language to the longer, more involved, vernacular stories and novels of the Ming (1368-1644) and Ch'ing (1644-1911) dynasties. Special emphasis will be placed on tracing the development of fiction in terms of narrative stance, characterization, and plot, as well as on comparisons between different genres of Chinese imaginative writing. Lectures and discussion. Prer., junior standing or permission of instructor. M. K. Spring.

Chin. 483-3. Chinese Drama in Translation. *Spring, alternate years.* A survey of the major works of Chinese drama, with emphasis on historical background, social milieu, structure, theme, and language. Special attention is given to dramas of the Yuan dynasty (1279-1368), especially the works of Kuan Han-ch'ing. The class will also read two *nan-hsi* or "Southern dramas"—T'ang Hsien-tsu's "Peony Pavilion" and K'ung Shang-jen's "Peach Blossom Fan." Lectures and discussion. Prer., junior standing or permission of instructor. J. M. Hargett.

Japanese

Jpn. 101-5. First-Year (Beginning) Japanese. *Fall.* Skills of listening, speaking, reading, and writing are progressively developed on the basis of pattern approach.

Jpn. 102-5. First-Year (Beginning) Japanese. *Spring.* Continuation of Jpn. 101 or equivalent.

Jpn. 211-5. Second-Year (Intermediate) Japanese. *Fall.* Skills of reading and writing are further developed; comprehension of instructional Japanese. Prer., Jpn. 102 or equivalent.

Jpn. 212-5. Second-Year (Intermediate) Japanese. *Spring.* Continuation of Jpn. 211.

Jpn. 311-3. Third-Year (Advanced) Japanese. *Fall.* This course will develop the student's competence in reading a wide variety of materials by contemporary Japanese writers. Prer., Jpn. 212 or equivalent.

Jpn. 312-3. Third-Year (Advanced) Japanese. *Spring.* Continuation of Jpn. 311.

Jpn. 411-3. Readings in Classical and Modern Japanese. *Fall.* A study of selected works of classical literature, mainly from the Heian and medieval periods; reading, writing, and discussing a wide variety of works of modern writers. Prer., Jpn. 312 or equivalent.

Jpn. 412-3. Readings in Classical and Modern Japanese. *Spring.* Continuation of Jpn. 411.

Jap. 910-940. Independent Study (Undergraduate).

Jap. 950-980. Independent Study (Graduate).

Japanese Courses in English. The following courses require no knowledge of Japanese:

Jpn. 221-3. Language and Patterns of Thinking and Behavior in Japanese Culture. *Fall.* Analysis and elucidation of the patterns of the language as related to the thought and behavior of the Japanese people in the social and cultural context. W. T. Nagai.

Jpn. 483-3. Classical Japanese Literature. *Spring, alternate years.* A study of major works of classical literature, both poetry and prose, from the earliest period to the mid 19th century. Prer., junior standing or permission of instructor. W. Nagai.

Jpn. 484-3. Modern Japanese Literature. *Spring, alternate years.* A study of major works of modern literature, both poetry and prose, from the Meiji period (1868-1912) through the postwar period (World War II). Prer., junior standing or permission of instructor. W. Nagai.

PHILOSOPHY

Specific class content varies by semester. Complete course descriptions are available each semester from the Philosophy Department, Hellems 169.

Phil. 100-3. Introduction to Philosophy. An introduction to the fundamental questions of philosophy through a study of the ideas of several major philosophers.

Phil. 102-3. Ethics. Introductory study of major philosophies on the nature of the good for man, principles of evaluation, and moral choice.

Phil. 103-3. Ways of Knowing. An introductory study of the nature and sources of knowledge and related topics.

Phil. 104-3. Philosophy and Society. Introduction to philosophical thought through critical analysis of the institutions of society. Representative topics: the university in American society, militarism, imperialism, racism, revolution, participatory democracy vs. representative democracy or others.

Phil. 105-3. Philosophy and Religion.[1] A philosophical introduction to problems of religion, such as the existence of God, faith and reason, religious language, etc.

Phil. 106-3. Philosophy and the Sciences. Consideration of topics and problems related to the physical and biological sciences, such as freedom and determinism; mind and body; artificial intelligence; sciences and ethics; current theories of the universe, space, time, matter, energy, causality, etc.

Phil. 107-3. Philosophy and the Arts. Consideration of philosophic questions involved in the analysis and assessment of artistic experiences and of the objects with which the arts, including the literary arts, are concerned.

Phil. 110-3. Philosophy Through Literature. Introduction to philosophy through literature. Selected novels, plays, and short stories which exemplify traditional problems in philosophy.

Phil. 112-3. Introductory Logic. Introductory study of definition, informal fallacies, and the principles and standards of correct reasoning. Practice in analyzing, evaluating, and constructing frequently encountered types of arguments. Does not fulfill major requirement in logic.

Phil. 192-3. Open Topics in Philosophy. A variety of new courses at the introductory level for which existing descriptions are not appropriate. See current departmental announcements for specific content.

All courses at the 200 level require 3 hours of philosophy unless otherwise indicated.

Phil. 202-3, 203-3. Nature of Law I and II. An examination of the nature of law with focus on its underlying principles and its historical and comparative development.

Phil. 209-3. Philosophy and Psychology. Interdisciplinary course on issues where philosophy and psychology meet; for example, topics such as selfhood, motivation, psychotherapy, freedom, human behavior. Selected readings in philosophy and psychology.

Phil. 220-3. Major Social Theories. Introductory study of major philosophies of the past in relation to political, economic, and social issues.

[1]Also available through correspondence study.

Phil. 244-3. Symbolic Logic. Prer., sophomore standing.

Phil. 292-3. Open Topics in Philosophy. A variety of new courses at the 200 level for which existing descriptions are not appropriate. See current departmental announcements for specific content.

Phil. 294-3. Philosophy and Women. (W.St. 294.) Provides for the exploration of different approaches to the study of women.

All courses at the 300 level require 6 hours of philosophy unless otherwise indicated.

Phil. 300-3. History of Philosophy. Ancient and medieval. No. prer.

Phil. 301-3. History of Philosophy. Modern. No prerequisite.

Phil. 302-3. Ethical Theory. A study of major issues and theories in ethics. Prer., 6 hrs. of philosophy or instructor's consent.

Phil. 305-3. Topics in the History and Philosophy of Physics. (Phys. 305.) Topics will vary from year to year and may include scientific methodology, the role of experiment, and case studies in the history of physics. Prer., one year of physics or consent of instructor.

Phil. 310-3. Chinese Philosophy. An examination of various schools of Chinese philosophy including Confucianism, Taoism, Buddhism, and new-Confucianism. No prer.

Phil. 314-3. Environmental Ethics. Examines the major traditions in moral philosophy to see what light they shed on value issues in environmental policy and the value presuppositions of the economic, ecological, and juridical approaches to the environment. Prer., junior standing, or Phil. 102, 104, 220, 302, or 320.

Phil. 315-3. Models of Medicine. An examination of such problems as the nature and evidence for current medical models; the roots of modern medicine in Greek thought; alternative models of medicine (Shamanistic, Eastern, Holistic); the medical model and psychoanalytic therapies; the concepts of mental health and physical health; the relation of medical and therapeutic models to theories of human nature. Prer., upper division standing.

Phil. 316-3. Ethical Issues in Medicine. An analysis of ethical problems involved in such issues as abortion, euthanasia, organ transplants, eugenics, the treatment of the patient as a person, and the institutional nature of the health care delivery system. Prer., upper division standing.

Phil. 320-3. Social and Political Philosophy. Systematic discussion and analysis of such philosophic ideas as community, freedom, political power, violence, etc.

Phil. 326-3. International Human Rights. An examination of the international human rights movement and the philosophical issues it raises. Topics include the history and documents of the human rights movement, the nature and grounds of human rights, skeptical doubts about human rights, and the relevance of human rights to foreign policy. Prer., upper division standing.

Phil. 330-3. Philosophy of Mind. Problems in the philosophy of mind, including the mind-body problem, knowledge of other minds, compatibility of free will and determinism, etc., and discussion of such concepts as action, intention, desire, enjoyment, memory, imagination dreaming, self-knowledge, etc.

Phil. 335-3. Metaphysics and Epistemology.

Phil. 340-3. Philosophy of Science. Examination of some major concepts and problems of scientific thought: explanation, confirmation, causality, measurement, and theory construction.

Phil. 341-3. History of Science, Ancients to Copernicus. (Nat.Sci. 321.)

Phil. 342-3. History of Science, Copernicus to Newton. (Nat.Sci. 322.)

Phil. 343-3. History of Science, Newton to Einstein. (Nat.Sci. 323.)

Phil. 344-3. Perspectives of 20th-Century Science. (Nat.Sci. 324.)

Phil. 349-3. Philosophy of Language. Examination of theories and problems regarding the nature of language and its relation to reality. Concepts discussed will include sense, reference, conventions, intentions, and their relation to science and social life. The relevant literature includes readings in Frege, Russell, Quine, Putnam, Kripke, and Chomsky.

Phil. 360-3. Philosophy of Religion. Nature of religion and methods of studying it.

Phil. 361-3. From Paganism to Christianity. (Clas. 361.) Treats the history of Greek and Roman religion from its Bronze Age origins through the use of Christianity. Prer., Clas. 110 recommended.

Phil. 370-3. Aesthetic Theory. Introduction to major theories of aesthetics and contemporary discussions of problems in aesthetics; i.e., the nature of art, the problem of evaluations in art.

Phil. 391-3. Open Topics in Philosophy. A variety of new courses at the 300 level for which existing descriptions are not appropriate. See current department announcements for specific content.

Phil. 392-3. Open Topics in Philosophy. A variety of new courses at the 300 level for which existing descriptions are not appropriate. See current departmental announcements for specific content.

All courses at the 400 level require 9 hours of philosophy unless otherwise indicated.

Phil. 404-3. Twentieth-Century Philosophy. Study of two or three major philosophies prominent during the present century.

Phil. 407-3. Existentialist Philosophy.

Phil. 408-3. Introduction to Phenomenology. An examination of the contribution of phenomenology to selected topics in the theory of meaning, philosophy of mind, ontology, and epistemology through a study of such philosophers as Husserl, Heidegger, Satre, and Merleau-Ponty.

Phil. 409/509-3. Philosophy and Psychological Theory. Conceptual problems in psychological theories, e.g., issues such as models, metaphysical views, value assumptions, theory in psychotherapy. Selected readings in both philosophy and psychology. Prer., 9 hrs. of philosophy or psychology.

Phil. 425-3. Marxism. A historical and systematic study of the principal themes of Marxist thought, from its Hegelian origins to its contemporary varieties, emphasizing in particular the works of Marx and Engels themselves.

Phil. 426-3. Philosophy of Law. Consideration of various views of the nature of law, its role in society, and its relation to other disciplines. Investigation of philosophic commitments which underlie and affect legal conceptions and procedures. No prer.

Phil. 438-3. Rationality, Democracy, and Policy. The object of this course is to provide philosophical and political approaches to an understanding of social decision making and to examine the possibilities for choosing rational courses of action. To this end, concrete problems in rational decision making will be dealt with. Prer., any two-course combination in political science, philosophy, or economics.

Phil. 444/544-3. Mathematical Logic. Prer., Phil. 244.

Phil. 460-1. Theology Forum Seminar. Discussions on a variety of theological and philosophical topics. Some reading, much discussion, occasional guest speakers. Students may enroll for repeated credit with permission of instructor to a maximum of 3 hours.

Phil. 470-3. History of Aesthetics. Study of the principal historical systems of aesthetic inquiry, tracing the development of central themes in such writers as Plato, Aristotle, Plotinus, Kant, and Hegel.

Phil. 473-3. Philosophy and Literature. (Comp. Lit. 484/584.) No prer.

Phil. 474-3. Philosophy and Literature: Philosophical Sources of Literature. Study of individual philosophers and philosophic movements which are significant for the understanding of literature.

Phil. 490-3. Open Topics in Philosophy. A variety of new courses at the 400 level for which existing descriptions are not appropriate. See current departmental announcements for specific content.

Phil. 491-3. Single Philosopher. Intensive study of one systematic philosophy with attention to the scope, methods, and integrity accomplished by it. Prer., 6 hours of philosophy.

Phil. 493-3. Open Topics in Philosophy. A variety of new courses at the 400 level. See current departmental announcements for specific content.

Phil. 495-3. Honors Thesis.

Phil. 498-3. Special Topics in Philosophy. Seminars not listed as courses in which the instructor meets regularly with three or more students to discuss special topics in philosophy.

All courses at the 500 and 600 levels require 12 hours of philosophy unless otherwise indicated.

Phil. 503-3. Philosophy and Social Policy. A study of philosophical approaches to social and political issues such as abortion, bioethics, environmental preservation, human rights, and reverse discrimination. Attention will be given to the strengths and weaknesses of philosophical treatments of these issues. Prer., 12 hours of philosophy or consent of instructor.

Phil. 504-3. Theory of Value.[1] This course will examine the nature and variety of types of values, with the focus placed on conflicts among values and the role of values in decision making and the development of social policy. Prer., 12 hours of philosophy or graduate standing.

Phil. 508-3. Ethics.[1] Representative positions in normative ethics and metaethics.

Phil. 509-3. Philosophy and Psychological Theory. (Same as Phil. 409.)

Phil. 510-3. Topics in the History of Philosophy.

Phil. 514-3. Seminar on Environmental Philosophy. A philosophical examination of several different approaches to environmental problems: economic, juridical, political, and ecological. Some specific environmental problems will be discussed, focusing on their moral dimensions, e.g., wilderness preservation, animal rights, and land use and urban planning.

Phil. 522-3. Social and Political Philosophy.[1] Systematic study of traditional and current theories of the philosophical justification of kinds of social and political orders, etc. Prer., 12 hours philosophy or consent of instructor.

Phil. 530-3. Philosophy of Mind.[1] Some of the main topics in philosophy of mind, such as the mind-body problem, the problem of knowledge of other minds, etc.; and discussion of such concepts as consciousness, self-knowledge, action, explanation of behavior, intention, dreaming, sensations, etc.

Phil. 534-3. Epistemology.[1] A study of some of the main topics of epistemology, such as skepticism, the foundations of knowledge, perception, introspection, belief, certainty, the analytic-synthetic distinctions, etc.

Phil. 538-3. Metaphysics.[1] Traditional and contemporary theories of the basic categories used to describe nature and man's relationship to it, including such concepts as substance, identity, space and time, causality, determination, systematic ontology, etc.

Phil. 542-3. Philosophy of Science. Topics connected with development and nature of science; structure of scientific theories, testing of hypotheses. Theory of decisions in science and ethics. Basic conceptions and models of abstraction in history of science.

Phil. 549-3. Philosophy of Language. A study of some of the main topics in the philosophy of language, such as meaning and theories of meaning, translation, speech acts, rules of language, references, relevance of psycholinguistics, language and thought, language and ontology, etc.

Phil. 560-3. Philosophy of Religion. A study of topics falling under the philosophy of religion such as proofs for God's existence; religious language; mysticism; psychology of religion; modern theological movements; miracles; and study of individual theologians.

Phil. 565-3. Analytic Philosophy. A survey of representative philosophers, methods, or problems in the 20th-century analytic tradition.

Phil. 570-3. Aesthetics. An analysis of the principal topics of aesthetics, including such issues as the formal structure of aesthetics, the nature of critical judgments, and the status of the work of art.

Phil. 580-3. Philosophy of Plato.[1] (Clas. 580.)

Phil. 581-3. Philosophy of Aristotle.[1] (Clas. 581.)

Phil. 582-3. Philosophy of Hume.

Phil. 583-3. Philosophy of Kant.[1]

Phil. 584-3. Philosophy of Spinoza.

Phil. 586-3. Philosophy of Wittgenstein.

Phil. 589-3. Philosophy of Hegel. Textual explication of Hegel's *Logic* and his *Phenomenology of the Spirit*, with special emphasis on the latter.

Phil. 591-3. Philosophy of St. Thomas Aquinas. Study of major writings of St. Thomas.

Phil. 592-3. Philosophy of Husserl.

Phil. 593-3. Later Work of Sartre. A study of Sartre's sociological and psychological theory as developed in the *Critique of Dialectical Reason* and in the sociopsychological biographies of Genet and Flaubert. Prer., course on early work of Sartre.

Phil. 594-3. Topics in Recent Philosophy.

Phil. 595-3. Topics in Values and Social Policy. Deals with topics in the area of philosophy and public policy and is often interdisciplinary in focus. Topics may vary from one semester to another. Course may be repeated when topic is different. Prer., 12 hrs. of philosophy or graduate standing.

Phil. 598-3. Special Topics in Philosophy. Seminars not listed as courses in which the instructor meets regularly with three or more students to discuss special topics in philosophy. Prer., 12 hours of philosophy and consent of instructor.

Phil. 646-3. Seminar: Phenomenology.

Phil. 690-3. Master's Research.

Phil. 700-4 to 6. Master's Thesis.

Phil. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Phil. 810-10. Doctor's Dissertation. This should be used for students who wish to register for 10 hours of thesis work.

Phil. 920-variable credit. Independent Study.

Phil. 940-variable credit. Independent Study.

Phil. 950-variable credit. Independent Study.

Courses in other individual philosophers will occasionally be given. Prer., consent of instructor.

PHYSICAL EDUCATION AND RECREATION

Physical Education

P.E. 113-2. Conditioning.

P.E. 176-2. Advanced Life Saving.

P.E. 177-2. Water Safety Instructor.

P.E. 197-1. Recreational Dance Forms. Dance techniques. Open to dance, physical eduation, and recreation majors.

P.E. 225-2. Advanced First Aid. Standardized Red Cross certification for immediate care. CPR included.

P.E. 235-1. Conditioning.

P.E. 237-1. Golf.

P.E. 238-1. Gymnastics.

P.E. 239-1. Badminton.

[1]These graduate level courses are offered at least every other year.

P.E. 240-1. Recreational Sports.

P.E. 241-1. Tennis.

P.E. 242-1. Track and Field.

P.E. 260-1. Activities of Low Organization.

P.E. 261-2. Adapted Activities.

P.E. 262-1. Basketball.

P.E. 263-1. Field Hockey.

P.E. 264-1. Flag Football/Speedaway.

P.E. 266-1. Soccer, Speedball.

P.E. 267-1. Softball.

P.E. 268-1. Volleyball.

P.E. 279-3. Kinesiological Anatomy. Anatomy as applied to human movement and basic movement skills and sports will be presented. The central focus will be the study of skeletal and muscular systems of the body. This is a lecture and laboratory class designed for physical education majors. Prer., one year of college biology; EPOB 121-122 suggested. Students may not receive credit for both P.E. 279 and EPOB 342.

P.E. 280-3. Kinesiological Physiology. This course designed for physical education majors, will focus on the body systems and their functions especially in relationship to how they are affected by exercise and movement. Prer., EPOB 123, 124, and Chem. 101-104. Students may not receive credit for both P.E. 280 and EPOB 343.

P.E. 293-3. Survey of Contemporary Health. A survey of selected health problems of contemporary man.

P.E. 295-3. Environmental Health. The impact of the environment on man's health including the effects of population, pollution, communicable diseases, and climate.

P.E. 298-1 to 3. Practicum in Physical Education. Practical experience in coaching or teaching in organized situations with direct supervision.

P.E. 320-3. Sport and American Society. Introduction to sport as one of the most pervasive human activities in America. Relationship of sport to various social institutions and processes. Utilizing a multidisciplinary approach to subject matter taken from physical education, sociology, psychology, American literature, religious studies, and anthropology. Not open to P.E. majors.

P.E. 323-3. Health and Physiological Values of Exercise. Physiological adaptations to exercise with consideration of the biophysical values of exercise in maintaining fitness and health throughout an individual's life span. Not open to physical education majors.

P.E. 342-3. Nutrition and Health. The basic principles of nutrition and their relationship to health. Students may not receive credit for both P.E. 342 and Psy. 206.

P.E. 346-3. Introduction to Special Physical Education. Overview of handicapping conditions, Public Law 94-142, mainstreaming, behavior management techniques, assessment and evaluation, and perceptual motor learning and the exceptional child. Prer., EPOB 342 or P.E. 279 or instructor's consent.

P.E. 350-3. Human Development and Movement Behavior. Development from infancy through adulthood with emphasis upon interrelationships which affect behavior, performance, and personality.

P.E. 369-3. Sports Humanities. The development, characteristics, and values of sport and exercise systems in American culture with reference to societal values assigned these ares in past cultures.

P.E. 371-3. Psychosocial Aspects of Sport and Physical Activity. This course examines some of the behavioral dimensions that underlie performance in physical activity and competitive sport including attitude, motivation, personality, stress, and anxiety. Implications for coaching and teaching.

P.E. 372-3. Motor Learning and Performance. An introduction to theories of perceptual motor learning and variables affecting motor performance; laboratory sessions and individual research projects are required.

P.E. 401-1 to 3. Professional Seminar: Physical Education. Presentation of special aspects of current practices, materials, and trends in physical education.

P.E. 402-1. Seminar in Teaching. Sophomore year. Introduction to teaching physical education in elementary and secondary schools.

P.E. 413-3. Curriculum and Administration in Physical Education. In this course the development of curriculum in physical education is examined. In addition, the functions and processes of administration and the organization of instructional and interscholastic athletic programs are presented. School visitations included in the course.

P.E. 415-3. Management of Aquatic Programs. Designed to provide the necessary techniques, management skills and knowledge required to administer modern aquatic programs.

P.E. 417-3. Physical Education in the Elementary School. Activities, program planning, teaching methods for grades 1-6. Prer., P.E. 260, 350. A 2.5 grade point average is required.

P.E. 418-2. Theory of Athletic Coaching. Fundamental and technical problems in connection with coaching of athletic teams. Prer., junior standing.

P.E. 419-2. Leadership and Values in Modern Sports Programs. Explores the underlying values and principles that dictate the nature, scope and practices associated with the administration and management of sports programs.

P.E. 429-3. Tests and Measurements in Physical Education. The purpose of this course is to analyze and apply the techniques for constructing, interpreting and administering performance, affective, and knowledge tests in physical education settings. Includes an introduction to computer applications in physical education. Prer., junior standing.

P.E. 437-1 to 6. Internship in Physical Education. Opportunity for field/laboratory work in a variety of different settings. Consult with faculty for approval.

P.E. 445-3. Disabilities and Motor Development. Survey of orthopedic and perceptual motor conditions encountered within the realm of special physical education, suggested screening and corrective procedures.

P.E. 446-3. Prevention and Management of Sports Injuries I. Application of activity science concepts to sports injury prevention. Techniques of basic evaluation and treatment of injuries common to organized and recreational sport. Lab. included in the four contact hours weekly. Prer., P.E. 279 or EPOB 342.

P.E. 448-3. Perspectives on Aging. Designed to create an awareness of aging as a developmental process and to foster an understanding of the older person in a changing social milieu. Physiological, psychological, and sociological aspects of aging will be examined.

P.E. 449-2. Seminar-Practicum in Adapted Physical Education and Recreation. Theory and practice in therapeutic aspects of physical education and/or recreation. Readings, discussions on current trends and problems. Prer., P.E. 346 or permission of instructor.

P.E. 454-3. Biomechanics of Human Movement (Kinesiology). Mechanical and anatomical concepts employed as a basis for analysis of movement; applications made to sports performance, physical activity, and therapy. Classroom and lab. experience. Prer., P.E. 279 or EPOB 342.

P.E. 458-3. Methods of Teaching Physical Education in Secondary Schools. Prer., P.E. 350, and seven of eight required professional activity courses (numbered between P.E. 235-268) completed or in progress.

P.E. 466-3. Exercise Physiology. The major emphasis of the course will be to examine the physiological adjustments that occur in selected organ systems with acute and chronic exercise. After a strong base in the physiological adjustments to exercise has been established, an overview of how environmental and genetic factors affect these adjustments will be studied. Prer., EPOB 342 and 343 or P.E. 279 and 280.

P.E. 467-3. Exercise Science Laboratory Techniques. Laboratory procedures and biomedical instrumentation pertinent to measuring and evaluating human performance. Prer., P.E. 466.

P.E. 468-3. Exercise Management. Lectures and practical experiences in delivery principles and practices for wellness programs. Application of physiological and biomechanical principles to normal and clinical populations is presented. Prer., P.E. 454, 466, college anatomy and physiology.

P.E. 484-2. Physical Education and Health for the Elementary School. (For elementary education majors only.) A study of activities, teaching methods, and program planning for grades 1-6. Also involves discussions of middle school activities and programs. Opportunities to work with children will be provided.

P.E. 490-3. Introduction to Research in Health, Physical Education, and Recreation. An introduction to types of research, the methods for accomplishing research, and the skills necessary to complete research in the fields of health, physical education, and recreation. Prer., junior standing.

P.E. 501, 502, 503-1 to 3. Seminar. Presentation of special topics in physical education, recreation, or sport.

P.E. 514-3. Current Trends in Teaching Physical Education. An examination of current trends in teaching physical education at all levels. Topics will include movement education, personalizing physical education, open gym, contracts, team teaching, and differentiated staffing.

P.E. 531-3. Trends in Recreation. Analysis of changing political, social, economic, and industrial orders and the possible influences on leisure-time pursuits.

P.E. 532-3. Therapeutic Recreation Service Systems. The analysis and evaluation of clinical and community therapeutic recreation service system models from both theoretical and applied approaches. Several local systems will be examined as case studies.

P.E. 534-3. Education, Schools, and Recreation Services. The role of the education system in the provision of recreation and leisure services will be explored. Topics include community education, leisure education, community schools, interagency cooperation, advising councils, and citizen involvement in the leisure service delivery system.

P.E. 538-3. Recreation Leadership at the Administrative Level. Designed to study the characteristics of leadership as they relate to influencing the delivery of recreational leisure services in public and private agencies. Concise content includes decision making, communications, group dynamics, and techniques in leadership assessments.

P.E. 539-3. Organization and Administration of Community Recreation. Analysis, synthesis, and evaluation of administrative organization and operations of community recreation/leisure delivery systems. Course includes a community assessment project.

P.E. 552-3. Seminar: Physical Growth and Motor Development.[1] Evaluation of current literature pertaining to physical growth; implications of growth patterns for performance of physical activities.

P.E. 560-3. Physiological Basis for Physical Activity. Immediate and long range adaptations of the body to exercise. Adjustment of selected body systems to the stress of physical activity. Prer., college physiology or physiology of exercise. Except with consent of the instructor, the course is to be taken concurrently with P.E. 566.

P.E. 562-3. Prevention and Management of Sports Injuries II. Lectures and laboratory presentations relative to physical aspects of sports training, rehabilitation, nutrition, prevention, evaluation and injury management. The medical aspects of sport are emphasized. Prer., college anatomy, P.E. 446, or equivalent desirable.

P.E. 563-3. Sports Medicine. Investigation and demonstration of applied exercise physiology, medicine, biopsychology, and other related disciplines contributing to the assessment and improvement of human physical performance.

P.E. 565-3. Clinical Aspects of Exercise in Health and Disease. An assessment of the use of exercise as a tool for preventive medicine and rehabilitation from disease. Includes exercise evaluation, exercise prescription, and cardiac rehabilitation.

P.E. 566-3. Human Performance Laboratory Techniques. Laboratory procedures and biomedical instrumentation pertinent to human performance laboratories are presented through lecture and laboratory participation. Except with consent of instructor, to be taken concurrently with P.E. 560.

P.E. 567-3. Exercise Science Laboratory Techniques. Laboratory procedures and biomedical instrumentation pertinent to measuring and evaluating human performance.

P.E. 568-3. Exercise Management. Lectures and practical experiences in delivery principles and practices for wellness activity programs. Applications of physiological and biomechanical principles to normal and clinical populations are presented. Prer., P.E. 454, 466, and college anatomy and physiology.

P.E. 570-3. Sociological Basis of Sport.[1] An examination of the interrelationships between human movement and sociocultural variables with emphasis on the social structure and dynamics of sport groups.

P.E. 572-3. Motor Learning. Presumes a background in learning theory. Critical analysis of theories and conditions affecting motor learning and modification of performance. Laboratory sessions and individual research projects required. Prer., undergraduate course in educational psychology or behavioral psychology.

P.E. 575-3. Psychology of Sport. Behavioral phenomena associated with sport, the participant, and coach. Prer., educational psychology, psychology of learning.

P.E. 579-3. Psychological Basis for Human Performance. An advanced course dealing in depth with specialized topics relevant to motor learning and performance. Critical analysis of theories and research concerning skill acquisition. Discussion, evaluation, and pursuit of research interests and projects of students and faculty. Prer., P.E. 572, some undergraduate psychology and/or educational psychology dealing with learning theory, or consent of instructor.

P.E. 580-3. Historical Basis of Sport and Physical Activity.[1] A cultural, historical development of sport and exercise in ancient societies with emphasis on the development in America from the colonial period to the current era.

P.E. 585-3. Interpretation of the Values of Physical Activity.[1] Identification, analysis, and interpretation of the values of human movement and physical activity in contemporary society.

P.E. 588-3. Philosophical Basis of Sport and Physical Activity.[1] An analysis of the various schools of philosophic thought and their influence on the meanings inherent in sport and physical activity.

P.E. 592-3. Applications of Statistics in Health, Physical Education, and Recreation. Considerations of descriptive, inferential, and correlational statistics and how they apply specifically to health, physical education, and recreation data. Introduction to related computer programs.

P.E. 601, 602-1 to 3. Seminar.[1] Presentation of special topics in physical education, recreation, or sport.

P.E. 620-3. Administration of Physical Education and Athletics. Affords an examination and analysis of modern administrative practices in physical education and athletics. Current problems of the teacher, coach and administrator are reviewed in the context of administration and management.

P.E. 640-3. Special Physical Education. Advanced theoretical and applied studies in physical education for individuals with chronic and permanent disabilities and individuals with developmental disabilities; perceptual motor learning theories and the exceptional child; organization and administration; diagnostic and prescriptive techniques; implications of federal and state law; applied behavior analysis; and mainstreaming techniques. Prer., human anatomy, human physiology, and biomechanics of human movement.

P.E. 662-3. Current Topics in Exercise Science. An assessment of metabolic functions in man during, and as a result of, physical activity. Energy sources and metabolic pathways are presented and evaluated. Prer., college physiology.

[1]Not taught on a yearly basis.

P.E. 690-3. Methods of Research in Health, Physical Education, and Recreation. Delineation of research problems; types of research; design of experiments; specific research procedures and tools; instruction in preparation of proposals, research papers, and thesis.

P.E. 699-1 to 3. Research Project. Scholarly investigation of a selected topic utilizing literature and/or experimental techniques. Advisor required.

P.E. 700-1 to 6. Master's Thesis.

P.E. 920-variable credit. Elective Activity. Only by consent of departmental chairman.

P.E. 930-1 to 3. Independent Study: Physical Therapy.

P.E. 940-1 to 3. Independent Study: Physical Education (Undergraduate).

P.E. 950-1 to 3. Independent Study (Graduate).

P.E. 951-1 to 3. Independent Study: Therapeutic Recreation (Graduate).

P.E. 999-0. Master's Degree Candidate.

Recreation

Rec. 201-3. History and Philosophy of Recreation and Leisure. An introduction and historical overview of leisure behavior focusing on the concepts of leisure, play, and recreation. Significant historical and philosophical foundations of the recreation and leisure movement and current societal trends are studied. Emphasis is placed on the development of a personal philosophy of leisure and an awareness of the importance of healthy leisure pursuits.

Rec. 212-3. Recreation Leadership. Leadership styles appropriate in the provision of recreation activities and services are identified and studied. Topics include leadership techniques, group process, value clarification, communication, risk taking, decision making, and problem solving. Theoretical and practical applications of leadership are experienced through classroom and community experiences.

Rec. 310-3. Leisure Behavior and Recreation Services. Leisure patterns and behaviors of selected age and interest groups and the various systems to deliver leisure services are social/psychological aspects of the leisure experience. Organizational patterns and structures used to deliver leisure services are identified and studied.

Rec. 317-1 to 4. Fieldwork—Leisure Behavior. Through observation and involvement, each student experiences the provision of leisure activities in select settings. Skills and knowledge are applied under agency supervision allowing for a refinement of leadership and programmatic techniques.

Rec. 320-3. Principles of Outdoor Recreation. An investigation into the conceptual, phenomenal, behavioral, social, ethical, and environmental aspects of outdoor recreation.

Rec. 327-1 to 4. Fieldwork in Outdoor Recreation. See course description under Rec. 317.

Rec. 330-3. Recreation for Special Populations. Assessment and activity analysis of recreation services for special groups with limitations or disabilities is the focus of the course. Cultural, social, environmental, and physical limitations preventing full participation in traditional leisure experiences are studied and appropriate modification techniques identified.

Rec. 337-1 to 4. Fieldwork—Therapeutic Recreation. See course description under Rec. 317.

Rec. 340-3. Principles of Commercial Recreation. Development of commercial recreation and the significance of American travel and tourism are the major topics for this course. Others include private/public sector relationships, recreation for profit, historical development, economic impact of recreation services, administative structures, and planning objectives.

Rec. 347-1 to 4. Fieldwork—Commercial Recreation. Through observation and involvement, students experience the provision of recreation services in select settings. Skills and knowledge are applied under agency supervision allowing for a refinement of leadership and programmatic techniques.

Rec. 400-2. Senior Seminar in Recreation. Current topics of importance to the recreation and leisure profession are identified and discussed. Research studies, journal articles, and select outstanding professionals provide the basis for the study of leisure behavior in this course. Prer. Rec. 201, 212, 310 and Senior status.

Rec. 401-3. Program Planning. Basic principles of developing significant leisure experiences for various populations are examined. Program proposals, implementation, and evaluation provide the basis for this learning experience. Client involvement, participant characteristics, scheduling, marketing, and other topics pertinent to effective program planning are studied. Prer., Rec. 201, or 340, Junior/Senior status and majors only.

Rec. 403-3. Marketing Park and Recreation Areas and Facilities. Effective development and promotion of areas and facilities commonly used for recreation are studied. Federal, state, and local resources and guidelines are studied with special focus on management, programming and maintenance. Prer., Rec. 210, 310, or 340, Junior/Senior status, and majors only.

Rec. 405-3. Organizational Management in Recreation. Involves the study of organizational structure of the various recreation delivery systems. Evaluative techniques used to determine the effectiveness of these structures are related to administration of programs and policies. Prer., Rec. 201, 310 or 340, Junior/Senior status, and majors only.

Rec. 407-3. Financial Management of Leisure Services. Specific techniques of financial mangement currently utilized by the recreation profession. Bids, grants, tax status, program accounting, public and private funding approaches are studied. Prer., Rec. 201, 310 or 340, Junior/Senior status, and majors only.

Rec. 410-3. Administration of Leisure Service Agencies. Designed to provide understanding of the broad scope of recreation administration and to develop competency in the various administrative techniques. Prer., Rec. 201, 310 or 340, Junior/Senior status, and majors only.

Rec. 418-10. Internship—Leisure Behavior. A semester placement with a leisure service agency to study the total operation of how services are managed and delivered, and how those services impact participants. Prer., all recreation requirements completed and advisor's permission. Pass/Fail only.

Rec. 420-3. Management of State and Federal Parks and Recreation. Lect., fieldwork and lab. Experience in parks and recreation administration. Problems in management, evaluation of park and recreation facilities. Prer., Rec. 201 and 320.

Rec. 428-8. Internship—Outdoor Recreation. See course description under Rec. 418. Pass/Fail only.

Rec. 430-3. Techniques in Therapeutic Recreation. Study of various techniques used in recreational and leisure services designed and adopted to meet varying abilities of disabled and handicapped individuals in hospitals, schools, rehabilitation centers, and recreation centers. Prer., Rec. 201 and 330, or consent of instructor.

Rec. 434-3. Clinical and Community Aspects of Therapeutic Recreation. Examination of selected clinical and community therapeutic recreation service programs for the purpose of evaluating the impact of various models of service delivery on special populations. Prer., Rec. 201, 310, and 330.

Rec. 438-10. Internship—Therapeutic Recreation. See course description under Rec. 418. Prer., junior and senior majors only. Pass/Fail only.

Rec. 440-3. Leisure Behavior Travel and Tourism. There will be an in-depth analysis of tourism as an industry. This analysis is to include both the economic and social effects commercial recreation and tourism have on society with appropriate required and outside readings from current publications and the *TTRA Journal.* Prer., junior or senior standing; Rec. 201 and 350. Majors only.

Rec. 448-10. Internship — Commercial Recreation. A semester placement with a commercial recreation agency to study the total operation of how services are managed and delivered, and how those services impact participants. Prer., all recreation requirements completed and advisor's permission. Pass/Fail only.

Rec. 941-1 to 3. Independent Study in Community Recreation. Prer., consent of instructor.

Rec. 942-1 to 3. Independent Study in Outdoor Recreation. Prer., consent of instructor.

Rec. 943-1 to 3. Independent Study in Therapeutic Recreation. Prer., consent of instructor.

Rec. 944-1 to 3. Independent Study in Commercial Recreation. Prer., consent of instructor.

PHYSICS

Phys. 101-3, 102-3. Physical Science for Nonscientists. Three hrs. lect. per wk. Topics range from Newtonian mechanics to modern physics. Emphasizes the social and historical aspects of physics and its connection to the humanities. Prer for Phys. 102 is Phys. 101 or permission of instructor.

Phys. 111-4. General Physics. Three lect., one rec. per wk., plus three evening exams in the semester. First semester of 3-semester sequence for science and engineering students. Covers kinematics, dynamics, momentum of particles and rigid bodies, work and energy, gravitation, simple harmonic motion, and introduction to thermodynamics. Prer., knowledge of algebra, geometry, and trigonometry; coreq., calculus through derivatives and indefinite and definite integrals of polynomials and trigonometric functions, as typically covered in Math. 130 or A.Math. 135.

Phys. 112-4. General Physics. Three lect., one rec. per wk., plus three evening exams in the semester. Second semester of 3-semester introductory sequence for science and engineering students. Covers electricity and magnetism, wave motion, and geometric optics. Prer., Phys. 111; coreq., Math. 230 or A.Math. 136.

Phys. 114-1. Experimental Physics. To be taken concurrently with Phys. 112. One lect., one 2-hour lab. per wk.

Phys. 115-2. Experimental Physics. To replace Phys. 114 and to be taken concurrently with Phys. 112 for physics majors in Plan 3. Two 2-hour labs. per wk. Registration by special arrangement with A. Bartlett.

Phys. 116-4. General Physics—Honors. First semester of a two-semester sequence covering the material of Phys. 112, 213, and 214. Prer., Phys. 111 and permission of instructor.

Phys. 207-3. Energy in a Technical Society. Three lect. per wk. Various aspects of energy: the physics involved in the sources and uses of energy in our society, the state of depletion of the fossil fuels, nuclear energy, solar energy, and other alternative sources of energy and their possible effects on the environment. No background in physics is required.

Phys. 208-3. The Physics of Contemporary Social Problems. Three lect. per wk. Continuation of Phys. 207. Various contemporary areas of concern such as air and water pollution, transportation, resources, and communications are discussed from the point of view of the physical principles involved and the impact on society. The object of this course is to understand the scientific questions involved in making decisions in these areas. No background in physics is required.

Phys. 212-4. General Physics: Electricity, Magnetism, and Optics. Covers the properties of electric and magnetic fields, Maxwell's equations, electromagnetic waves and wave equation, and the required vector analysis. Also serves as an introduction to geometrical and physical optics. The course is a sequel to Phys. 111 designed especially for students enrolled in the Department of Electrical Engineering. Students may not earn credit for both Phys. 212 and 112. Prer., Phys. 111, Math. 230, or A.Math. 136; coreq., Math. 240 or A.Math. 236.

Phys. 213-3. General Physics. Three lect. per wk. Third semester of introductory sequence for science and engineering students. Covers special relativity, quantum theory, atomic physics, solid state, and nuclear physics. Prer., Phys. 112 and 114.

Phys. 214-3. Methods of Theoretical Physics. Three rec. per. wk. Introduces mathematical techniques required for a quantitative understanding of the phenomena of modern physics, including vector algebra and vector calculus, Fourier analysis, and some of the differential equations of physics. Prer., Phys. 213.

Phys. 215-1. Experimental Physics. One lect., one 2-hour lab. per wk. To accompany Phys. 213. The course includes many experiments of modern physics, including atomic physics, solid state physics, electron diffraction, radioactivity, and quantum effects.

Phys. 216-2. Experimental Physics. To replace Phys. 215 and to be taken concurrently with Phys. 213 for physics majors in Plan 3. Two 2-hour lab. per wk. Registration by special arrangement with A. Bartlett.

Phys. 217-4. General Physics—Honors. Second semester of a two-semester sequence covering the material of Phys. 112, 213, and 214. Prer., Phys. 116.

Phys. 297, 298, 299-variable credit. Special Topics in Physics. Various topics not normally covered in the curriculum; offered intermittently depending on student demand and availability of instructors.

Phys. 301-5, 302-5. General Physics. Three demonstration lectures, one two-hr. lab/rec. per wk., plus four evening exams in the semester. Phys. 301 covers mechanics, heat, and sound; 302 covers electricity and magnetism, light, and modern physics. An elementary but thorough presentation of the fundamental facts and principles of physics. Majors in mathematics, chemistry, and others taking calculus are urged to take instead Phys. 111, 112, 114, 213, and 215. Prer., 11/2 years high school algebra and satisfactory grade on mathematics placement test.

Phys. 305-3. Topics in the History and Philosophy of Physics. (Phil. 305.) Topics will vary from year to year and may include scientific methodology, the role of experiment and case studies in the history of physics. Prer., one year of physics or consent of instructor.

Phys. 317-2, 318-2. Junior Laboratory. One lect. and one 3-hour lab. per wk. Includes experiments on data handling, electrical measurements, electronics, optics, vacuum techniques, heat and thermodynamics, mechanics, and modern physics. Emphasis will be on developing basic skills and on design of experiments. Each student will carry at least one project experiment each semester. Coreq. for Phys. 317 is Phys. 331. Phys. 317 is prer. for Phys. 318.

Phys. 321-3. Analytical Mechanics. Three rec. per wk. Newtonian mechanics, oscillations, Lagrange's and Hamilton's equations, central forces, and scattering. Analytical procedures employing the methods of vector analysis and calculus. Prer., A.Math. 236 or equivalent.

Phys. 322-3. Analytical Mechanics and Quantum Mechanics. Three rec. per wk. Non-inertial reference frames, rigid body motion, coupled oscillators, introduction to quantum mechanics, Bohr theory, simple solutions to the Schroedinger equation, and perturbation theory. Prer., Phys. 321.

Phys. 331-3, 332-3. Principles of Electricity and Magnetism. Elements of mathematical theory of electricity and magnetism, including electrostatic, magnetostatics, polarized media, direct and alternating current theory, introduction to electromagnetic fields, waves, and special relativity. Prer. for Phys. 332 is Phys. 331.

Phys. 341-3. Thermodynamics and Statistical Mechanics. Statistical mechanics applied to macroscopic physical systems; statistical thermodynamics, classical thermodynamic systems; applications to simple systems. The relationship of the statistical to the thermodynamic points of view is examined. Prer., Phys. 321.

Phys. 414-4. Experimental Plasma Physics. (APAS 514) Introductory course describing and experimentally verifying fundamental concepts of the physics of ionized gases; one lect. plus one lab. session weekly. Prer., senior standing or consent of instructor.

Phys. 446-3. Solid-State Physics. (E.E. 434.) Primarily for senior physics majors. Crystal structure lattice dynamics, band theory, semiconductors, ferromagnetism, etc. Prer., Phys. 322 and 341.

Phys. 451-3. Optics. Basic electromagnetic theory of light, using Maxwell's equations. Examples in geometrical optics; extensive applications in physical optics including diffraction and polarization. Spectra, including Zeeman effect and fluorescence. Recent advances

in experimental techniques: microwaves, lasers, image converters, etc. Prer., Phys. 332.

Phys. 461-2, 462-2. Physics Honors.

Phys. 491-3, 492-3. Atomic and Nuclear Physics. Topics include a quantum mechanical treatment of the one-electron atom, atomic shell structure, atomic and molecular spectroscopy, band theory of solids, X-rays, nuclear properties, radioactivity, and the properties of the fundamental particles. Prer., passing grade of *C* or better in Phys. 322 and 332, or permission of instructor.

Phys. 495-2, 496-2. Senior Laboratory. One lect., one lab. per wk. to be taken with Phys. 491, 492. Experiments introduce the student to realities of experimental physics so that he will gain a better understanding of theory and an appreciation of the vast amount of experimental work done in the physical sciences today. For students registered for Phys. 496 and not 455, and with 451 as a prerequisite, or instructor consent, some experiments from the light laboratory can be included on a replacement basis. Prer., consent of the instructor.

Phys. 497, 498, 499-variable credit. Special Topics in Physics. Various topics not normally covered in the curriculum; offered intermittently depending on student demand and availability of instructors.

Phys. 501-3. Health Physics. *Spring, alternate years.* Two lect., one lab. per wk. Health Physics is a course to provide job-oriented skills. Topics covered include radiation dosimetry, radiation biophysics, radioecology, reactor health physics, and medical physics. The labs include exercises with radioactive isotopes as well as tours of off-campus facilities. Prer., consent of instructor.

Phys. 503-3, 504-3. Intermediate Mathematical Physics I, II. (Math. 553, 554.) Survey of classical mathematical physics, starting with complex variable theory and finite dimensional vector spaces. Topics in ordinary and partial differential equations, the special functions, boundary value problems, potential theory, and Fourier analysis. Prer., Math. 431 and 432 or equivalent.

Phys. 505-3. Science Communication Seminar. Study and practice of public interest writing in science and technology. Writers' understanding of science, scientists' understanding of writing for communication to the general public. Practice through writing and discussion with those engaged in public interest science.

Phys. 515-3. Introductory Plasma Physics. (APAS 515.) *Spring.* Basic phenomena of ionized gases; static and dynamic shielding, linear waves, instabilities, particles in fields, collisional phenomena, fluid equations, collisionless Boltzmann equations, Landau damping, scattering and absorption of radiation in plasmas, elementary nonlinear processes, WKB wave theory, controlled thermonuclear fusion concepts, astrophysical applications, experimental plasma physics (laboratory). Prer., APAS 554 or equivalent; Phys. 331.

Phys. 516-3. Intermediate Plasma Physics. (APAS 516.) *Fall.* Continuation of Phys. 515. Topics vary yearly but include nonlinear effects such as wave coupling, quasilinear relaxation, particle trapping, nonlinear Landau damping, collisionless shocks, solitons; nonneutral plasmas; kinetic theory of waves in a magnetized plasma; anisotropy; inhomogeneity; radiation—ponderomotive force, parametric instabilities, stimulated scattering; plasma optics; kinetic theory and fluctuation phenomena. Prer., Phys. 515 or instructor consent.

Phys. 517-3. Advanced Plasma Physics. *Spring.* Continuation of Phys. 516. Radiative transfer of plasma waves, advanced kinetic theory of plasmas, spontaneous emission, transport phenomena, fluctuation-dissipation theorems, modulational instability, wave trapping and collapse, turbulence, special topics. Prer,. Phys. 516 or instructor consent.

Phys. 585-3. Gravitational Theory. (Theory of General Relativity). *Alternate years.* Three lect. per wk. Einstein's relativistic theory of gravitation is presented from geometric viewpoint; applications to astrophysical problems (gravitational waves, stellar collapse, etc.) are given.

Phys. 595-2, 596-2. Modern Physics Laboratory. One lect., one lab. per wk. Experiments in nuclear physics, atomic physics, and condensed matter introduce the student to a variety of techniques useful in contemporary research. Students with limited background in laboratory work are urged to take this course.

Phys. 602-2. Design and Analysis of Experiments. Intended to aid students in planning and carrying out experiments. Methods for estimating expected noise level and maximizing signal-to-noise ratio. Topics in electronics, optics, vacuum techniques, and statistics. Examples from various areas of low energy experimental physics at the University of Colorado.

Phys. 603-3, 604-3. Advanced Mathematical Physics I, II. (Math. 653, 654.) Hibert space, theory of distributions, L^2-spaces, Sobolev spaces, methods of functional analysis, spectral theory of operators, applications to quantum theory, and group theory. Prer., Math. 431 and 432, and Math. 445 and 535.

Phys. 605-3, 606-3. Advanced Mathematical Physics III and IV. (Math. 655, 656.) Further topics in modern mathematical physics with applications. Prer., Phys. 603, 604.

Phys. 621-3. Theoretical Mechanics. Variational principles, Lagrange's equations, Hamilton's equations, motion of a rigid body, relativistic mechanics, transformation theory, continuum mechanics, small oscillations, Hamilton-Jacobi theory.

Phys. 625-3, 626-3, 627-3. Introduction to Quantum Mechanics I, II, and III. Quantum phenomena, relation to classical physics, Schroedinger and Heisenberg picture, application to problems, approximation techniques; angular momentum; scattering theory; Pauli spin theory; radiation theory; relativistic wave equations with simple applications; introduction to field theory and second quantization. Coreq., Phys. 621 for Phys. 625; Phys. 631 for Phys. 626.

Phys. 628-3. Advanced Quantum Theory. Quantum theory of fields, elementary particles, symmetry laws, and topics of special interest. Prer., consent of instructor.

Phys. 631-3, 632-3. Electromagnetic Theory. Electromagnetic fields; applications of Maxwell's equations to electromagnetic wave propagation, and fundamental properties of light; relativistic electrodynamics, radiation theory. Prer.,' Phys. 331-332, or equivalent; Phys. 603 or equivalent is recommended.

Phys. 644-3. Statistical Mechanics. Classical and quantum statistical theory, including the study of both equilibrium and nonequilibrium systems. Topics covered in Phys. 644 include kinetic theory, degenerate gases, marocanonical and grand canonical ensembles, and irreversible processes. Prer., Phys. 625-626.

Phys. 652-3. Atomic, Molecular, and Nuclear Processes. *Alternate years.* Study of physical processes of importance in astrophysics, including atomic and molecular spectrum lines, absorption, ionization, recombination, collision processes involving electrons or heavy particles, line broadening, nuclear reaction mechanisms and rates, neutrino processes.

Phys. 653-3. Topics in Chemical Physics. *Alternate years.* A broad survey is made of molecular structure as deduced primarily from molecular spectra. Topics selected from interaction of radiation with matter, molecular rotation, molecular vibration, molecular electronic energy levels, structural information provided by nuclear magnetic resonance, electron spin resonance and molecular-beam spectroscopy, structural information provided by electron, neutron and X-ray diffraction, molecular optical dispersion phenomena. Prer., introductory quantum mechanics, Phys. 322, Chem. 552, or equivalent.

Phys. 656-3. Atomic and Molecular Spectra. Theory of atomic structure and spectra, including coupling of angular momenta, tensor operators, energy levels, fine and hyperfine structure, transition probabilities, Zeeman and Stark effects. Molecular spectra: electronic, vibrational, and rotational states. Rotation matrices, symmetric top.

Phys. 685-3. Theory of Relativity. *Alternate years.* Principles and applications to physics of the special and general theories of relativity.

Phys. 687-3, 688-3. Nuclear Physics. *688, alternate years.* Intrinsic properties of nucleons and the nucleon-nucleon interaction, nuclear models, scattering of nucleons by nuclei in terms of an optical model, and nuclear reactions.

Phys. 690-3, 691-3. Theory of the Solid State. *691, alternate years.* Stresses application to the solid state of physical concepts basic to

much of modern physics, single-particle approximation and the energy-band description of electron states in solids, pseudopotential theory applied to ordered and disordered systems, dynamical behavior of electrons in solids, lattice dynamics, Hartree-Fock and random-phase approximation in solids, many-body aspects of magnetism and super-conductivity.

Phys. 692-3, 693-3. Theory of Elementary Particles. *693, alternate years.* Systematics of elementary particles; quantum numbers, Lorentz group and spin; the S-matrix and invariant amplitudes; analytical properties of amplitudes; dispersion relations; dynamical calculation of quantum numbers and masses; elementary particle spectroscopy; higher symmetries.

Phys. 695, 696, 697, 698, 699-variable credit. Special Topics in Physics. Various topics not normally covered in the curriculum; offered intermittently depending on student demand and availability of instructors.

Phys. 700-4 to 6. Master's Thesis. An approved problem in theoretical or experimental physics under the direction of staff members. Intended to introduce the student to procedures in research and development work. Work of an original nature is expected.

Phys. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Phys. 940-variable credit. Independent Study. Selected topics for undergraduate independent study. Subject matter to be arranged. Prer., consent of instructor.

Phys. 950-variable credit. Selected Topics for Graduate Independent Study. Subject matter to be arranged. Prer., consent of instructor.

POLITICAL SCIENCE

Note: Some of the courses listed below are not necessarily offered every year.

American

LOWER DIVISION

P.Sc. 110-3. The American Political System. Emphasis upon interrelations among levels and branches of government, formal and informal institutions, processes, and behavior.

P.Sc. 210-3. Introduction to Public Policy Analysis. A study of the policy-making processes in American government, the factors which shape public decision, and the issues and questions which are relevant to political inquiry.

P.Sc. 248-3. Introduction to the Legal Process. Basic legal concepts and processes with emphasis on the American system. Special attention to the political functions of law. Recommended as preparation for P.Sc. 447, 448, 449.

UPPER DIVISION

P.Sc. 353-3. Government and Capitalism in the United States. An examination of competing theoretical approaches to questions related to the origins, development, and purposes of modern government in the United States; particular attention is paid to the impact of transformations in the underlying structure of the capitalist economy.

P.Sc. 400-3. Government Regulation of Business. Consideration of theory and practice of government relationship to business and professional activity on both state and national levels. Analysis of selected regulatory programs and policies and their impact on the constitutional system. Not open to freshmen and sophomores.

P.Sc. 401-3. The American Presidency. Covers the constitutional and institutional foundations and historical development of the presidency; roles, powers, selection, recent modifications, and institutionalization. Lectures and class discussion are utilized.

P.Sc. 402-3. Legislatures and Legislation. Structure and organization of legislatures and process of statute law-making.

P.Sc. 403-3. Political Parties and Pressure Groups. Practice of party politics in the United States. Nature, structure, organization, and functions of political parties and pressure groups. Analysis of pressure politics and political behavior.

P.Sc. 404-3. Advanced American Government: the Congress. Provides an intensive examination of the role of Congress in American government including congressional elections, representation, the organization of Congress, and congressional policymaking. The larger context of congressional politics, including the political parties, the president, and interest groups will also be examined. Students who have credit in P.Sc. 404 prior to the fall semester 1983 may not receive credit in this course.

P.Sc. 405-3. Public Opinion and Political Behavior. Measurement of public opinion and evaluation of its impact on governmental policy formation, including survey research techniques and field work in opinion sampling.

P.Sc. 406-3. State Government and Administration. Present-day national, state, and interstate relations; constitutional development; legislative, executive, and judicial processes and problems; administrative organization and reorganization; state finances; major state services; future of the states. Special attention is given to the government of Colorado.

P.Sc. 407-3. Urban Politics. Examination of the structure of political and social influence in urban areas; selection of urban leadership; relationship of the political system to governmental and social institutions.

P.Sc. 408-3. Municipal Government and Administration. Municipalities and relationships to the states and the national government; local politics; forms of municipal government; application of ideas and techniques of public administration to management of municipal affairs; activities of cities, e.g., planning, public utilities, law enforcement, fire protection.

P.Sc. 409-3. Comparative Metropolitan Systems. Comparative analysis of the major metropolitan systems of North America and Europe: the structural environment, decision making in the bureaucracies and political groupings, governmental interaction and communication.

P.Sc. 432-3. Public Administration. A comprehensive basic course which considers the power of organization, the problem of bureaucracy, the determination of organizational objectives, decision making, the allocation of resources, organizational structure, staffing problems, and the evaluation of institutional performance.

P.Sc. 434-3. National Security Organization and Policy Making. Analysis of the governmental structure and the policy-making processes for American national security planning, decision making, and action.

P.Sc. 435-3. The Environment and Public Policy. Consideration of constitutional, political, and geographic factors in the development of public policy affecting the use of natural resources and management of the environment; organization, procedures, and programs for use of natural resources; administration of environmental policies.

P.Sc. 437-3. Public Priorities: Revenues and Program Expenditures. Public goals as expressed in government budgets. The politics and processes involved in raising public moneys and in determining public spending programs.

P.Sc. 445-3. American Political Thought.[1] Development of American political theories and ideas from colonial period to present.

P.Sc. 446-3. Administrative Law. General nature of administrative law, types of administrative action and enforcement, analysis of rule making and adjudication, administrative due process, judicial review.

P.Sc. 447-3. Constitutional Law I. Nature and scope of the following American constitutional principles as developed by the U.S. Supreme Court: federalism, jurisdiction of the federal courts, separation of powers, the taxing power, and the commerce power. Case method. Not open to freshmen and sophomores.

[1]Also listed under Theory.

P.Sc. 448-3. Constitutional Law II. Continuation of P.Sc. 447, with emphasis on the war power, powers of the President, citizenship, the Bill of Rights, and the Civil War amendments. Case method. Not open to freshmen and sophomores. Not open to students who have not completed P.Sc. 447 or its equivalent or who do not have prior approval of the instructor.

P.Sc. 449-3. The Judicial System. Examination of the principal actors in the legal system—police, lawyers, judges, citizens—and the roles they play in the political process. Differential treatment of varying economic groups will be emphasized.

P.Sc. 451-3. Black Politics. Elitism and black powerlessness; black interest groups; base, structure, and functions of black political organizations; goals and political styles of black politicians; community control; trends (radicalism and separatism vs. accommodation) and future of black politics in the United States.

P.Sc. 452-3. Urban Policy Analysis. Examination of the processes whereby governments formulate, implement, and evaluate programs designed to deal with major social and economic problems. Special emphasis on an evaluation of urban programs in welfare, education, law enforcement, housing, and urban renewal.

P.Sc. 454-3. War, Peace, and Strategic Defense. The role of force in American foreign policy, especially in relation to other super powers. Particular emphasis is placed on the political and economic analysis of strategic forces and their effects. Arms control treaties and negotiations are studied.

P.Sc. 455-3. The Mexican American in Politics. (Ch.St. 455.) Analysis of the social, cultural, and economic factors which affect political behavior of Mexican Americans. Special attention will be paid to the Mexican American cultural heritage and to relations between Mexican Americans and Anglo-Americans.

P.Sc. 456-3. Bureaucratic Power in American Politics. Examines public agencies as political actors engaging in public policy making including sources of bureaucratic power; securing public support; relationships with legislature, political executives, interest groups, and other agencies; and an analysis of the freedom and limitations resulting from these relationships.

P.Sc. 457-3. The Free Market and Limited Government. This seminar involves an intense critical examination of classical conservative and neoconservative theories concerning the relationship between the free market and limited government, ranging from the work of John Locke to Milton Friedman and Irving Kristol. Elements of the theories will be tested in light of historical developments in economy, society, and policy. Prer., P.Sc. 110, Econ. 201-202.

P.Sc. 492-3. Women and the Law. Role of the courts in the development of public policy toward women. Case law will be combined with readings on the political position of women in society and the structure of judicial decision making.

International/Comparative

LOWER DIVISION

P.Sc. 201-3. Introduction to Comparative Politics: Developed Political Systems. Comparison of legal-institutional features; social, economic, ideological forces; patterns of recruitment and decision making; implications of planned socioeconomic and political change in Western politics. Geographical emphasis will vary with the instructor, but there will be a balanced comparison of several countries representing a broad cross section of the Western world. Closed to those with credit in P.Sc. 211 and/or P.Sc. 212.

P.Sc. 202-3. Introduction to Comparative Politics: Developing Political Systems. Comparison of political features within the non-Western world: traditional political culture, nationalism, political integration, political structures and groups, modes of recruitment, the style of politics, implications of planned socioeconomic change. Geographical emphasis will vary with instructor, but there will be a balanced comparison of several countries representing a broad cross-section of the non-Western world.

P.Sc. 203-3. Introduction to Asian Politics. Survey of selected political systems of East, Southeast, and South Asia. Systematic examination of the nationalist era and political history; consideration of regional and international politics in the area and their effects on the domestic politics in the selected systems.

P.Sc. 211-3. Governments of Great Britain and France. Governments and politics in present-day Great Britain and France, especially in comparison with the U.S. government. Emphasis on postwar reform legislation in U.K. and recent party politics in France. Not open to those who have credit in P.Sc. 201.

P.Sc. 212-3. Governments of Germany and Russia. Government and politics in present-day Russia and Germany. Development and present status of Bolshevist theory and practice. Democratic and totalitarian trends in German governments, past and present. Not open to those who have credit in P.Sc. 201.

P.Sc. 222-3. Introduction to International Relations. Introductory conceptual approaches, the actors, national and international dynamics of the international environment, problems and issues.

P.Sc. 270-3. International Violence. Introduction to knowledge about international violence. Emphasizes ecological causes of war found in the global system and ways in which decision makers and ordinary citizens can choose peace.

UPPER DIVISION

P.Sc. 410-3. Advanced Comparative Politics—Western Europe. An intensive comparative analysis of the political systems and processes of the Western European democracies. Political culture and constitutionalism; executive-legislative relationships; parties and interest groups; administrative processes and the impact of social changes on political institutions.

P.Sc. 411-3. Third World Politics. Examination of the political process in the non-Western world. Survey of different methodological approaches to the study of the non-Western systems. The components of political development. Effective political units in a transitional society. Prevailing "styles" of political action.

P.Sc. 412-3. The Canadian Political System. The political practices and institutions of Canada. Monarchy, Parliament, administration, and courts; federal-provincial relations; provincial and local government; political parties and political behavior at all levels; Canadian relations with the United States and with the Commonwealth.

P.Sc. 413-3. Latin American Political Systems. Impact of social, cultural, and economic variables on the political system. Key political groups. Varying patterns of political organization and behavior. Sources of conflict and violence. Major developmental problems and obstacles to change.

P.Sc. 415-3. Political Systems of the Middle East and North Africa. Comparative analysis of the political process in the Middle East and North Africa. Islamic political theory and its contemporary manifestation. The role of nationalism and the "quest for modernity" in the development of this region. Programmed modernization in transitional politics.

P.Sc. 416-3. Political Systems of China, Japan, and Korea. Contemporary government and politics in China, Japan, and Korea. Analysis of selected political structures, processes, and problems in the light of changing patterns of sociopolitical thought and behavior and economic conditions. Comparisons with other nations.

P.Sc. 417-3. Eastern European Communism: Soviet Satellites and Yugoslavia. Developments in the Soviet satellites and Yugoslavia, their governmental organizations, and their relation to the Soviet Union and the West.

P.Sc. 419-3. Political Systems of Sub-Saharan Africa. Analysis of major types of political systems in Sub-Saharan Africa and intensive case studies of selected countries exemplifying each type. Anti-colonial movement and adoption of new political institutions and values. Special political problems of multiracial and multicultural societies.

P.Sc. 421-3. International Relations. Readings and discussion of the actors, international interaction, and the international system. Emphasis on assessing relationships between concepts, approaches, goals, methods, and substance of relations among states and on trends which transcend sovereignty.

P.Sc. 422-3. Seminar: Control of Foreign News Coverage—International Perspectives. Studies formal and informal controls and their consequences, chiefly in print media. Special attention to the new information order, and opportunities for substantive/conceptual and empirical research with domestic and foreign materials.

P.Sc. 423-3. American Foreign Policy. Examination of the foundations, assumptions, objectives, and methods of U.S. foreign policy. Special attention to the domestic and external problems of adapting U.S. policy to the changing world environment.

P.Sc. 425-3. International Organization. The objective of this course is to analyze the phenomenon known as international organization, to determine whether it is an effective instrument for achieving peace and security and for the promotion of human welfare.

P.Sc. 426-3. International Law. An investigation of the body of law which regulates relations between nation states and provides a framework for the solving of common problems. Its nature and effectiveness will be explored as well as its adaptability to a changing environment.

P.Sc. 428-3. International Behavior. Presentation of alternate theoretical frameworks for the explanation of international processes. Theories of conflict behavior and social organization are applied to problems of war and peace.

P.Sc. 429-3. Alternative World Futures. This course aims to help students think about the future of the world in a systematic way. Focuses on alternative projections and policies dealing with major problems.

P.Sc. 460-3. Governments of South Asia. The study of the political systems of India, Pakistan, Ceylon, and Nepal. The impact of British rule on the development of political institutions on the subcontinent as well as the problems of political development at all levels will be considered.

P.Sc. 461-3. The Government and Politics of Israel. Historical and contemporary responses by Jews to the conditions of diaspora and statehood are studied. Israel's political culture, governmental structure and processes, and party politics. Problems of integration, defense, and relations with the diaspora Jewish community.

P.Sc. 463-3. Problems in Latin American Politics. Analysis of selected political problems of specific countries. Focus will vary from year to year. Emphasis on political change and conflict.

P.Sc. 467-3. The Military in Politics. An analysis of the sources and uses of the political power of the armed forces, the causes and consequences of military intervention in politics, and contrasting patterns of civil-military relationships in Western and non-Western societies. Prer., P.Sc. 201 and 202, or consent of instructor.

P.Sc. 470-3. Europe in the International System. European and Atlantic regionalism. Discussion of such communities as the Council of Europe, NATO, EFTA, Comecon, and OECD, and a detailed examination of the European Common Market. Theories of integration, problems of partnership and interdependence, rival nationalisms and strategic doctrines.

P.Sc. 472-3. Soviet Foreign Policy. Foreign policy of the Soviet Union, including the international Communist movement, its ideological bases, its impact on international politics, and its relations to domestic developments in the U.S.S.R.

P.Sc. 473-3. The Middle East and World Affairs. Evolution and revolution in the Middle East. The character of nationalism in the area. Analysis of intraregional and international problems affecting the Middle East with special emphasis on the Arab-Israeli imbroglio.

P.Sc. 476-3. International Relations of China, Japan, and Korea. Major developments in the modern relations of China, Japan, and Korea with each other and with other world regions. Analysis of selected issues in contemporary East Asian international politics.

P.Sc. 479-3. Senior Seminar: International Affairs. An interdisciplinary course designed primarily to help majors in international affairs bring together, review, and apply what they have learned in their IA courses in the various disciplines and geographic areas. Emphasizes interrelation between fact and theory. For seniors only.

Theory

LOWER DIVISION

P.Sc. 240-3. Introduction to Political Theory. Introduces the student to the main issues and concepts of both political philosophy/ethics and empirical theories as they try to deal with contemporary political realities.

UPPER DIVISION

P.Sc. 300-3. Varieties of Political Analysis. A survey of the genesis and evolution of the discipline of political science. Analysis of the various approaches to the study of politics such as historical, institutional, normative, sociological, systemic, quantitative, etc. The environment of political inquiry and theory building.

P.Sc. 438-3. Rationality, Democracy, and Policy. Philosophical and political approaches to an understanding of social decision making; examination of the possibilities for choosing rational courses of action and of concrete problems of rational decision making.

P.Sc. 439-3. History of Political Philosophy. Study of the main political philosophies and political issues of the Western culture, from antiquity to the 20th century.

P.Sc. 441-3. Seminar. Intensive analysis and discussion of the major theories and issues of both contemporary political thought and the history of political philosophy. The topic will be announced by the instructor, but might include analysis of concepts (justice, human rights, democracy, etc.) or major theories. Emphasis will be on advanced discussion plus individual research.

P.Sc. 442-3. Politics and Literature. An examination of broadly political topics as they are presented in important literary works and an analysis of the problems involved in using the literary mode to present political teachings.

P.Sc. 443-3. Jurisprudence. Development of different legal theories and their social signficance. Special attention will be given to the modern jurisprudential concepts and to the political parameters of their formation.

P.Sc. 445-3. American Political Thought. [1]

P. Sc. 490-3. Revolution and Political Violence. Study, discussion and evaluation of alternative frameworks for the analysis of revolution and political violence. The theoretical material will be firmly couched in case situations such as Western, class, colonial, urban, international, historical, racial, religious, and intergenerational violence.

P.Sc. 494-3. Quantitative Research Methods. Introduction to quantitative research methods used in political science. Basic tools of analysis: data collection, processing, and evaluation, with special attention to survey techniques. Elite and case study analysis. Aggregate, cluster, and content analysis. Use of computers in political research.

P.Sc. 497-3. General History of Law. A comparative survey of the development of written law and case law systems in the Western world. Special attention will be paid to the historical bases of the contemporary Anglo-American, French, German, and Soviet legal concepts and institutions. Prer., P.Sc. 248 or consent of instructor.

Other Courses in Political Science

P.Sc. 480-3 to 6. Internship in Government. Working individually under the guidance of a public official, students will be assigned to projects selected for their academic suitability as well as for their value to the official. A biweekly seminar will be held by the instructor to evaluate experiences, discuss relevant readings, or present project papers. Since prior approval by both the instructor and the public official is required, prospective students should make their interest known before early registration. Prer., 15 hours of political science and consent of instructor.

[1] Also listed under American.

P.Sc. 481-3. Honors in Political Science Seminar. Writing and discussion of selected topics in political science. Critical review of the major methodological and conceptual features of the discipline. Students will prepare their honors papers in seminar.

P.Sc. 940-1 to 3. Independent Study. Subjects are chosen and arrangements are made to suit the needs of each student. Although exceptions can be made, independent study is for upper division students who have completed 9 semester hours of political science and who have an overall average of at least 3.0. Not more than 6 semester hours of independent study may be credited toward the minimum requirements in the political science major. Special Independent Study Approval Agreement forms must be obtained from the department.

Graduate Courses and Seminars

Note: Some of the courses listed below are not necessarily offered every year.

AMERICAN GOVERNMENT AND POLITICS

P.Sc. 501-3. Seminar: American Politics. Primarily for students who have taken an undergraduate course in American politics. Emphasis is on the preparation of research papers and of literature in the field. Prer., graduate standing or consent of instructor. Costain, Everett.

P.Sc. 503-3. Seminar: Political Attitudes and Behavior. Intensive examination of topics in political attitudes and behavior such as political participation, ideology, voting, and elite behavior. Review of the methodology of behavioral research and introduction to ICPSR data archive and computer-based research. Stone.

P.Sc. 504-3. Seminar: The Presidency. Intensive examination and preparation of research papers on the historical, functional, and constitutional aspects of the presidency. Broad attention will be given to the literature on the presidential system and to analytical comparisons with other executive systems. McBride.

P.Sc. 505-3. Seminar: The U.S. Congress. Comprehensive examination of the literature and selected research topics concerning the United States Congress. McBride.

P.Sc. 509-3. Seminar: Urban Public Policy. Focus on the formulation, revision, and outcomes of public policy in American urban communities. Some comparative Canadian and European literature also used. Winter.

P.Sc. 550-3. Public Policy Analysis I (Decision Process). Provides an introduction to a comprehensive conceptual model of the policy decision process. A completed policy is conceived to evolve through intelligence, promotion, prescription, invocation, application, appraisal, and termination. Theoretical and case studies are used to elaborate and specify the model. Brunner.

P.Sc. 553-3. Problems in Public Policy Analysis. Intensive examination of selected public policy issues. Government outputs and policy alternatives are emphasized in terms of their contribution to the net social welfare. The approach is more economic than behavioral. Brunner, Fitch.

P.Sc. 555-3. Seminar: Colorado Public Policy. Examines issues of development and decline in the state. Topics change each term, but focus on policies to accommodate growth, curtail it, or ameliorate its effects; or on the political structures and processes through which growth policy decisions are made. Brunner.

P.Sc. 656-3. The Corporate State in American Politics. An examination of the impact of the emergence of the mature, integrated corporation upon American political life and upon the general outlines of government policy. Greenberg.

See also P.Sc. 523 listed under International Relations; 532, 535, and 536 listed under Public Administration; 545 listed under Political Philosophy; and 547 and 549 listed under Law and Politics.

COMPARATIVE POLITICS

P.Sc. 510-3. Seminar: Comparative Politics Western Europe. Examination and writing of research papers on selected topics of industrial democracies, especially those of Western Europe. Focus on a comparative analysis of changes in political institutions and processes and their impact on macroeconomic policies, e.g., growth, employment, redistribution, and welfare. Safran.

P.Sc. 513-3. Seminar: Latin American Politics. Seminar designed to stress intensive study of the political process in Latin America with special emphasis on the variables which affect Latin American political behavior and development. Prer., P.Sc. 477 or consent of instructor. Fitch.

P.Sc. 519-3. Seminar: Comparative Politics—Sub-Saharan Africa. Writing and discussion of analytical literature reviews and research papers on various aspects of political change in Sub-Saharan Africa. Stress on comparisons among African political systems as well as with other areas of the world, and on explanation of change. Scarritt, Skurnik.

P.Sc. 560-3. Seminar: Comparative Political Parties and Interest Groups. Critical examination of topics relating to social forces, parties, and interest groups. Analysis of concepts, theories, and case studies with particular emphasis on Western political systems. Party systems in comparison. The role of groups and the determinants of group politics. Everett, Safran.

P.Sc. 563-3. Seminar: The Middle East. Advanced comparative study and critical examination of the modern Middle East. Stress will be given to the analysis of political consequences of modernization, the Arab-Israeli problem, pan-Arabism, and petroleum politics. Seminar papers reflecting a research design will be required. Pfaff.

P.Sc. 565-3. Comparative Politics and Ideologies. Scholarly analysis and instruction on the contrast between contemporary totalitarianism and liberty under law. Taught by outstanding professors from leading universities in the United States and abroad. Designed primarily for social science teachers, graduate students, newspapermen, clergymen, and radio and television commentators. Offered only during the summer as an institute. Rozek.

See also P.Sc. 509 listed under American Government, 538 listed under Public Administration, and 590 listed under Empirical Theory and Methodology.

EMPIRICAL THEORY AND RESEARCH METHODOLOGY

P.Sc. 546-3. Research Methods in Political Science. Analysis and evaluation of research methods, techniques, and materials in political science. Required of all candidates for the Ph.D. degree. Eckart.

P.Sc. 590-3. Seminar: Conflict Behavior—The Politics of Violence. Theoretical and empirical analyses of conflict behavior with special emphasis on the explanation of political violence. Revolution, international warfare, and urban unrest are studied as forms of political violence. Midlarsky.

P.Sc. 591-3. Seminar: Science and Politics. Intensive reading and discussion of the impact of the scientific enterprise on the world of politics. The scientific and the political perspectives; democracy and the technological society; science and the non-Western world; nuclear science and international relations. Pfaff.

P.Sc. 594-3. Seminar: Political Psychology. Role of personality variables in political attitudes, behavior, and system-maintenance and change; human nature as a parameter; political relevance of psychoanalytic, behaviorist, existential, and social psychology; alienation, ethnocentrism, dogmatism, and aggression as political variables. Cummings. (Denver Campus.)

P.Sc. 643-3. The Analysis of Political Systems. Examination of concepts, propositions, and theories employed in the analysis of territorially inclusive political systems—national, subnational, and international. Systems, functional and political economy, conceptual frameworks and their relationship to personality, cultural, role, group, power, elite, and conflict "theories." Scarritt.

See also P.Sc. 549 listed under Law and Politics, 537 listed under Public Administration, and 503 and 553 listed under American Government and Politics.

INTERNATIONAL RELATIONS

P.Sc. 521-3. Seminar: International Relations. Review of the salient literature on international relations, and subsequent presentation and critical discussion of analytical studies. Students have wide latitude in substantive and methodological approaches. Emphasis on changing trends, and on efforts to understand the bases for cooperation and conflict. F. Beer, Codding, Midlarsky, Skurnik.

P.Sc. 523-3. Seminar: American Foreign Relations. Critical review of select conceptual, prescriptive, and methodological literature: examination of select foreign policy problems; discussion of seminar papers. Accent is on student contribution and participation. Skurnik.

P.Sc. 525-3. Seminar: International Relations — Law and Organization. Seminar devoted to study and research on selected problems concerning international law as a viable legal order and the role of international organization in relations among nations. Codding.

P.Sc. 572-3. Soviet Foreign Policy. Seminar on the foreign policy of the Soviet Union, its relation to Marxism-Leninism and/or Russian nationalism, as well as to the international Communist movement. Special attention will be focused on the impact of domestic and foreign factors and science and technology on policy formation. Rozek.

See also P.Sc. 580 listed under Public Administration and 590 listed under Empirical Theory and Methodology.

LAW AND POLITICS

P.Sc. 542-3. Criminal Justice. Evaluative study of the criminal law system of the United States and of its actual work in comparative perspective. Prer., P. Sc. 443, or consent of instructor. Krystufek.

P.Sc. 547-3. Seminar: American Constitutional Law. Intensive analysis of the most recent doctrinal developments in the key areas of constitutional law. Designed primarily for graduate students who intend to offer American government as a field for examination for an advanced degree. Lorch, Wilson.

P.Sc. 548-3. Seminar: Comparative Human Rights — Asia and the United States. Comparative study of selected human rights and liberties in the law, politics, and society of some Asian countries and the United States. Exploration of highly specific issues as well as comparative theories. Discussions of common readings. Reports and papers.

P.Sc. 549-3. Seminar: Behavioral Study of Public Law. Intensive, critical examination of theoretical and substantive literature dealing with the behavior of the primary actors in the legal system—police, lawyers, judges, and citizens. Emphasis will be on the empirical approach and quantitative methods. Research papers will be required. Stover.

POLITICAL PHILOSOPHY

P.Sc. 541-3. Seminar: Selected Political Theories. Selected political philosophies or theories in classical or modern political thought. Cummings, Krystufek, Mewes.

P.Sc. 641-3. Seminar: Political Theory. Intensive research in and presentation of selected topics. Introduces the student to broad context within which political ideas arise. Deals with classical and modern thought. Prer., P. Sc. 440, 441, or consent of instructor. Mewes.

See also P.Sc. 603 listed under American Government and Politics.

PUBLIC ADMINISTRATION

P.Sc. 531-3. Seminar: Public Personnel Administration. Intensive research into the issues of public personnel administration in national, state, and local governments; organization, functions, and policies; loyalty and security; human relations; the role of unions, recruitment and selection; compensation; and related topics. Prer., introductory course in public administration (400 level). Buechner, Lorch.

P.Sc. 532-3. Governmental Planning. Application of governmental planning to problems of the nation, the states, cities, and urban counties; organization, procedures, and problems of planning agencies. Emphasis is given to planning in cities. Winter.

P.Sc. 535-3. Seminar: Natural Resources Policy and Administration. Resources in the American economy, consideration of constitutional, political and geographic factors in development of resources policy; organization procedures, and programs for administration and development of natural resources; selected topics. McBride.

P.Sc. 537-3. Policies, Decisions, and Public Organizations. An examination of decision-making behavior within public organizations. Investigation of collective or public decision making involving theories of power, goals, and strategies, competition and coalition formation, information processing — all applied to a variety of public organizational contexts. Eckart.

P.Sc. 580-3. The Political System and Telecommunications. Introduction to roles played by political institutions in the utilization of telecommunications for the common good. Emphasis on American regulatory agencies, such as the Federal Communications Commission, and agencies of international cooperation, such as the International Telecommunications Union. Codding.

P.Sc. 630-2 or 3. Internship in Public Policy. Students are assigned to projects where they will obtain a guided experience in dealing with a public policy problem in the area of their academic specialization. An analytical paper or research project report is required. Consent of instructor and departmental approval are required.

See also P.Sc. 509, 550, 553, and 555 listed under American Government and 526 listed under International Relations.

GENERAL COURSES IN POLITICAL SCIENCE

P.Sc. 599-1 to 3. Topics in Political Science. Not a free option; must be approved by the student's advisor and department chairman. Does not count as a seminar.

P.Sc. 698-1 to 3. Additional Graduate Research Topics.

P.Sc. 699-1 to 3. Graduate Research Topic. Independent research in a topic of special interest. Arrangements are made to suit the needs of each particular student. Not a free option; must be approved by student's advisor and chairman of the department. Does not count as a seminar.

P.Sc. 700-4. Master's Thesis.

P.Sc. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

PSYCHOLOGY

Psy. 100-4. General Psychology. Three hrs. lect. and one hr. rec. per wk. Students are required to participate as subjects for several hours in ongoing research. General one-semester survey of major topics in psychology, including sensory and perceptual processes, human development, personality, frustration and conflict, learning and memory, and the biological bases of behavior.

Psy. 205-3. Introduction to Biopsychology. Three hrs. lect. per wk. A broad survey course in the physiological, endocrine, and genetic bases of behavior. Topics to be covered include the biological bases of learning, motivation, emotion, movement, comparative animal

behavior, sexual and reproductive activity, instinctual behavior, neurobiology of language and thought, neurophysiology, and neuroanatomy in relation to behavior. Prer., Psy. 100.

Psy. 206-3. Nutrition and Behavior. A basic introduction to the science of nutrition together with an examination of its relationship to the biochemical and physiological foundations of behavior.

Psy. 210-4. Statistics and Research Methods in Psychology. *Fall, Spring.* Three hrs. of lect. and one 2-hr. lab. per wk. Introduction to descriptive and inferential statistics and to their roles in psychological research. Topics include correlation, regression, *t* test, analysis of variance, and selected nonparametric statistics. Required of psychology majors. Prer., Psy. 100. College algebra is recommended.

Psy. 221-3. Human Sexuality. See A.S. 221.

Psy. 230-3. Psychology of Adjustment. A survey of concepts bearing upon the processes of normal psychological adjustment, with emphasis upon using the concepts to understand common human problems in personal growth and relationships with others. Prer., Psy. 100.

Psy. 245-3. Social Psychology of Social Problems. An examination of social psychological aspects of a variety of social issues and problems in contemporary society. Issues will be very diverse, ranging from problems of poverty or minority status to topics such as prejudice, drug use, student protest, and patterns of sexual behavior. Psychological theory and research relevant to these areas will be considered as will the processes involved in defining social behavior as a "problem." Prer., Psy. 100.

Psy. 264-3. Child and Adolescent Psychology. Principles of development in childhood and adolescence. Not recommended for majors. Majors should take Psy. 468 in the junior or senior year. Prer., Psy. 100.

Psy. 265-2. Child Psychology Practicum. Volunteer work with children in local day-care centers, nursery schools, community youth organizations, etc. Periodic training sessions and discussion group meetings with agency and departmental staff. Prer., Psy. 100; Psy. 264 must be taken concurrently.

Psy. 270-3. Psychology of Contemporary American Women (Wm.St. 270.) A survey of psychological theory and research concerning contemporary American women. The course deals with issues including the following: masculine bias in American culture; sex differences in cognitive functioning and personality; psychological conflict for women between career and home; and, finally, specific areas pertaining to women's mental health. Prer., Psy. 100.

Psy. 300-3. Honors Seminar. *Fall.* Discussion of current theoretical issues and participation in research problems in psychology. Open only to juniors and seniors who have been accepted into the psychology department honors program. Consent of the psychology honors director is required.

Psy. 400-3. Honors Seminar. Survey and integration of general psychology for seniors majoring in psychology. Open only to juniors and seniors who have been accepted into the psychology department honors program. Consent of the psychology honors director is required.

Psy. 401-1 to 6. Senior Thesis. Prer., 3.00 overall GPA, junior standing. An honors thesis consists of (1) a critical review of some aspect of the psychological literature; (2) a scholarly analysis of a major psychological issue, and/or (3) an empirical research project. See psychology honors director for further information.

Psy. 403-4. Laboratory Computers in Psychology. Lect. and lab. Programming of real-time computers as control and data collection devices. Studies of applications of real-time computers in various areas in psychology. Prer., one or more courses in computer science, or knowledge of Fortran programming language.

Psy. 405/505-4. Physiological Psychology. An intensive survey of the morphological, neurochemical, and physiological aspects of behavior. One lab./disc. section per wk. required. Prer., Psy. 100, 3 hours of biology, or consent of instructor.

Psy. 409/509-3. Hormones and Behavior. Represents the application of endocrinological concepts and techniques to the problems of motivation and behavior. Prer., junior standing and at least one year of biology.

Psy. 410/510-3. Behavioral Genetics. The inheritance of behavioral characteristics. Prer., one course in general psychology. Seniors who have had this course may take Psy. 510.

Psy. 411-2. Behavioral Genetics Laboratory. Demonstrations and experiments in behavioral genetics. Basic behavioral and genetic techniques employed in studying the inheritance of behavior in laboratory animals. Emphasis will be placed upon individual projects. Enrollment limited. Prer., Psy. 410 and consent of instructor.

Psy. 412/512-3. Quantitative Genetics. Survey of the principles of genetics of quantitative characteristics. Topics will include gene frequencies, effects of mutation, migration, and selection; correlations among relatives, heritability, inbreeding, crossbreeding, and selective breeding. Prer., consent of instructor.

Psy. 413/513-3. Drugs and the Nervous System. The physiological basis of drug action on the nervous system and behavior, with emphasis on the use of drugs as analytic tools in the study of behavior. This course is not concerned with the subjective, social, or legal consequences of drug use. Part I: Chemical basis of conduction and transmission in the nervous system. Part II: Pharmacology of sleep, pain, addiction, dependence, appetite, anxiety, learning, memory, and perception. Prer., Psy. 405.

Psy. 414-4. Cognitive Psychology. One lab., three lect. per wk. Introduction to the study of cognitive processes of human beings: memory, conceptual behavior, and thinking. Emphasis of the course will vary with the instructor. Prer., Psy. 100 and 210, or consent of instructor.

Psy. 416-4. Psychology of Perception. An analysis of peripheral and central mechanisms involved in the transduction and interpretation of experience. Special attention will be given to vision and audition; major theories in these areas will be discussed in terms of the research they have inspired. One lab. per week. Prer., Psy. 100 and 210 or consent of instructor.

Psy. 420-4. Psychology of Learning. One lab. per wk. Conditions of learning in animals and men as found in experimental literature. Prer., Psy. 100 and 210 or consent of instructor.

Psy. 421/521-3. Gerontology: A Multidisciplinary Perspective. Covers biological, psychological, and social issues in gerontology. The topics emphasized in these three main research areas include brain changes with age, learning/memory changes with age, and social impact of an increasingly older population distribution. Prer., Psy. 405 or 420 or 440 or consent of instructor.

Psy. 422-3. Introduction to Language Behavior. An introduction to psycholinguistics, covering what the English language is and how its characteristics influence one's ability to produce and understand words and sentences. Attention will be given to language as sound, as a system of rules, as a medium for communicating, and as a biological and developmental process. Prer., Psy. 100 and 210.

Psy. 424-3. Teaching of Psychology. Students will receive concrete experience in the teaching of general psychology under supervision of a psychology faculty member. Alternative pedagogical strategies will be discussed. Prer., 16 hrs. of psychology with grade *B* or better plus instructor's consent.

Psy. 425-3. Comparative Psychology. Behavior of animals. Similarities and differences between animals. Principles of behavior in a variety of species. Prer., 6 hours of psychology or EPOB 101-102.

Psy. 430-3. Abnormal Psychology. Borderline disorders as extreme variations of the normal personality. Major functional and organic disorders. Theories of mental disorders and methods of psychotherapy. Not open for credit to those who have credit for Psy. 431. Prer., Psy. 100, or consent of instructor; not open to freshmen or sophomores.

Psy. 431-4. Psychopathology. One two-hr. rec. per wk. Intensive analysis of the major theories of personality and behavior disorders. Not open for credit to those who have credit for Psy. 430. Prer., Psy. 100 plus 6 hours of psychology. *(Open to majors only.)*

Psy. 438/538-3. Advanced Animal Behavior. This course discusses behavior of representative members of each animal phylum. Empha-

sis is placed on ontogeny of behavior as well as on phylogeny. Prer., general psychology, general biology. Recommended: Psy. 420. Chiszar.

Psy. 440-3. Social Psychology. General psychological principles underlying social behavior. An overview and analysis of the major social psychological theories, methods, and topics, including attitudes, conformity, aggression, attraction, social perception, helping behavior, and group relations. Prer., at least 12 hrs. of psychology including Psy. 100 and 210.

Psy. 443-3. Human Judgment and Social Policy. Two lect., one lab. per wk. A systematic treatment of the problem of human judgment in relation to social policy and its application to social problems. Prer., junior standing and 9 hours of psychology.

Psy. 445-3. Psychology of Personality. The psychological study of the structure, organization, and development of the person as a whole. Analysis of major theories, methods, and research dealing with personality, including topics such as emotion, motivation, temperament, inner experience, identity and the self, personality change, and the influence of the sociocultural context. Prer., 16 hours of psychology.

Psy. 448-3. Women in Cross-Cultural Perspective. The course will review contemporary theory and research on the psychology of women. The course material will be drawn from the fields of anthropology, social psychology, clinical psychology, and sociology. Prer. Psy. 100 and course in child development, psychology major or consent of instructor.

Psy. 449-3. Cross-Cultural Psychology. Social factors in the development of personality. Social and cultural variations in mental illness. The psychology of cultural and social change, including revolutions, economic growth, etc. Prer., 12 semester hours of courses from psychology, sociology, and anthropology.

Psy. 450/550-4. Behavior of Zoo Animals. *Summer.* An intensive examination of behavioral research conducted at zoos of the world. Emphasis will be placed on courtship and copulation, offspring development, socialization, intellectual processes, and animal communication. Classes and labs will be held at the Denver Zoo. Prer., EPOB 121-122, Psy. 100 and 210, 121-122.

Psy. 451-3. History of Psychology. Outline of development of psychological theories since the Greek philosophers. The story of experimental psychology and its problems. Schools of psychological thinking. Readings of original sources in English and English translations. Prer., 16 hours of psychology.

Psy. 465-3. Special Topics in Developmental Psychology. Developmental psychology covers a wide range of content areas in human development: cognition, social knowledge and social behavior; language, perception, and a variety of special topics including reading. Prer., Psy. 100.

Psy. 468-3. Developmental Psychology. An overview of major theories concerning the development of knowledge in children. Emphasis is on the contrast between empiricist, nativist, and constructivist viewpoints, as applied to the same content areas (e.g., perception, cognition, social development). Open only to juniors and seniors. Prer., Psy. 100.

Psy. 470-3. Women and Mental Health. (Wm.St. 470.). Examines mental health issues of women by focusing on theories of female personality development. Prer., one of the two-semester lower division sequences, Psy. 270, 430 or 431, or consent of instructor.

Psy. 471-3. Survey of Clinical Psychology. Theories and practices relating to problems of ability and maladjustment. Diagnostic procedures and treatment methods with children and adults. Prer., Psy. 100 and 431, or consent of instructor.

Psy. 472-3. Community Psychology and Mental Health. This course will focus on issues in the organization, financing and delivery of mental health services within the community, innovative techniques for the provision of mental health-related services, the role of community factors in the production of emotional disorder, and the technologies of community change. Prer., Psy. 430 or 431, or consent of instructor.

Psy. 485-4. Principles of Psychological Testing. Lect. and lab. A psychological and statistical analysis of the principles underlying construction and use of tests of ability and personality. Prer., Psy. 210.

Note: 500-level courses are available to undergraduate and graduate students. Undergraduate students must obtain approval of instructor.

Psy. 503-1 to 4. Seminar: Laboratory Use of Computers. Theory and practice of computation in psychological research. Fall: introduces programming language, emphasizing basic skills; no prerequisites. Spring: control of experimental devices and collection of data in psychological research; prer., fall section or knowledge of Fortran.

Psy. 504-3. Mammalian Neurophysiology. In-depth examination of selected topics in the neurophysiological basis of higher brain function in mammals. Central theme is how neurophysiological data can provide insight into the type of information processing involved in sensation, perception, cognition, and action. Prer., Psy. 405 or consent of instructor.

Psy. 506-4. Functional Neurochemistry. Mechanisms of neuronal signaling will be examined in the course of a timely review of the experimental literature in the areas of transmitter synthesis, transport, secretion, turnover, re-uptake, and post-synaptic effect. Other special topics to be included. Prer., Psy. 405 or equivalent upper division neuroscience course.

Psy. 508-2. Seminar: Biological Psychology. Special topics concerning the biological bases of behavior.

Psy. 511-3. Concepts in Behavioral Genetics. Each term selected topics will be examined in greater detail than is possible in the comprehensive undergraduate course in behavioral genetics. (Psy. 410). Topics covered may include the inheritance of behavioral characteristics from the perspectives of pharmacogenetics, transmission genetics, biochemical genetics, and evolutionary genetics. Course may be repeated. Prer. Psy. 410.

Psy. 520-3. Current Issues in Human Infancy. Examination of theoretical issues and experimental methods in the study of human infant behavior and development. Specific topics vary with current interests of students and instructors. Prer., consent of instructor.

Psy. 525-2. Seminar: Animal Behavior. Theories and methods of experimentation in the field of animal behavior are critically examined. Observations on live animals in structured environments are conducted with emphasis on innate behavior patterns. Prer., consent of instructor.

Psy. 526-3. Mammalian Neuroanatomy. Topic covers microscopic anatomy and function of different brain regions. Emphasis on correlation between structure and function, particularly at cellular and synaptic level. Course includes brain dissection, description of neuroanatomical and neurohistological techniques, and an introduction to the ultrastructure of neurons. Prer., Psy. 405 or EPOB 420 or MCDB 418 or consent of instructor. Fifkova.

Psy. 527-3. Neuronal Plasticity. Describes the current state of knowledge on the types of changes which occur in the nervous systems as a result of lesions or altered environment during development. These changes are examined relative to factors that provoke them, to their significance for the organism, and to the mechanisms that underlie them. The course is a contribution to the understanding of such phenomena as behavioral plasticity and recovery of function after injury. Prer., Psy. 526 or consent of instructor. Fifkova.

Psy. 528-3. Basic Neurosciences. An overview of major disciplines in the fields of basic anatomy, physiology, and pharmacology of the neuron and the system's developmental neurobiology, and adaptation of the brain to injury and experience during development and adulthood. Prer., consent of instructor.

Psy. 529-2. Current Research Issues in Perceptual Development. The first half of the semester will include background lecture on perception, physiology, and philosophical questions of how man knows his world. The second half of the course will focus on current research in the development of perception and information processing capacities. Prer., consent of insturctor. Olson.

Psy. 530-3. Proseminar: Developmental Psychology—Theory and Issues. In-depth survey of issues in theoretical approaches to developmental psychology. Open to graduate students and senior undergraduate psychology majors with consent of instructor.

Psy. 531-3. Proseminar: Developmental Psychology—Sensory Development. An intensive coverage of selected topics in sensory development. Emphasis will be on the role of experience in the development of neural mechanisms of human sensory systems. Considerable attention will be given to understanding the historical foundations of current problems. Open to graduate students or senior undergraduate majors with consent of the instructor.

Psy. 533-3. Proseminar: Developmental Psychology—Perceptual Development. The development of human perception and information processing is considered from physiological and behavioral perspectives. Open to graduate students and senior undergraduate psychology majors with consent of instructor.

Psy. 534-3. Proseminar: Developmental Psychology—Cognitive Development. Theoretically oriented survey of major approaches to cognitive development, with primary emphasis on Piaget's theory. Open to graduate students and senior undergraduate psychology majors with consent of instructor.

Psy. 560-2 to 565-2. Proseminar: Social-Personality Psychology. Six topics providing a systematic introduction to the area of social-personality psychology. Two are offered each semester on a rotating basis. Topics are as follows: 560, organizational and small group processes; 561, cognitive social psychology; 562, social interaction; 563, advanced personality theory; 564, ethnic, sex, and cross-cultural perspectives in psychology; 565, social psychology of the individual.

Psy. 566-3, 567-3. Proseminar: Advanced Experimental Psychology. *Fall.* An advanced and intensive survey of topics in experimental psychology. General areas are conditioning and learning, and cognitive psychology.

Psy. 568-3, 569-3. Proseminar: Advanced Experimental Psychology. *Spring.* Ad advanced and intensive survey of topics in experimental psychology. General areas will include sensation and perception, and history and theory.

Psy. 587-4. General Statistics. A survey of probability and statistics in psychology.

Psy. 588-4. General Statistics. A continuation of Psy. 587.

Psy. 591-3. Proseminar: Quantitative Psychology. Introduction to measurement, scaling, and test theory.

Psy. 592-3. Proseminar: Quantitative Psychology. Introduction to mathematical approaches in information processing and memory.

Psy. 593-3. Proseminar: Quantitative Psychology. Introduction to the use of computer simulation in psychological theorizing.

Note: 600-level courses are available to graduate students only.

Psy. 601-0 to 3. Research in Behavioral Genetics. Individual research projects.

Psy. 602-2. Research Problems.

Psy. 603-2. Research Practicum.

Psy. 605-2. Research Practicum. Ongoing, current research projects will be discussed and students will formulate and complete an empirical study of their own. For cognitive and social graduate students.

Psy. 606-2. Research Practicum. A continuation of Psy. 605.

Psy. 610-2. Seminar: Behavioral Genetics. Intensive study of selected topics in behavioral genetics. Emphasis will be on recent research, and attention will be given to both human and animal studies. Prer., consent of instructor.

Psy. 612-3. Experimental and Quasi-Experimental Methods in Social Psychology. The uses and limitations of experimental methodologies for the study of social behavior are examined. Alternative small-scale methodologies are considered including simulation, systematic observation and content analysis.

Psy. 620-2. Seminar: Learning. A detailed study of one or more important topics in the psychology of learning. Content of seminar varies from semester to semester.

Psy. 621-2. Seminar: Experimental Psychology. An advanced seminar dealing with different specialized topics, at the discretion of the instructor, in different years. The topics chosen are within the broad range of experimental psychology.

Psy. 648-2. Advanced Personality Theory. Consideration of foundation issues in the construction of theories of the person; appraisal of the structure and content of representative theories of personality; analysis of the implications for theory of various current areas of personality research.

Psy. 649-2. Developmental Psychopathology. Childhood psychopathology is presented as deviations from normal development. Both normal development and childhood psychopathology are reviewed from dynamic, cognitive, and behavioristic theoretical perspectives. Prer., Psy. 264 or 468 and 445, consent of instructor.

Psy. 652-3. History and Theory. An advanced seminar, briefly surveying the chronological development of psychology with emphasis on theories. The seminar also provides an opportunity for intensive examination of a few selected topics, which differ from year to year. Wertheimer.

Psy. 653-2. Seminar: Personality and Social Psychology. Selected topics in the area of social-personality psychology.

Psy. 654-2, 655-2. Seminar: Practicum in Community Social Psychology. The role and function of the community social psychologist will be discussed. Students will spend two hrs. in class and three hrs. weekly in an agency setting. This is a two-semester course; the student must sign up for both semesters in order to receive credit.

Psy. 659-2. Research Problems in Clinical Psychology. A systematic examination of research issues relevant to the field of clinical psychology and mental health for the purpose of developing familiarity with substantive and methodological problems facing the field.

Psy. 660-2. Practicum in Community Psychology. Direct field experience in community psychology and community mental health settings for Ph.D. candidates in clinical and social psychology only. Instructor consent.

Psy. 662-3. Issues in Developmental Psychology. Emphasis is on analysis of theoretical issues and research strategies. Gollin.

Psy. 663-2. Cross-Cultural Research. Survey of cross-cultural research in human social development.

Psy. 670-2, 673-2, 676-2. Seminar: Clinical Psychology. Selected topics in the area of clinical psychology.

Psy. 671-2. Practicum in Clinical Psychology. Direct clinical experience for Ph.D. candidates in clinical psychology only.

Psy. 674-2. Primary Prevention in Community Mental Health. A survey of the factors at work in the United States that have culminated in the community mental health movement and of the current factors to be considered in future developments in the field.

Psy. 677-3. Clinical Study of the Individual. A focus upon the ideographic study of the attitudes, values, and personality characteristics of individuals using data obtained from personal interviews. The theory and practice of various interviewing approaches are also covered. Ph.D. candidates in clinical psychology only.

Psy. 678-2. Advanced Psychopathology. An intensive survey of the major theories, research findings, and behavioral characteristics associated with deviant reaction patterns.

Psy. 683-2. Practicum in Survey Research. Students learn to do survey research by working on an actual, large-scale research project. Lectures cover such standard survey research topics as survey design, sampling, frame construction, questionnaire design, interviewing, editing and coding, computer analysis, budget preparation, and report writing.

Psy. 685-2. Personality Measurement. Theory and practice primarily in the area of individual intelligence testing. Intensive field work and report writing. Ossorio.

Psy. 686-2. Objective Testing in Clinical Psychology. Course will focus on administering and interpreting objective test results commonly used in clinical psychology practice. Probable inventories to be used will be the MMPI, SCII, WISC, WAIS, plus other objective measures where relevant. Case study format will be used.

Psy. 689-3. Causal Models and Correlational Data. The construction, estimation, and testing of causal models for correlational data. Particular attention given to models with unobserved variables.

Psy. 690-2. Mathematical Theories in Psychology. Seminar on topics in mathematical theories of psychology. Specific topics vary depending on interests of students and instructors.

Psy. 691-3. Multivariate Analysis. Scientific concepts, matrix theory, and computer techniques of multivariate analyses for psychological research. Topics include cluster and factor analysis, multiple regression, and discriminant functions. Emphasis on research technology rather than mathematical theory.

Psy. 692-3. Seminar: Psychotherapy. Selected topics in the field of psychotherapy including content consideration and pertinent research. Topics change from semester to semester.

Psy. 699-1 to 3. Teaching of Psychology. A consideration of problems, techniques, and subject matter related to the teaching of psychology. Prer., consent of instructor.

Psy. 700-4 to 6. Master's Thesis.

Psy. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Psy. 925-1 to 3. Independent Study (Lower Division). Freshman or sophomore standing.

Psy. 949-1 to 3. Independent Study (Upper Division). Junior or senior standing.

Psy. 959-1 to 3. Independent Study. Graduate student standing.

Psy. 999-0. Candidate for degree.

RELIGIOUS STUDIES

R.St. 162-3. Religious Dimension in Human Experience. A critical study of religion as individual experience and social phenomenon; varieties of religious language (symbol, myth, ritual, scripture, etc.); and varieties of religious experience: Asian, western, archaic.

R.St. 195-3. Women and Religion. An examination of attitudes toward women in the historic religions including the Judeo-Christian tradition, Hinduism, Buddhism, and the so-called primitive religions.

R.St. 260-3. World Religions: Western. An introduction to the literature, beliefs, practices, and institutions of Judaism, Christianity, and Islam, in historical perspective.

R.St. 262-3. World Religions: Eastern. An introduction to the literature, beliefs, practices, and institutions of Hinduism, Buddhism, Taoism, Shintoism, and Confucianism, in historical perspective.

R.St. 266-3. Mythic Visions of America. An examination and interpretation of mythic visions of America as a religious place and Americans as special human beings. Focus is on European, Anglo, Indian, Mexican, and Black visions of America.

R.St. 270-3. American Indian Religions. An examination of the history and structure of three American Indian religions: Aztec, Amazonian, and Sioux.

R.St. 300-3. The Christian Tradition. An exploration of the evolution of Christian theology, myth, ethics, ritual, and social institutions. Prer., R.St. 260 or consent of instructor.

R.St. 310-3. Judaism. An exploration of Jewish religious experience and its expression in thought, ritual, ethics, and social institutions. Prer., R.St. 260 or consent of instructor.

R.St. 320-3. Hinduism. An in-depth study of the literature, beliefs, practices, and institutions of Hinduism, in historical perspective. Prer., R.St. 262 or consent of instructor.

R.St. 330-3. Indian Buddhism. An in-depth study of the literature, beliefs, practices, and institutions of Theravada and Mahayana Buddhism, in historical perspective. Prer., R.St. 262 or consent of instructor.

R.St. 340-3. Japanese Religions. A study of the literature, beliefs, practices, and institutions of Shinto, Buddhism, and Confucianism within the development of Japanese culture. Prer., R.St. 262 or consent of instructor.

R.St. 345-3. Religions of Egypt. A historical and analytical survey of religious beliefs and practices in Egypt from ancient times to the present, including the Pharaonic, Jewish, Coptic Christian, Islamic, and folk traditions. Prer., R.St. 260 or consent of instructor.

R.St. 360-3. Islam. Introduction to the Islamic beliefs and practices through an examination of the Qur'an, Muhammad's life, ritual practices, law and theology, mysticism, and social institutions. Prer., R.St. 260 or consent of instructor.

R.St. 380-3. Religion and Psychology. An examination of the relation between religion and psychology in the understanding of human nature; religious methods (prayer, meditation, conversion, and mysticism), and the psychology of conviction as it is related to religious diversity. Prer., R.St. 162 or consent of instructor.

R.St. 385-3. Chinese Religion. A study of classical Confucianism, Taoism, Buddhism, and Neo-Confucianism within the historical context of Chinese culture. Prer., R.St. 262 or consent of instructor.

R.St. 390-3. Myth, Ritual, Symbol. An examination of religion and the study of religion focusing on religious performance, action, and behavior. Myths, rituals, and symbols of religions the world over are considered.

R.St. 395-3. Topics in Religious Studies. Intensive study of a selected area or problem in religious studies.

R.St. 400/500-3. Topics in New Testament. In-depth study of a selected book, passage, theme, or topic pertaining to the New Testament. Prer., R.St. 196, 300 or consent of instructor.

R.St. 401/501-3. Biblical Christianity. A study of Christian origins, including the Jewish and Greco-Roman contexts. Exegesis of representative passages from the synoptic, Johannine, and Pauline writings. Treatment of the historical person of Jesus and theological prespectives of the New Testament. Emphasis will be on methodology, e.g., textual criticism, literary criticism, form criticism.

R.St. 410/510-3. Biblical Judaism. A study of the development of Jewish religious thought and institutions in the Biblical period, with special emphasis on the literature of the Bible as a source for the study of religious experience. Prer., R.St. 260 or 310 or consent of instructor.

R.St. 415/515-3. Topics in Jewish Thought. Intensive study of a selected topic in Jewish theology, philosophy, or mysticism in the post-Biblical period. Prer., R.St. 260 or 310 or consent of instructor.

R.St. 420/520-3. Topics in Hinduism. Will examine in depth central themes, schools of thought, and movements in Hinduism, such as myth and ritual, renunciation, vedanta, and 19th-century Renaissance. The course will normally be offered every other year, alternating with R.St. 425.

R.St. 425/525-3. Topics in Buddhism. Will examine in depth central themes, schools of thought, and movements in Buddhism, such as Theravada in S.E. Asia, Mahayana and Tantrayana Thought, and Buddhism in America. The course will normally be offered every other year, alternating with R.St. 420.

R.St. 427/527-3. Zen Buddhism. An inquiry into the history and meaning of one of the most powerful traditions of China and Japan, based on the interpretation of primary sources and leading to an appreciation of its influence on Chinese and Japanese cultures.

R.St. 430/530-3. Topics in Native American Religions. An examination of a topic (to vary at different offerings) on which to focus the study of the religions of peoples indigenous to the Americas. Topics such as mythology; shamanism and medicine; trickster, clown, and fool; and crisis cult movements may be considered.

R.St. 435/535-3. Native American Religions: Regional Studies. An in-depth study of the religion(s) of a single native North American

tribe or geographic region within the context of the history and culture of the tribe(s).

R.St. 450/550-3. City and Symbol in Mesoamerican Religion. This course is an interdisciplinary analysis of Mesoamerican cosmology and ceremonial centers by means of history of religions and archaeoastronomy. Comparisons of North and South American sites will be considered in this examination of orientation, architecture, and ritual activities.

R.St. 460-3. Crisis Cults and Millenarian Movements. An examination of crisis cults from the variety of perspectives which constitute millenarian studies. Focus on causes, charismatic leaders, millenarian visions, and the impact of prophecies that fall on cult members. Special emphasis will be given to the crisis in scholarship created by attempts to study these religious outbursts. Prer., 6 hrs. R.St. courses.

R.St. 462/562-3. Topics in Christian Theology. An advanced study of a specific topic in Biblical, historical, or systematic theology. Prer., R.St. 400 or consent of instructor.

R.St. 468-3. Topics in Religious Studies. This course is offered periodically to permit advanced study of special topics such as cargo cults, Native American symbolism, and religious autobiography which do not get developed in the basic curriculum. As offered, details will be available in the religious studies office. Prer., 6 hours religious studies or consent of instructor.

R.St. 470/570-3. Islam in the Modern World. A global survey of Islam in the recent past and in the present, covering such topics as religion and politics; Islam and the West; the Islamic revival and its varied forms in Iran, Indonesia, Libya, and Pakistan; development and change; the status of women; and media and academic stereotyping.

R.St. 480/580-3. Confuciansim. A study of Confucianism, one of the most influential traditions of East Asia. The course will focus upon major writings of Classical Confucianism as well as Neo-Confucianism and analyze the religious dimension of the tradition.

R.St. 485/585-3. Taoism. The historical development and influence of the Taoist tradition in Chinese culture, focusing on classical philosophical Taoism, religious Taoism, and neo-Taoism. Prer., R.St. 385 or consent of instructor.

R.St. 489/589-3. Sufism. An in-depth study of the origins and aims of Islamic mysticism, with a concentration on the thought and practice of Al-Hujwiri, Al-Ghazali, and Rumi. Prer., R.St. 360 or consent of instructor.

R.St. 490-3. Methodologies of Religious Studies. A systematic exploration of the development of religious studies as a discipline, with close attention to the contributions of history, sociology, phenomenology, and anthropology. Prer., 6 hours R.St. courses or consent of instructor.

R.St. 495/595-3. Interdisciplinary Seminar on Religion: Topics. A variable topics course in religion, drawing from a variety of disciplines and methodologies as they shed light on specific traditions and issues.

R.St. 499-3. Senior Majors Seminar. This seminar is required of all majors and will normally be taken in the spring semester of the senior year. Topics and instructors will vary, but the goal will always be to bring advanced majors together in order to focus their major experience on significant topics and issues of common interest.

R.St. 591-3. Religious Texts and Contexts. This seminar will examine ways in which religious texts (e.g., scriptures, commentaries, pictographs) relate to their contexts (e.g., cultural, ritual, territorial). Variable topics: Mesoamerican codices and urban ceremonial centers, Buddhist scriptures and iconography in Southeast Asia, Confucian canon and state orthodoxy, and others.

R.St. 592-3. Religious Dimensions of Space and Time. This seminar will examine symbols, myths, rites, and contexts in which the categories space and time have religious meaning. Variable topics: sanctuaries, calendars, eschatologies, other worlds, pilgrimages, rites of passage, archaeoastronomy, topocosms, centers and peripheries, linear vs. cyclical time, seasons and others.

R.St. 690-3. Theory and Method in the Study of Religion. This seminar provides an advanced orientation in the academic study of religion, focusing on methods and theories. Historical, phenomenological, and social scientific approaches will be examined, in the context of the history and present state of the discipline.

R.St. 700. Master's Thesis.

R.St. 920-variable credit. Independent Study.

R.St. 940-variable credit. Independent Study.

R.St. 950-variable credit. Independent Study.

SLAVIC LANGUAGES AND LITERATURES

Polish

Pol. 101-5. Beginning Polish I. *Fall.* Elementary description and analysis of the pronunciation, morphology, grammar, and usage of modern standard Polish will be supported by contemporary readings in Polish. The course is not designed to enable students to fulfill the foreign language requirement of the College of Arts and Sciences.

Pol. 102-5. Beginning Polish II. *Spring.* Continuation of Polish 101.

Russian

Russ. 101-5. Beginning Russian. *Fall.* Introduction to the Russian language. Two different approaches are available. See department's general information announcement.

Russ. 102-5. Beginning Russian. *Spring.* Continuation of Russ. 101. Prer., Russ. 101 or equivalent.

Russ. 103-3. Beginning Russian for Scientists and Social Scientists. *Fall.* An approach to Russian through the reading of texts in the student's special field of study.

Russ. 104-3. Beginning Russian for Scientists and Social Scientists. *Spring.* Prer., Russ. 103.

Russ. 201-3. Second-Year Russian Grammar and Composition. *Fall.* Reading, writing, and understanding contemporary Russian. Recommended to students who intend to continue their formal study of Russian into the third and fourth years. Prer., 102 or equivalent.

Russ. 202-3. Second-Year Russian Grammar and Composition. *Spring.* Continuation of Russ. 201. Prer., Russ. 201 or equivalent.

Russ. 203-2. Second-Year Russian Oral Practice I. *Fall.* This course enables students to speak and understand contemporary spoken Russian. It is recommended to students who intend to continue their formal study of Russian into the third and fourth years. Prer., Russ. 102 or equivalent.

Russ. 204-2. Second-Year Russian Oral Practice II. *Spring.* Continuation of Russ. 203. Prer., Russ. 203 or equivalent.

Russ. 211-3. Reading Russian. Reading of significant texts in Russian from the sciences, social sciences, and press. Prer., Russ. 102 or 104 or equivalent.

Russ. 301-3. Third-Year Russian. A review of Russian grammar is coordinated with reading, speaking, writing, and understanding modern Russian. Some texts from modern and 19th-century Russian literature will be used. Prer., Russ. 202 or equivalent, or 211 and consent of instructor.

Russ. 302-3. Third-Year Russian. Prer., Russ. 301.

Russ. 303-2. Russian Conversation. Prer., Russ. 202 or equivalent.

Russ. 304-2. Russian Conversation. Prer., Russ. 202 or equivalent.

Russ. 320-3. Russian Phonetics. Scientific analysis of the sound inventory of Russian and the use of tape materials in the language laboratory. Prer., Russ. 202 or consent of instructor.

Russ. 401-3. Advanced Grammar Topics and Composition. Prer., Russ. 302 or consent of instructor.

Russ. 402-3. Advanced Grammar Topics and Composition. Prer., Russ. 401.

Prerequisite for all 400-level author/period courses: Russ. 302 or permission.

Russ. 431/531-3. Pushkin and His Time. A survey of Pushkin's major works and a study of his influence on Russian literature. Prer., Russ. 302, or consent of instructor.

Russ. 442/542-3. Gogol. Representative short stories, novels, and plays.

Russ. 443/543-3. Dostoevsky. Selected short novels and novels.

Russ. 444/544-3. Tolstoy. Noteworthy short stories, short novels, and novels.

Russ. 445/545-3. Chekhov. Major plays and short stories.

Russ. 446/546-3. Solzhenitsyn. Significant short novels and novels.

Russ. 451/551-3. Twentieth-Century Russian Poetry. A survey of the major figures in this period, with particular emphasis on Modernist poets active between 1895 and 1930.

Russ. 461/561-3. Twentieth-Century Russian Literature: Prose in the Soviet Union. A survey of short stories and novels written in Russian for citizens of the Soviet Union between 1917 and the present.

Russ. 492/592-3. History of the Russian Language. This course surveys the development of Russian from the 11th century to the present, supported by reading in medieval texts. Prer., Russ. 302 or permission.

Russ. 700-variable credit. Master's Thesis.

Russ. 910 through 940-variable credit. Independent Study (Undergraduate).

Russ. 950 through 960-variable credit. Independent Study (Graduate).

Russian Courses in Translation

Russ. 221-3. Introduction to Russian Culture. What Russians are like and how they got that way; development of national consciousness from feudalism through imperialism; Russian cookery, folklore, popular literature, religious thought, art, and architecture. Lectures, slides, films, guest speakers.

Russ. 222-3. Introduction to Soviet Culture. Forces shaping modern Soviet man's conception of himself. Evolution of Russian music, theatre, education, and ballet in the 20th century. Lectures, films. music, guest speakers, slides.

Russ. 481-3. Nineteenth-Century Russian Literature. Background survey of Russian literature from 1000 to 1900. Russian writers and literary problems in the 19th century with emphasis on major authors: Pushkin, Gogol, Dostoevsky, Tolstoy, and Chekhov.

Russ. 482-3. Twentieth-Century Russian Literature. Emphasis on Soviet literature, major writers and problems, the theory and practice of Socialist Realism.

Slavic

Slav. 461-3. Ukrainian Literature, World War I to World War II. Chronological examination of the greater figures, forces, and ideas in the Ukrainian literature between the two world wars.

Slav. 462-3. Ukrainian Literature Since World War II. Analysis of significant works and literary figures in the Ukrainian Soviet Republic and the free world. Problems and ideas of dissident literature.

Slav. 471-3. Introduction to Ukrainian Civilization. A survey of Ukrainian history and culture from prehistoric to present times. Prer., upper division standing or consent of instructor.

Slav. 472-3. Slavic Immigrants in North America and the Free World. This course is a general introduction to the history of Slavic emigration, settlement in various countries; process of assimilation; contribution to the social, cultural, political, and economic life of the particular countries with emphasis on North America. Prer., upper division standing or consent of instructor.

Slav. 495-2. Methods of Teaching Russian.

Slav. 503-3. Old Church Slavonic. This is a first course in the oldest Slavic literary language (9th-10th centuries A.D.) with background on its history and with intensive reading of canonical Old Church Slavonic texts.

Slav. 910 through 940-variable credit. Independent Study (Undergraduate).

Slav. 950 through 960-variable credit. Independent Study (Graduate).

SOCIOLOGY

Soc. 119-3. Deviance. Devoted to a consideration of the processes of social differentiation which confirm a conventional normality within certain sectors of the population while simultaneously producing and maintaining deviant forms against which conventional normality assumes its moral meaning and significance.

Soc. 128-3. Race and Minority Problems. Race and racism; facts and myths about great populations, including psychological, social, and cultural sources of bias and discrimination.

Soc. 191-3. Contemporary Social Issues. Introductory consideration of some 30 current social controversies, such as democracy, capitalism, race and ethnic groups, marriage, the family, crime, international tensions, and world order, designed to improve the student's ability to understand current debate and to formulate opinions for himself.

Soc. 193-3. Social Issues in Health and Medicine. A discussion of current moral and policy issues facing society in health and medicine. Topics will vary somewhat from semester to semester covering such topics as alcohol and drug abuse, organ transplants and substitutes, genetic engineering, contraception and abortion, fetal research, occupational safety, and health, death and euthanasia.

Soc. 200-3. Sociology of Death and Dying. The causes of death, who dies, the experience of dying (nursing homes, emergency rooms, intensive care, hospices), ethical and political issues: right to life, right to death, euthanasia, bionics, genetic engineering, cryogenics, environmental and occupational health.

Soc. 205-3. The Social Construction of Sexuality. A contemporary analysis of how social class, education, age, peer and family influences, religion, and sex roles influence sexuality. Emphasis on sociological critique, analyzing the interfacing of societal, psychological, and cultural influences. An interactional perspective of human sexuality is presented.

Soc. 206-3. Sex Roles and Stratification I. An examination of the causes and consequences of sex differentiation and sex stratification at the individual and societal levels. Emphasis on historical and cross-cultural context of sex roles and sex status. Major theories of sex stratification are reviewed.

Soc. 210-3. Twentieth-Century Social Theory. A review of the major sociological theories of the 20th century. The course will consider briefly the major works of such pre-World War II writers as Emile Durkheim and Max Weber. It will then concentrate on the postwar work of Garfinkel, Duncan, Goffman, and others.

Soc. 211-3. Introduction to Sociology I. General survey of the field of sociology. Sociology as a science; man and culture; social groups; social institutions; social interaction; social change.

Soc. 212-3. Introduction to Sociology II. Continuation of Soc. 211-3. Prer., Soc. 211 or consent of instructor.

Soc. 214-3. Social Inequality. Examines the distribution of power and rewards in American society and is concerned with three basic issues: how social inequality is structured, how such structures are maintained, and the consequences of social inequality.

Soc. 220-3. Introduction to Demography and Human Ecology: The Sociology of Survival. Explores global survival issues such as overpopulation, poverty, pollution, and environmental degradation in terms of socioeconomic organization, technology, environment, and population dynamics.

Soc. 226-3. Asian-American Ethnic Communities. An examination of the experience of Asian Americans from a sociological perspective. Emphasis will be on an analysis of Asian American ethnic communities and their histories, social institutions, activities, and social problems. Prer., Soc. 211.

Soc. 227-3. Race and Minority Problems. Race and racism; facts and myths about great populations, including psychological, social, and cultural sources of bias and discrimination. Prer., Soc. 211.

Soc. 230-3. Sociology of Folk Medicine and Psychiatry in Mexican/Chicano Communities. Focuses on folk medicine and folk psychiatry in the Mexican/Chicano communities of the Southwestern United States. Includes theories on the roles, characteristics, prevalence, and future of folk practitioners in their dealings with illnesses as well as beliefs in magic and witchcraft. Prer., Soc. 211.

Soc. 239-3. Mass Society. Social theory is applied in an analysis of structural features of modern society, entertaining the consequences of technology, bureaucracy, urban life, and massive communications systems, including theories of community, social disorganization, alienation, popular cultural solutions to problems of individual identity, and individual adaptations to mass societal conditions.

Soc. 246-3. Introduction to Social Psychology. A survey of the following varieties of social psychology: psychoanalysis, symbolic interactionism, culture and personality, structural-functionalism, and psychological social psychology. Topics to be treated on the introductory level.

Soc. 248-3. Social Movements. The social bases and development features of modern social and political movements.

Soc. 250-3. Social Problems and Social Change. Deals with major theories of social change, change in major social institutions, and current social problems: distribution of power in society, unemployment, poverty, racism and sexism, the changing role of the family, sexual norms and behavior, drugs, and psychophysical methods of awareness.

Soc. 251-3. Social Institutions. Organized system of practices and social roles developed about values. Machinery evolved to regulate the practices and behavior—family, church, government, economy, recreation, and education.

Soc. 255-3. Analysis of Modern Society. An examination of various sociological views of modern society including those of Lundberg, Richardson, Mills, Riesman, Goffman, Sorokin, Cohen, and others.

Soc. 263-3. Social Construction of Reality: Sociology of Knowledge. The initial perspective will be that the foundations of knowledge are largely grounded in social determinants. Exploration of the parameters of this social process as well as evaluation of different social perspectives. The works of A. Maslow, C. Castanedas, and I. Shah will be considered.

Soc. 275-3. Sociology of Natural and Social Environments. A sociological interpretation of the increasingly traumatic interaction of ecological and social systems in the Rocky Mountain West, where the natural environment is impacted by recreation and energy development.

Soc. 289-3. Social Issues in Mental Health. Focus on some of the sociological aspects of mental health and mental illness. Discussion of such issues as poverty, aging and social policy, and mental health, as well as ethical issues in mental health. Prer., Soc. 211 or consent of instructor.

Soc. 315-3. History of Sociological Thought I. Major social theorists from early times to date including such writers as Aristotle, Plato, Machiavelli, Comte, and Spencer.

Soc. 316-3. History of Sociological Thought II. Continuation of Soc. 315. Prer., Soc. 315.

Soc. 317-3. Statistics. Quantitative techniques used in analyzing social phenomena. Prer., Math. 107, its equivalent, or consent of instructor.

Soc. 325-3. Sociology of Nonviolence. What nonviolent social behaviors do societies invent in response to violence? Special attention given to racial and economic justice movements, nonmilitary national defense, civil disobedience, and conscientious objection to war.

Soc. 331-3. The Sociology of Language. The record in languages of society and culture. The uses of language in social and cultural processes and involvements. The conveyance of meaning treated as the prime topic of sociological inquiry. Studies of conversations and of social facts put into words.

Soc. 332-3. Applied Sociology of Language. This course is a continuation of Soc. 331 and deals with problems such as language planning and standardization, language maintenance and shift, problems of education and development which are language related, second-language learning, and selection and development of standard language varieties in third world countries and in underdeveloped areas of modern industrial states. Emphasis will be upon the application of sociolinguistic concepts and theories to both macro and micro sociological problems. Field work projects will be encouraged.

Soc. 337-3. Population and Society. This course will examine population, its structure and processes and its relationships to selected areas of the social structure; and population control and its political, social, and economic implications. Malthusian, neo-Malthusian, and Marxist perspectives will be examined.

Soc. 342-3. Sociology and Perspectives on Alienation. Comparison of historical and contemporary conceptions of alienation in sociology with other perspectives (crucially the religious, the psychoanalytic, and the artistic) in an attempt to arrive at an evaluation of the cogency of the concept in the sociological task of understanding and explaining the historical and contemporary situation of man.

Soc. 346-3. Self and Consciousness. An exploration of inner space, drawing upon the relevant literature of East and West and revolving around the basic issues of living in this complex society.

Soc. 360-3. Social Relations. The course has two aims: first, to improve the student's abilities to observe, analyze, and understand his own behavior and that of others in everyday interpersonal situations; and second, to improve his ability to see the small group as a social system. The student is expected to demonstrate his abilities by effective participation in his group as well as in periodic written analyses. Problems for analysis are drawn from events in the group. The class is designed as a self-analytic training group.

Soc. 370-3. Women, Development, and Fertility. An investigation of the consequences of social and economic development for women and the relationships of the status of women and fertility; fertility and development.

Soc. 384-3. Environment and Behavior. Focuses on the influence of both natural and man-made environments upon human behavior and social organization. Consideration is given both micro-environments and their influence on individuals as well as the impact of macro-environments on the organization of society.

Soc. 400-3. The Creative Self. A mind games exploration of inner space and social relationships.

Soc. 401-3. Honors Seminar. A critical review of the major accomplishments of sociology. First half deals with sociological work from the middle of the 19th century to 1950. The second half deals with 1950 to the present. Prer., grade point average of 3.25 or permission of instructor.

Soc. 402-3. Senior Honors Thesis. Preparation of an honors thesis to be presented before appropriate faculty representatives to fulfill the requirements for graduation with honors. Prer., grade point average of 3.25 or permission of instructor and Soc. 401.

Soc. 404-3. Social History of Women. Sociological analysis of women's place in the mode of production and social organization. The course will focus upon the transition from feudalism to capitalism and the impact of capitalistic development upon the status of women in contemporary developed and third world nations.

Soc. 405-3. Intergroup Relations. A study of intergroup (race) relations at the small-group level. Includes analysis of a group that has been stratified into a majority number of white students and fixed number of minority students.

Soc. 406-3. Sex Role and Sex Stratification. Causes and consequences of sex role differentiation at the individual, group, and societal levels. Extent of empirically established sex differences. Review of biological, psychological, and sociological explanations for sex role differences; emphasis on the socialization processes.

Soc. 420-6. Research Methods and Field Experience. Comprises two components: (1) survey research, statistics, and computer programming (students will be required to design a research project, collect and analyze data, and report findings), and (2) intensive interviewing and participant observation (students will be required to conceptualize a field work project which includes qualitative analysis of some ongoing social setting). Prer., Soc. 211-212 or permission of instructor.

Soc. 426-3. Urban Sociology. The city in terms of its social structure, residential and institutional patternings, processes of interaction, demographic processes, and patterns of growth and change.

Soc. 428/558-3. Sociology of the Future. A systematic analysis of future societies. Emphasis on examining a variety of possible social arrangements, and on assessing economic and political consequences of each, with computer simulation as an optional method.

Soc. 432/539-3. Education in Multilingual Communities. Considers role of language in education and mechanisms of social stratification, i.e., inequality, particularly in communities where children enter school with differing mother tongues. Sociology of bilingual education: politics, pedagogy, and development. Field research encouraged.

Soc. 433-3. Communities. Review and appraisal of community studies.

Soc. 435-3. Sociology of Health and Illness. This course will analyze sociological theories of illness causation and differentiate them from the epidemiological and medical models. It will examine the relationship between belief systems and illness causation. The course will also examine the ways in which socioeconomic status and social stress are related to disease. Deviant illness and the social role of the sick person will also be discussed. Finally, the course will examine how American society handles the ultimate outcome of illness: death.

Soc. 436-3. Ideas in Society. Mannheim's *Sociology of the Mind.* Experimental and historical studies of collective representations. Sociological epistemologies.

Soc. 437-3. Sociology of Health Institutions. This course will analyze health institutions in the general context of theories of social institutions and their relationships. It will examine how people learn health institutional roles, how they carry them out and the pattern of their relationships. The organizational context of health institutions will be discussed, particularly the hospital. Finally, patterns and problems in the restructuring of health institutions will be analyzed and various alternatives discussed.

Soc. 438-3. Practicum in Sociolinguistics. Approaches through language to the study of society and culture. The examination and appraisal of languages and of language productions as records and expressions of social facts. Field projects and documentary and laboratory investigations of language related to social and cultural formations. Sociological treatments of texts, accounts, and conversations.

Soc. 439-3. Practicum in Ethnography. Ethnographic investigations of contemporary settings. The ethnographic search for formal social features and the deviation of theoretical constructs from ethnographic accounts. Ethnography related to formal and experimental analysis and the testing and appraisal of ethnographic methods and findings. Ethnography informed by such outlooks and approaches as hermeneutics, phenomenology, and ethnomethodology.

Soc. 440-3. Sociology of Adolescence. Adolescence in primitive, traditional, and modern society, with special emphasis on the contemporary United States. The possible existence of a youth culture is investigated. The relationship between social climates and individual academic orientations, dating patterns, etc., is analyzed.

Soc. 441/541-5. Group Structures and Behavior. Collective behavior, personality, group, and culture. The problems of publics, crowds, social movements, and human relations of a changing, dynamic nature.

Soc. 443-3. Technology and Modernization. A description and analysis of changing social structures and social relationships as a response to technological innovation and change. Emphasis also given to the role of technology in the development of selected countries outside the United States.

Soc. 444-3. Social Stratification. Status, social mobility, and class in selected societies; elites and leadership problems.

Soc. 445-3. Public Opinion and Popular Culture. Studies of voting, opinion formation, mass communications, and popular taste. Democratic theory and the logic of collective action in modern mass societies.

Soc. 449-3. Social Control. Informal and formal regulative processes in social behavior, with reference to techniques and processes of social control, such as propaganda, the political order, and other institutions.

Soc. 450-3. Social Problems: Advanced Analysis. Advanced sociological analysis of persistent social problems, such as poverty, discrimination, and social and political alienation; and of problems of the life cycle, such as those associated with adolescence, marriage and parenthood, and old age. Emphasis upon the application of sociological theory to the analysis of these problems and to the development of techniques and programs for intervention and control. Open only to senior sociology majors or by consent of instructor.

Soc. 453-3. Social Change. The process of change in Western society and its effects on the individual, the family, and economic and political institutions. Attention is given to extremist response to tensions produced by rapid social change in America. An historical analysis of the causes of Western development serves as a context in which to study the factors aiding and impeding the modernization of the emerging nations.

Soc. 455-3. Sociology of the Family. The family as a social institution. Historical development and contemporary cross-cultural analysis with emphasis on the contemporary American family.

Soc. 456-3. Family and Society. It is the aim of this course to examine, from a sociological and historical perspective, the relationship between family structure and economic structure. Contemporary attempts at changing the family will be studied in the context of the economic, political, legal, and ideological basis of the family.

Soc. 461-3. Sociology of Religion. Social origin of religion. Religious factor in culture. Significance of religion as social control in contemporary society. Religion as an institution and its relation to other institutions.

Soc. 463-6. Research Methods in Sociology. Teaches quantitative research methods, most particularly methods of survey research. Topics included will be sampling, measurement, interviewing, computer methods, and statistical analysis. Class will design and execute a survey research project from start to finish. Students will prepare a research paper on the basis of data collected in the project. Prer., Soc. 211 and 212.

Soc. 464-6. Field Experience in Sociology. Emphasizes ethnographic techniques, intensive interviewing, direct observation, and participant observation. Students will conceptualize and execute a field research project, including data collection, analysis, and a report on some ongoing social setting. Prer., Soc. 211 and 212.

Soc. 465-3. Religion in American Society. Social, cultural, and historical foundations of American religious belief and the organization of the church. Relation of religious belief to other institutions, e.g., economy, politics. Analysis of contemporary social movements in the United States which are either explicitly religious or have a strong religious quality.

Soc. 466-3. Social Psychology. A basic course in social psychology viewed from a sociological perspective.

Soc. 467-3. Sociology of Education. Analysis of the school as a social organization. Among the topics considered are power and control in the school; classroom organization and procedures and their relation to learning and personality development in children; roles of educators; and reciprocal relations of school and community.

Soc. 468-3. Sociology of Science. Science as a social institution; social factors in the development of science; the social organization of

science; social processes in scientific discovery. The place of science in modern society and the social responsibilities of science.

Soc. 470-3. Sociology of Law. A consideration of the formulation, interpretation, and legitimacy of legal rules within a context of social organization.

Soc. 472/572-5. War. Evolution of war through animal, primitive, historical, and modern times from the points of view of drives, techniques, functions, and theories of war. Causes and control of war today.

Soc. 473/573-3. Formal Theories of Conflict. Logic of bargaining, negotiation, conflict, and war. Formulations such as those of Richardson, Boulding, and the game theorists. Empirical research examples drawn from the fields of small groups, politics, and international relations.

Soc. 475-3. Sociological Analysis of Revolution. A comparative analysis of major revolutions with emphasis on causation, revolutionary process, and long-term consequences. Attention is given to social stratification, political organization, economic processes, ideological systems, and international relations.

Soc. 476-3. Sociology of Peacemaking. An analysis of the institutions of war and of forces emerging to counter them, such as negotiation, nonviolent national defense strategies, and peace movements.

Soc. 481-3. Family Planning and Population Control: Social and Policy Issues. Effects of social factors on the development and implementation of population policies in various societies. Values and assumptions underlying such concepts as "free choice on family planning," "birth control," and "population control." Impact of various population policies on societal goals and also on the autonomy of the individuals and families composing the society.

Soc. 482/582-3. Conflict Management in Social Systems. Exploring conflict resolution theory and method as applied to interpersonal, intergroup, and interorganization conflict.

Soc. 483/583-3. Population Studies: Fertility and Mortality. Sociological causes and consequences of different levels of fertility, mortality, and population growth. Course emphasizes methods, theory, and practical applications.

Soc. 484/584-3. Population Studies: Migration and Distribution. As mortality and fertility rates decline, migration is becoming the main determinant of population growth and distribution, especially in the U.S. The course will cover theory and methods but concentrate on social issues related to migration.

Soc. 486-3. Sociology of Aging. The role of the aged in today's society; relationships of the aged to the family and community; problems in retirement and leisure; the economics and politics of aging; problems in the health of the aged; and prospects for the aged in tomorrow's society.

Soc. 489-3. Sociology of Mental Health. History of mental health in America. Mental illnesses and social class. Communication and value systems bearing on mental health. The mental hospital as a small society. The "therapeutic community" and other new developments in social therapy. The structure of mental health services in America. Prer., Soc. 211 or consent of instructor. Pearson.

Soc. 490-3. Senior Seminar. A seminar provided for senior sociology majors in which important concepts, issues, and problems in sociology are considered.

Soc. 491/591-3. Statistics Through Computers. Introduction to basic statistical concepts and methods such as correlational and regression analysis. The student will learn how to use a computer in applying these methods to specific research problems.

Soc. 493-3. Social Issues in Health and Medicine. A discussion of current issues of concern to society in health and medicine. The following topics will be discussed in terms of their impact on society and on the individual: alcoholism, abortion, organ transplants, drug abuse, genetic engineering, health care delivery systems.

Soc. 494-3. Uses of Photography in Sociology. Designed to sharpen the student's observational skills by offering practice in still photography as a tool for discovering and interpreting social settings, conditions, and concepts. Surveys uses of photography in social research, explains basic camera techniques, how to design field studies, and ways of integrating visual and verbal texts. Each student will design and carry out a field project. Prer., any 35-mm camera.

Soc. 495-3. Criminology. Nature and causes of crime as a social phenomenon. The processes of making laws, breaking laws, and reaction toward the breaking of laws. Cultural significance of the processes of determining the reactions of the community to offenders of the law.

Soc. 496-3. Juvenile Delinquency. Factors involved in delinquent behavior. Problems of adjustment of delinquents, and factors in treatment and in post-treatment adjustment.

Soc. 497-3 or 4. The Treatment of Offenders. Four hours' credit if field experience is elected. Principles of treatment of offenders; application of social science principles to treatment of offenders, attitude formation and change, group dynamics, interviewing, guidance and counseling, social re-education. Prer., Soc. 495 or 496 or consent of instructor.

Soc. 500-3. Proseminar. A survey of sociological theory that focuses on the influence of social theorists from the 17th century into the early 20th century. Their relevance to the various fields of sociology will be discussed.

Soc. 501-3. Proseminar. A survey of modern perspectives in sociological theory: functionalism, symbolic interactionism, exchange theory, conflict theory, and phenomenology. Emphasis will be placed on post-World War II literature.

Soc. 502-variable. Research Methods I. First part of a two-semester sequence integrating research methodology and practice in the conduct of social research. The first semester emphasizes principles of research design, including the nature of scientific explanation, the relationship between theory and research, measurement problems, sampling, questionnnaire instruction, and aspects of statistical analysis.

Soc. 503-variable. Research Methods II. Second part of a two-semester sequence on the principles and practice of social research. Emphasis is upon modern methods of data analysis, including regression analysis, causal modeling, computer methods, and presentation of findings in written form. During this semester students will complete the research project begun in Soc. 502. Prer., Soc. 502.

Soc. 504-3. Research Practicum in Demographic Methods. A survey of demographic data, demographic methods, social indicators, ecological analysis, and cohort analysis. Individual research in area of interest. Prer., Soc. 502 and 503.

Soc. 505-3. Research Practicum in Survey Methods. Practical experience in performing sample surveys. Emphasis is placed upon sampling, questionnaire construction, interviewing skills, scaling, coding, and computerized data analysis. Prer., Soc. 502 and 503.

Soc. 506-3. Research Practicum in Ethnographic Methods. Explores methods, problems, and potentials of field work research, utilizing primarily qualitative methods of gathering and analyzing data of social situations. Primary purpose of field work is to learn to systematically observe people *in situ,* finding them where they are, staying with them in a role acceptable to them which allows intimate observations of their behavior, and reporting it in ways useful to social science but not harmful to those observed. Prer., Soc. 502 and 503.

Soc. 507-3. Research Practicum in Dialectical and Historical Methods. An introduction to dialectical logic and methods for use in the analysis of historical data will be followed by the formulation of group and/or individual research projects to be completed during the semester. Practical experience in conducting historical research is emphasized. Prer., Soc. 502 and 503.

Soc. 508-3. Sociology of Sex and Gender. Advanced and detailed analysis of sex roles in present and past societies. Sex stratification—its causes, consequences, and measurement. Theoretical perspectives on sex role differentiation and stratification by various social and biological scientists. Emphasis on empirical studies of sex differences in socialization, personality, institutions, and culture.

Soc. 510-3. Assessment Research. The seminar will be concerned with methods of assessing the effectiveness of action programs conducted in various institutional sectors of the community. Basic principles of research design, measurement, and administration in the

behavioral sciences will be applied to the situations likely to be encountered when social research is conducted in an action setting. Extensive case material will be utilized. Prer., Soc. 502 and 503.

Soc. 515-3. Social Theory I. Selected topics in sociological theory.

Soc. 516-3. Social Theory II. Selected topics in sociological theory.

Soc. 519-3. Deviant Behavior. Examination of current theory and research on deviant behavior with emphasis on the relationship between deviance and patterns of social exclusion.

Soc. 526-3. Seminar: Urban Sociology. Intensive examination of the social and cultural organization of the urban complex. History, contemporary growth, and future of the city are major perspectives; cross-cultural aspects of urban development also are emphasized.

Soc. 527-3. Models of Social Structure. Social structure as represented by networks of interrelated components. Application of the mathematical theory of finite graphs to the study of such networks.

Soc. 532-variable credit. Sociology of Knowledge.

Soc. 535-3. Practicum in Sociolinguistics. Approaches through language to the study of society and culture. The examination and appraisal of languages and of language production as records and expressions of social facts. Field projects and documentary and laboratory investigations of language related to social and cultural formations. Sociological treatments of texts, accounts, and conversations. Open to advanced undergraduates with consent of the instructor.

Soc. 544-3. Seminar: Social Stratification.

Soc. 546-3. Social Change and Policy Planning. A course giving students experience in writing research proposals, journal articles, project reports, and the like. Students' writing efforts will be criticized from stylistic, scientific, and managerial perspectives. Emphasis will be placed upon efficient use of library materials, computerized searches of relevant literature, and writing for the appropriate audience.

Soc. 553-3. Field Experience in Sociology. Provides systematic, supervised field experience in approved social settings, generally in an urban community. Each student will plan his field program with the professor in charge. Discussion and evaluation seminars will meet weekly.

Soc. 554-variable credit. Field Experience in Sociology. Continuation of Soc. 553.

Soc. 555-3. The Family. Recent trends in research and theory with emphasis on the American family.

Soc. 561-3. Sociology of Religion. Comparative analysis of religion as a social institution.

Soc. 563-3. Seminar: Sociology of the Chicano. A sociological perspective on Chicanos which explores the social science literature written by Anglos and Chicanos. The literature is critically evaluated and current Chicano thought is considered as an alternative to Anglo social science writings on the subject.

Soc. 565-3. Language and Knowledge. A practicum for student-conducted field projects involving all the sequential steps from collection of original data through its analysis and evaluation. Perspectives from the sociology of knowledge and science are united with those from the sociology of language.

Soc. 567-3. Sociology of Education. Analysis of selected topics in education from a sociological perspective.

Soc. 576-5. Modern Marxist Social Theory. An exposition and analysis of recent Marxist social thought. Consideration is given to modern Marxist theories of class structure, political economy, alienation, culture, and the state. The works of Althusser, Dobb, Gramsci, Lukacs, Mandel, and Marcuse are considered.

Soc. 577-3. Sociological Analysis of Organizations. An examination of theory and research in the field of formal organization. Special attention is given to problems of organizational change and to the difficulties a social scientist working in a bureaucratic organization might encounter.

Soc. 580-3. The Sociology of Occupational Behavior. The analysis of work behavior in general emphasizing selected occupational roles, structures, characteristics, and trends.

Soc. 581-3. The Professions in Society. A focus on the role and function of the professions which includes the extent, significance, and implications of their involvement in a changing society.

Soc. 586-3. Comparative Race and Ethnic Relations. A rigorous examination of macrolevel theory in race-ethnic relations and its applicability both to race-ethnic relations case studies drawn from a number of societies and to the general topics of ethnic communities, protest and change, assimilation, prejudice-discrimination, and contemporary social policies.

Soc. 592-3. Practicum in Conflict Management. Students learn conflict management skills in field placements with governmental, educational, industrial, and mediation organizations. Faculty field supervision supplements weekly seminars. Prer., Soc. 582.

Soc. 595-3. Criminology. Theories of causation of crime as a social phenomenon; theories of punishment and disposition of cases.

Soc. 599-3. Prevention and Control of Delinquency and Crime. Policies and programs that have been proposed or tried for prevention and control of delinquency and crime and theories underlying such programs. Examination and evaluation of specific programs. Principles involved in prevention and control.

Soc. 603-variable credit. Guided Research in Sociology. Consent of a staff member required.

Soc. 611-3. Advanced Statistical Analysis. Principles of multivariate statistical analysis such as path analysis and factor analysis. Application to sets of available data through various computer programs.

Soc. 614-3. Social Theory: Contemporary World Problems. Macrolevel structural theories of underdevelopment, overpopulation, food scarcity, and resource depletion. Current policies attempting to cope with such problems will be critically assessed.

Soc. 615-3. Advanced Social Theory. Selected topics in sociological theory.

Soc. 640-3. Social Psychology. Sociological approaches in the study of the self, role theory, persons in situations, identifications, socialization, and other characteristics of persons in society. Studies of group processes bearing upon personality processes.

Soc. 663-3. Advanced Theory and Methods. Synthesis of sociological theory and research with basic statistical methods. Application of matrix algebra and computer technology to theory construction and interpretation of correlational studies.

Soc. 700-4. Master's Thesis.

Soc. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Soc. 910-variable credit. Independent Study in Sociology. Consent of instructor required.

Soc. 940-variable credit. Independent Study in Sociology. Consent of instructor is required.

Soc. 950-variable credit. Guided Readings in Sociology. Prer., consent of a staff member.

Soc. 999-variable credit. Candidate for Degree.

SPANISH AND PORTUGUESE

Spanish

Span. 101-5. Beginning Spanish. *Fall, Spring.* Course will offer students a firm command of Spanish grammar. Recitation sections will reinforce structures discussed in lecture. Grammar will be used as point of departure for development of oral skills. Reading, writing will be stressed to a lesser degree.

Span. 102-5. Beginning Spanish. *Fall, Spring.* Continuation of Span. 101. Prer., Span. 101 or placement.

Span. 105-5. Beginning Spanish Review. *Fall, Spring.* An intensive review of the structures of Span. 101-102. Attention to reading, writing, and vocabulary building.

Span. 211-3. Second-Year Spanish. *Fall, Spring.* Grammar review. Study of Hispanic culture, civilization, literature, and art. Prer., Span. 102 or 105 or placement.

Span. 212-3. Second-Year Spanish. *Fall, Spring.* Grammar review. Study of Hispanic culture, civilization, literature, and art. Prer., Span. 211 or placement.

The following courses are taught in Spanish unless otherwise indicated.

Span. 301-3. Pronunciation, Diction, and Conversation. *Fall.* A practice in conversation with emphasis on pronunciation and diction together with exercises in oral composition and review grammar. Prer., Span. 212 or equivalent.

Span. 302-3. Conversation and Oral Composition. *Spring.* A practice in conversation with great emphasis in both oral and written composition. Prer., Span. 301 or equivalent.

Span. 303-3. Professional Spanish for Business I. *Fall.* Includes the study of terminology and techniques used in business transactions and the interpretation and understanding of the ideas expressed in business letters and simple documents. Prer., Span. 301, 302.

Span. 304-3. Professional Spanish for Business II. *Spring.* A practical business course including writing, interpreting, and elementary translation. Some attention is given to the writing of resumes and application letters, as well as to the entire job-search process. Prer., Span. 303.

Span. 305-3. Spanish Linguistics. *Fall.* Spanish phonology with practical exercises. Prer., Span. 212 or equivalent.

Span. 306-3. Structure of Modern Spanish. *Spring.* Contemporary Spanish grammar from a practical perspective. A study of difficult grammatical structures with exercises. An introduction to important topics. Prer., Span. 305.

Span. 331-3. Twentieth-Century Spanish Literature. A survey of the leading writers of Spain from 1889 until the present. In-depth studies of three or four narrative authors will balance the more superficial introduction to the works of other important authors. Prer., Span. 212 or equivalent.

Span. 332-3. Nineteenth-Century Spanish Literature. *Fall, Spring.* Main currents of Spanish peninsular literature of the 19th century. Prer., Span. 212 or equivalent.

Span. 334-3. Twentieth-Century Spanish-American Literature. *Fall.* Introduction to contemporary Spanish-American literature. Prer., Span. 212 or equivalent.

Span. 335-3. Spanish-American Literature to the 20th Century. *Fall, Spring.* An introductory reading course in 19th-century Spanish-American literature including relevant literary, philosophic, and religious background. Prer., Span. 212 or equivalent.

Span. 400/500-3. Mexican-American Culture of the Southwest. *Spring.* (Ch.St. 400.) May not count for major. See requirements. Taught in English.

Span. 401-3. Advanced Rhetoric and Composition I. *Fall.* Designed to improve written expression in Spanish. Detailed study of the nuances of grammar points most difficult for students. Attention will be given to errors in student compositions and to the various styles of written Spanish. Prer., Span. 302.

Span. 402-3. Advanced Rhetoric and Composition II. *Spring.* A continuation of Span. 401 with an emphasis on original work by students. Composition assignments will include the development of dialogues, synthesis of works by noted authors and original poems by students. Review of grammar when need is indicated. Prer., Span. 401.

Span. 406-3. Problems of Business Translation in Spanish I. *Fall.* The development of skills in English-Spanish and Spanish-English translation and interpretating. Prer., Span. 304 or equivalent.

Span. 407-3. Problems of Business Translation in Spanish II. *Spring.* Legal and commercial documents are studied, prepared, and discussed to enable students to perform successfully in real translation situations. Prer., Span. 406 or equivalent.

The following courses are taught in alternate years. Check schedule for each semester.

Span. 411-3. Women in Hispanic Literature. *Fall.* Image of women in Spanish literature through the centuries using works by representative female writers.

Span. 415-3. Masterpieces of Spanish Literature to 1700. *Fall.* Treats the major literary tendencies of Spanish literature from its origins to the end of the Baroque period.

Span. 416-3. Masterpieces of Spanish Literature: 1700 to Present. *Spring.* Requires a reading of selected masterpieces and an examination of major movements and figures in the literature of Spain from 1700 to the present. Taught in Spanish. Prer., successful completion of two Hispanic literature courses at the 300 level at C.U. or the equivalent.

Span. 417-3. Masterpieces of Spanish American Literature to 1888. *Fall.* Examines the major works of Spanish American literature from the colonial period to the late 19th century. Emphasis is on major figures and their works. Taught in Spanish. Prer., 6 credit hours in 300-level Spanish or equivalent.

Span. 418-3. Masterpieces of Spanish American Literature—1888 to Present. *Spring.* Examines the major works of Spanish American literature from the late 19th century to the present.

Span. 420-3. Spanish Culture. (Ch.St. 420.) An examination of the historical bases of modern Spain's cultural and political currents.

Span. 421-3. The Cultural Heritage of Latin America. *Fall.* Examines literary, artistic, and philosophical currents in Latin America beginning with the pre-Columbian indigenous cultures and continuing to the present.

Span. 422-3. Special Topics in Spanish and Spanish American Literature. *Fall.* Designed to examine intensively particular topics or issues concerning Spanish or Spanish American literature to be selected by the instructor. Prer., 6 hours of 300-level literature courses.

Span. 424-3. Literature Written in Spanish in the United States. *Fall.* The knowledge and study of this body of literature written in Spanish by Hispanos living in the United States gives another perspective of American letters and life within the Hispanic Group.

Span. 452-3. Golden Age Literature. The study of the works of the principal writers of the 17th century.

Span. 462-3. Cervantes. *Fall.* Includes a thorough reading and analysis of the Quijote, parts One and Two. Analyses will focus on Cervantes' historical accuracy, sociological concepts, literary constructs, and linguistic features.

Span. 493-1 to 4. Languages Internship for Professions. *Fall, Spring.* Enrollment only with instructor's consent. Participants interested in public service or management-oriented careers in government or business will be able to work as interns in public sector agencies or in private industry, on campus or abroad.

Span. 495/595-3. Methods of Teaching Spanish. *Fall.* Course will familiarize students with current methodology and techniques in foreign language teaching. Peer-teaching coupled with opportunity to teach mini-lessons will provide students with actual teaching experience in the foreign language classroom.

Span. 532-3. Spanish Literature Since the Spanish Civil War. (Denver Campus only.)

Span. 611-3. Seminar: Spanish Literature. Selected topics in Spanish literature.

Span. 612-3. Seminar: Spanish-American Literature. Selected topics in Spanish-American literature.

Span. 613-3. Seminar: Critical Approaches to Hispanic Literature. Various topics and genres will be treated, each requiring a semester's study, as needs and resources indicate. Special attention will be given to theoretical and critical analysis of Hispanic literature with greatest emphasis placed on contemporary trends. Genres might include narrative, poetry, and theatre.

Span. 614-2 to 4. Seminar: Spanish Literature, Medieval Period. Study of medieval works, authors, and themes. Principal influences from other literatures. Reading in Old Spanish.

Span 620-2 to 4. Seminar: Spanish Literature, Renaissance and Baroque. Various topics will be treated, each requiring a semester's study, as needs and resources indicate. Special attention will be given to developing the historical and current theoretical and critical background of each topic. Representative topics might include renaissance poetry in Spain, Cervantes, *Don Quijote* and *Novelas ejemplares*; picaresque novel; and the Spanish comedia of the 17th century.

Span. 621-2 to 4. Seminar: Spanish Literature, 19th Century. Various topics will be treated, each requiring a semester's study, as needs and resources indicate. Special attention will be given to developing the historical and current theoretical and critical background of each topic. Representative topics might include romantic prose, poetry, theatre, realism and naturalism (prose narrative), 19th-century poetry, 19th-century theatre.

Span. 622-2 to 4. Seminar: Spanish Literature, 20th Century. Various topics will be treated, each requiring a semester's study, as needs and resources indicate. Special attention will be given to developing the historical and current theoretical and critical background of each topic. Representative topics might include generation of 1898, poetry of the 20th century, theatre of the 20th century, pre-Civil War novel, and post-Civil War novel.

Span. 630-2 to 4. Seminar: Spanish American Literature, Colonial Period. Various topics, each requiring a semester's study, will be treated as needs and resources indicate. Special attention will be given to developing the historical and current theoretical and critical background of each topic. Representative topics might include pre-Columbian literature, colonial prose narrative, colonial poetry, and colonial theatre.

Span. 631-2 to 4. Seminar: Spanish American Literature, 19th Century. Various topics, each requiring a semester's study, will be treated as needs and resources indicate. Special attention will be given to developing the historical and current theoretical and critical background of each topic. Representative topics might include the romantic novel, the realist and naturalist novel and short story, 19th-century poetry, 19th-century theatre, 19th-century essay, and gaucho literature.

Span. 632-2 to 4. Seminar: Spanish American Literature, Modernism to World War II. Various topics, each requiring a semester's study, will be treated as needs and resources indicate. Special attention will be given to developing the historical and current theoretical and critical background of each topic. Representative topics might include modernism, theatre, the essay, the regional novel, and the novel of the Mexican Revolution.

Span. 633-2 to 4. Seminar: Spanish American Literature, World War II to the Present. Various topics, each requiring a semester's study, will be treated as needs and resources indicate. Special attention will be given to developing the historical and current theoretical and critical background of each topic. Representative topics might include the modern novel, the essay, contemporary theatre, contemporary poetry, and fantastic literature.

Span. 640-2 to 4. Seminar: Spanish Phonology. Topics within Spanish phonology will be treated, each requiring a semester's study, as needs and resources indicate. Special attention will be given to different schools and contemporary theoretical developments. Representative topics may include generative phonology applied to Spanish, Spanish phonology for college teaching, and different schools of Spanish phonology.

Span. 641-2 to 4. Seminar: Spanish Syntax. Topics within Spanish syntax will be treated, each requiring a semester's study as needs and resources indicate. Special attention will be given to different schools and contemporary theoretical developments. Representative topics may include generative/transformational grammar applied to Spanish, fundamental problems in Spanish syntax, different schools of Spanish syntax.

Span. 642-2 to 4. Seminar: History of the Spanish Language. Topics within the history of the Spanish language will be treated, each requiring a semester's study as needs and resources indicate. The linguistic evolution of Spanish from neo-Latin to its present status as a world language: important historic, linguistic, literary, and cultural currents. Representative topics may include a diachronic study of Spanish linguistic forms, the extension of Spanish to the New World, linguistic and literary texts in Old Spanish.

Span. 643-2 to 4. Seminar: Hispanic Linguistics. A major topic from an important area such as phonology, syntax, history of the Spanish language, Hispanic linguistics and literature, or applied Hispanic linguistics will be announced. This topic will be studied in detail during the semester.

Span. 700-4. Master's Thesis.

Span. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Span. 910-1 to 3. Independent Study.

Span. 940-1 to 3. Independent Study.

Span. 950-1 to 3. Independent Study.

Span. 960-1 to 3. Independent Study.

Portuguese

Port. 101-5. Beginning Portuguese. *Fall.*

Port. 102-5. Beginning Portuguese. *Spring.* Prer., Port. 101.

Port. 211-3. Second-Year Portuguese Reading and Conversation. *Fall.* Prer., Port. 102 or its equivalent in proficiency.

Port. 212-3. Second-Year Portuguese Reading and Conversation. *Spring.* Prer., Port. 211 or its equivalent in proficiency.

Port. 403/503-3. Topics: Luso-Brazilian Civilization. *Fall.* Prer., two years of any other romance language.

Port. 404/504-3. Topics: Luso-Brazilian Civilization. *Spring.* Prer., Port. 403 or equivalent.

Port. 411/511-3. Survey of Brazilian Literature I. *Fall.* Prer., Port. 212 or consultation.

Port. 412/512-3. Survey of Brazilian Literature II. *Spring.* Prer., Port. 212 or consultation.

Port. 415/515-3. Survey of Portuguese Literature I. *Fall.* Prer., Port. 212 or consultation.

Port. 416/516-3. Survey of Portuguese Literature II. *Spring.* Prer., Port. 212 or consultation.

Port. 451/551-3. Contemporary Brazilian Prose Fiction I. *Fall.* Prer., Port. 212 or consultation.

Port. 452/552-3. Contemporary Brazilian Prose Fiction II. *Spring.* Prer., Port. 212 or consultation.

Port. 455/555-3. Contemporary Portuguese. Peninsular Portuguese contemporary literature. The neo-realism as a literary tendency from Miguel Torga to Fernando Namora.

Port. 456/556-3. Contemporary Portuguese Literature in Africa. Literature of the African countries of Portuguese colonization.

Port. 940-1 to 3. Independent Study.

Port. 950-1 to 3. Independent Study.

THEATRE AND DANCE

Theatre

Thtr. 230-3. Acting: Beginning. Course emphasizes principles of acting, focusing on exercises in relaxation, talking and listening, use of images, sense memory, actions and objectives, and basic concepts of process work. There is a required reading list of five plays.

Thtr. 231-3. Text Analysis for Performance. The student learns to perceive literary form and content and to translate that perception into classroom performances of selected modern plays and short stories.

Thtr. 232-3. Acting: Intermediate. Continuation of the techniques introduced in Thtr. 230. Emphasis is placed on scene study using plays of modern realism for material. Basic techniques in building a character are explored. There is a required reading list of five plays and three texts. Prer., Thtr. 230, 231.

Thtr. 233-3. Voice and Speech. Concentration upon the freeing and training of the vocal instrument. Students develop skills in relaxation, breath control, vocal placement, and articulation. Prer., Thtr. 230.

Thtr. 245-2. Introduction to Shakespeare in Production: Director and Text. A study of the relationship between script analysis and directorial approach in the production of three Shakespeare plays presented in the current Colorado Shakespeare Festival.

Thtr. 246-1. Introduction to Shakespeare in Production: Staging Methods. A study of how production elements are determined and integrated in the staging of three Shakespeare plays presented in the current Colorado Shakespeare Festival.

Thtr. 247-1 to 2. Basic Problems in Producing Shakespeare. Provides exploration, through practical experience and research, of the nature and solution of a specific problem in the production of a Shakespeare play.

Thtr. 270-3. Introduction to Theatre. Survey of theatre forms past and present, the development of the physical theatre, and staging techniques throughout the ages; readings, lectures, demonstrations.

Thtr. 276-3. Introduction to Stagecraft. Theory and practice. An introduction to stagecraft, including basic mechanical drawing, mechanics, lighting, costume and makeup, and their application to the scenic arts.

All 300-level practica are graded *pass* or *fail*; to receive a *pass* one must complete required work at a satisfactory level of proficiency, put in all required hours, and meet all calls.

Thtr. 321-1 to 3. Practicum in Costuming. One hour of credit equals 45 hours of work, done Monday-Friday, 7-10 p.m., for three weeks prior to a show's opening, plus working the run of the show. Majors may repeat course to a maximum of 8 credits with advisor's consent. Prer., Thtr. 276.

Thtr. 322-1 to 3. Practicum in Technical Theatre. One hour of credit equals 30 hours of work in scenery and/or lighting, done Monday-Friday, 1-6 p.m., plus working the run of the show. Majors may repeat course to a maximum of 8 credits with advisor's consent. Prer., Thtr. 276.

Thtr. 323-1 to 3. Practicum in Theatre Management. One hour of credit equals 60 hours of work in one or several publicity office, box office, house management, and assistant stage management. Majors may repeat course to a maximum of 8 credits with advisor's consent. Prer., Thtr. 276.

Thtr. 324-1 to 3. Practicum in Acting. One hour of credit earned for doing a role in a University Theatre proscenium or arena production. Only 1 credit hour may be earned in any semester. Majors may repeat course to a maximum of 8 credits with advisor's consent. Prer., Thtr. 230.

Thtr. 325-1 to 3. Practicum in Playwriting. One hour of credit earned for a project in playwriting. Majors may repeat course to a maximum of 8 credits with advisor's consent. Prer., Thtr. 475 or Thtr. 485, plus instructor's consent.

Thtr. 326-1 to 3. Practicum in Directing. One hour of credit earned for serving as assistant director to a faculty member on a University-sponsored production, including the Colorado Shakespeare Festival. Majors may repeat course to a maximum of 8 credits with advisor's consent. Prer., Thtr. 474 plus instructor's consent.

Thtr. 327-1 to 3. Practicum in Theatrical Make-up. One credit equals 60 hours of work in learning and practicing techniques of theatre make-up, plus doing the make-up for a University Threatre-sponsored production. Majors may repeat course to a maximum of 8 credits with advisor's consent. Prer., Thtr. 276. Not offered every year. See *Schedule of Courses*.

Thtr. 330-4. Acting: Survey of Styles. Acting principles and techniques learned in prerequisite courses will be adapted and applied to five period styles, with emphasis on standardizing speech sounds, developing speech styles appropriate to plays studies, and exploring how costumes, properties, and activities shape movement and characterization. Prer., Thtr. 230, 231, 232 (concurrent enrollment in 233 encouraged).

Thtr. 350-5. Studio I: Internal Acting Process. An in-depth study of the internal acting process for the student training for a career in professional theatre. Includes craft work in voice, speech, dialects, and stage movement as well as text analysis of contemporary plays. Prer., at least sophomore standing and admission to B.F.A. program in theatre performance.

Thtr. 351-5. Studio II: External Acting Process. Continues the acting principles begun in Studio I and builds external technique for the purposes of physicalizing actions and exploring character based on external choices, with concentration in voice and speech styles, dialects, beginning period movement. Prer., Thtr. 350.

Thtr. 376-3. Advanced Stagecraft. Theory and practice. A continuation of beginning stagecraft. Prer., Thtr. 276.

Thtr. 377-3. Introduction to Costuming. A brief outline of costume as well as theory and practices in the design and construction of costumes for the stage.

Thtr. 389-variable credit. Problems in Theatre. Study in problem areas in the field of theatre. Work is basically investigative in character. Prer., consent of supervising instructor.

All 400-level practica will be graded.

Thtr. 421-1 to 3. Advanced Practicum in Costuming. Projects in design only under close supervision of senior faculty. Majors may repeat course to a maximum of 16 credits with advisor's consent. Must be done on a University Theatre production. Prer., Thtr. 321 plus instructor's consent.

Thtr. 422-1 to 3. Advanced Practicum in Technical Theatre. Projects in scenery or lighting design on University Theatre-sponsored productions under close supervision of senior faculty. Majors may repeat course to a maximum of 16 credits with advisor's consent. Prer., Thtr. 322 plus instructor's consent.

Thtr. 423-1 to 3. Advanced Practicum to Theatre Management. Advanced projects in Theatre or Stage Management under close supervision of senior faculty, on a University Theatre sponsored production. Majors may repeat course to a maximum of 16 credits with advisor's consent. Prer., 2 credits of Thtr. 323, plus instructor's consent.

Thtr. 424-1 to 3. Advanced Practicum in Acting. Projects in advanced theatre performance—interpretation or acting, under close supervision of senior faculty. Majors may repeat course to a maximum of 16 credits with advisor's consent. Prer., 3 credits of Thtr. 324, plus instructor's consent.

Thtr. 425-1 to 3. Advanced Practicum in Playwriting. Advanced projects in playwriting under close supervision of senior faculty. Majors may repeat course to a maximum of 16 credits. Prer., Thtr. 475 or Thtr. 485, one credit of Thtr. 325 plus instructor's consent.

Thtr. 426-1 to 3. Advanced Practicum in Directing. Projects in hands-on directing under close supervision of senior faculty; students are encouraged to seek production space outside the University The-

atre. Majors may repeat course to a maximum of 16 credits with advisor's consent. Prer., Thtr. 326 plus instructor's consent.

Thtr. 427-1 to 3. Advanced Practicum in Theatrical Make-up. Advanced projects in theatrical make-up under close supervision of senior faculty. Majors may repeat course to a maximum of 16 credits. Prer., Thtr. 327 plus instructor's consent. Not offered every year. See *Schedule of Courses.*

Thtr. 430-3. Advanced Performance of Literature. Analysis and performance of fiction and nonfiction. Research into the life and times of a historical personage, culminating in the creation of a script and one-person performance. Emphasis upon scripting and ensemble performance. Prer., Thtr. 231 and upper division standing.

Thtr. 445-2. Shakespeare in Production: Director and Text. A study of the theory and implications of the director's script analysis and production approach as related to the three plays of the current Colorado Shakespeare Festival. Prer., upper division (junior or senior) standing; courses in theatre or dramatic literature, or instructor's consent.

Thtr. 446-1. Shakespeare in Production: Staging Theory and Technique. A study of the intentions, methods, and results achieved in integrating the production elements involved in the staging of three Shakespeare plays. Prer., upper division (junior or senior) standing; courses in theatre or dramatic literature or instructor consent.

Thtr. 447-1 to 2. Advanced Problems in Producing Shakespeare. Provides exploration, through practical experience and research, of the nature and solution of a complex problem in the production of a Shakespeare play. Prer., upper division (junior or senior) standing; same-summer enrollment in one of the Shakespeare in Production courses, and consent of producing director, CSF.

Thtr. 448-5. Shakespeare in Production. A detailed study of script analysis, directing concepts, staging, and criticism of three plays being produced by the Colorado Shakespeare Festival. Prer., upper division (junior or senior) standing; background in both theatre and dramatic literature or instructor consent.

Thtr. 450-3. Studio III: Master Class in Specialized Style Work. Students study advanced problems in a particular acting style—oriental or another highly conventionalized form. Concentration is on analysis and performance. Choice of style varies, dependent upon instructors, and the course may be repeated (as long as each repetition encompasses a different style). Prer., Thtr. 350 and 351 or by audition.

Thtr. 451-4. Studio IV: Elizabethan Acting Styles. Speech and movement styles characteristic of the period will be explored in depth, through study of sense, scansion, sound, shape, imagery, decorum, manners, and presentational acting. Analyses and performance from the work of seven playwrights, including Shakespeare, are required. Prer., Thtr. 350 and 351, and concurrent enrollment in Thtr. 450.

Thtr. 452-4. Studio V: Classical Acting Styles. Examines the acting styles necessary to perform the works of pre-19th century playwrights. Emphasis is given to the vocal and physical aspects of presentational performance balanced with the internal acting process. Prer., Thtr. 350, 351, 450, and 451.

Thtr. 453-3 to 12. UCB Touring Theatre. Participation in Colorado Caravan Touring Theatre program. Prer., Thtr. 350, 351, 450, 451, and 452 with a grade of *A* or *B*.

Thtr. 471-3. History of the Theatre I. Study of theatres, methods of presentation, actors, and acting from primitive times to 1700, with some readings of plays to illustrate the points covered. Prer., upper division standing.

Thtr. 472-3. The Theatre of Asia. Survey of Asian theatre history, methods, content and social function, with a special focus on India, China, and Japan. Prer., background in theatre or in Asian Studies. Prer., upper division standing.

Thtr. 474-3. Directing. Theory and practice of directing. Prer., Thtr. 230 and 276, or 270, consent of instructor, and upper division standing.

Thtr. 475-3. Playwriting: Short Form. Writing the short play. Prer., upper division undergraduate status.

Thtr. 476-3. Scene Design. The study and practice of scenic design with an emphasis on the study of design theory, color, and space. Special emphasis is placed on two-dimensional and three-dimensional presentation of ideas. Prer., Thtr. 276 and 376.

Thtr. 477-3. Costume Design. Study and application of the principles of design as applied to stage costume with special emphasis on the two-dimensional presentation of ideas. Prer., Thtr. 377 or consent of instructor.

Thtr. 479-3. Theatre Practice (Music Theatre-Dance). Study of and participation in various styles of dance in music theatre.

Thtr. 481-3. History of the Theatre II. Continuation of Thtr. 471. From 1700. Prer., upper division standing.

Thtr. 482-3. History of Costume I. A detailed study of the history of costume from the Egyptian and Asian civilizations to the European Renaissance, including fabrics, accessories of dress, and ornaments; influence of cultural factors; study of available collections. Prer., upper division standing.

Thtr. 483-3 to 12. Touring Theatre Dance. Participation in Colorado Caravan Touring Theatre Dance Program. Prer., consent of instructor.

Thtr. 485-3. Playwriting: The Long Form. Writing the full-length play. Prer., consent of instructor.

Thtr. 486-3. Stage Lighting Design. The study and practice of lighting and design with emphasis on the principles of electricity, optics, color theory, instrumentation, and their aesthetic application to the stage. Prer., Thtr. 276.

Thtr. 487-3. History of Costume II. Continuation of Thtr. 482. A detailed study of the history of costume from the Renaissance to contemporary times, including fabrics, accessories of dress, and ornaments. Prer., upper division standing.

Thtr. 489-1 to 4. Problems in Theatre. Opportunity for students to explore, upon consultation with the instructor, areas in theatre which the normal sequence of offerings will not allow. Prer., consent of instructor and upper division standing.

Thtr. 490-3. Methods of Teaching Theatre. *Fall.* Curriculum, materials, methods, evaluation, and related aspects of instruction. Secondary level. Prer., 18 hours of theatre courses or consent of instructor.

Thtr. 491-1 to 4. Problems in Theatre. Opportunity for students to explore, upon consultation with the instructor, areas in theatre which the normal sequence will not allow. Prer., consent of instructor and upper division standing.

Thtr. 530-3. Advanced Performance of Literature. Analysis and performance of fiction and nonfiction. Research into the life and times of a historical personage, culminating in the creation of a script and one-person performance.

Thtr. 545-2. Shakespeare in Production: Director and Text. Same as Thtr. 445 with the addition of a research paper. Prer., graduate standing; courses in theatre or dramatic literature or instructor's consent.

Thtr. 546-1. Shakespeare in Production: Staging Theory and Technique. Same as Thtr. 446 with the addition of a research paper. Prer., graduate academic standing; courses in theatre or dramatic literature or instructor consent.

Thtr. 547-1 to 2. Advanced Problems in Producing Shakespeare. Same as Thtr. 447. Provides exploration, through practical experience and research, of the nature and solution of a highly complex problem in the production of a Shakespeare play. Prer., graduate standing; same-summer enrollment in one of the Shakespeare in Production courses; consent of producing director, Colorado Shakespeare Festival.

Thtr. 548-5. Shakespeare in Production. Same as Thtr. 448 with the addition of extensive research and critical writing. Prer., graduate academic standing; background in both theatre and dramatic literature or instructor consent.

Thtr. 550-3. Studio III: Master Class in Specialized Style Work. Same as Thtr. 450. Students study advanced problems in a particular acting style—oriental or another highly conventionalized form. Concentration is on research, analysis, and performance. Choice of style varies, dependent upon instructors, and the course may be repeated (as long as each repetition encompasses a different style). Prer., graduate standing and by audition only.

Thtr. 551-4. Studio IV: Elizabethan Acting Styles. Same as Thtr. 451. Speech and movement styles characteristic of the period will be explored in depth, through study of sense, scansion, sound, shape, imagery, decorum, manners, and presentational acting. Analyses and performances from the work of seven playwrights, including Shakespeare, are required, as well as research into the Elizabethan world picture and mores. Prer., graduate standing and by audition only.

Thtr. 552-4. Studio V: Classical Acting Styles. Same as Thtr. 452. Examines the acting styles necessary to perform the works of pre-19th century playwrights. Emphasis is given to the vocal and physical aspects of presentational performance balanced with the internal acting process. Students will conduct research on selected periods and playwrights to serve as a basis for performances. Prer., graduate standing and by audition only.

Thtr. 572-3. Problems in Asian Theatre. Same as Thtr. 472 with the addition of a research paper.

Thtr. 574-3. Directing: Theory and Practice. Advanced study of theory and practice of play direction with particular attention to style. Prer., Thtr. 474 or consent of instructor.

Thtr. 576-3. Scene Design. Same as Thtr. 476 with addition of a graduate project.

Thtr. 577-3. Costume Design. Same as Thtr. 477. Study and application of the principles of design as applied to stage costume with special emphasis on the two-dimensional presentation of ideas.

Thtr. 578-3. Seminar: Drama. Readings and explorations in drama. Prer., consent of instructor.

Thtr. 579-1 to 2. Theatre Practice. Same as Thtr. 479. Participation in University Theatre productions. Credit hours to be arranged by director of the theatre.

Thtr. 582-3. History of Costume I. Same as Thtr. 482 with the addition of a research paper.

Thtr. 585-3. Problems in Playwriting. Writing and adapting playscripts.

Thtr. 586-3. Stage Lighting Design. Same as Thtr. 486 with the addition of a research paper and/or project.

Thtr. 587-3. History of Costuming II. Same as Thtr. 487 with the addition of a graduate project.

Thtr. 589-1 to 4. Problems in Theatre. Same as Thtr. 489. Opportunity for students to explore, upon consultation with the instructor, areas in theatre which the normal sequence of offerings will not allow. Prer., consent of instructor.

Thtr. 591-1 to 4. Problems in Theatre. Opprtunity for students to explore, upon consultation with the instructor, areas in theatre which the normal sequence of offerings will not allow. Prer., consent of instructor.

Thtr. 603-3. Seminar: Theatre Aesthetics. Studies in performance and dramatic theory. Prer., demonstrable sophistication in theatre and/or drama, consent of instructor.

Thtr. 660. Theatre Dramaturgy. Provides a study of the roles and techniques of the dramaturg in the contemporary theatre of Europe and America with specific applications to the Colorado Shakespeare Festival. Prer., graduate standing, undergraduate major in theatre, strong background in dramatic literature and theatre history. Instructor consent.

Thtr. 671-3. Seminar: Theatre History. Advanced study and research in depth in specialized areas of world theatre history.

Thtr. 672-3. Seminar: Asian Theatre. In-depth study and research on major theatre forms in Asian countries, with a specific focus on dramas and theatres of India, China, and Japan.

Thtr. 674-3. Directing the Long Play: Theory and Practice. Experience (theory and practice) in directing a long play. Play selection, study, casting, rehearsals, and performance in consultation with an instructor. Prer., consent of instructor.

Thtr. 678-3. Seminar: Contemporary Theatre. Research and study of the contemporary theatre, its impulses, achievements, and trends. Such areas as scholarship, theory and criticism, playwriting, production arrangements, staging methods, and social effect or importance may be considered.

Thtr. 679-3. Problems in Developmental Theatre. Study of application and participation in developmental theatre.

Thtr. 689-variable credit. Problems in Developmental Theatre. Opportunity for students to explore, upon consultation with the instructor, areas in developmental theatre and dance which the normal sequence of offerings will not allow. Prer., consent of instructor.

Thtr. 700-1 to 4. Master's Thesis.

Thtr. 800-30. Doctor's Dissertation. All doctoral students must register for not fewer than 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit refer to the Graduate School portion of the catalog under Change in Requirements for Doctoral Degree.

Thtr. 930-1 to 3. Independent Study. Prer., written consent of instructor.

Thtr. 940-1 to 3. Independent Study. Prer., written consent of instructor.

Thtr. 950-1 to 3. Independent Study. Prer., written consent of instructor.

Thtr. 960-1 to 3. Independent Study. Prer., written consent of instructor.

Thtr. 970-1 to 3. Independent Study. Prer., written consent of instructor.

Thdn. 601. Introduction to Graduate Studies. Resources and approaches to scholarly research and writing. Expectations in class participation, performance activities, and writing. Requirements and procedures of the department and of the Graduate School. Required for all departmental graduate students.

Dance

Dnce. 151-1, 152-1. Dance Techniques: Recreational Dance Forms. Open to dance, physical education, and recreation majors, and by consent of instructor.

Dnce. 181-2. Dance Techniques: Ballet. *Fall.* Open to dance majors. Other students admitted by audition.

Dnce. 182-2. Dance Techniques: Ballet. *Spring.* Open to dance majors. Other students admitted by audition.

Dnce. 183-2. Dance Techniques: Ballet. *Fall.* Open to dance majors. Other students admitted by audition.

Dnce. 184-2. Dance Techniques: Ballet. *Spring.* Open to dance majors. Other students admitted by audition.

Dnce. 185-2. Dance Techniques: Ballet. *Fall.* Open to dance majors. Other students admitted by audition.

Dnce. 186-2. Dance Techniques: Ballet. *Spring.* Open to dance majors. Other students admitted by audition.

Dnce. 187-2. Dance Techniques: Ballet. *Fall.* Open to dance majors. Other students admitted by audition.

Dnce. 188-2. Dance Techniques: Ballet. *Spring.* Open to dance majors. Other students admitted by audition.

Dnce. 191-2. Dance Techniques: Modern Dance. *Fall.* Open to dance majors. Other students admitted by audition.

Dnce. 192-2. Dance Techniques: Modern Dance. *Spring.* Open to dance majors. Other students admitted by audition.

Dnce. 193-2. Dance Techniques: Modern Dance. *Fall.* Open to dance majors. Other students admitted by audition.

Dnce. 194-2. Dance Techniques: Modern Dance. *Spring* Open to dance majors. Other students admitted by audition.

Dnce. 195-2. Dance Techniques: Modern Dance. *Fall.* Open to dance majors. Other students admitted by audition.

Dnce. 196-2. Dance Techniques: Modern Dance. *Spring.* Open to dance majors. Other students admitted by audition.

Dnce. 197-2. Dance Techniques: Modern Dance. *Fall.* Open to dance majors. Other students admitted by audition.

Dnce. 198-2. Dance Techniques: Modern Dance. *Spring.* Open to dance majors. Other students admitted by audition.

Dnce. 214-2. Dance Improvisation. An exploration of the aesthetic elements of movement through improvisational structure. Guided dance experiences are designed to allow for individual response and group instruction while providing an opportunity for spontaneous self expression.

Dnce. 280-2. Theatre Dance Forms. Classes begin with a warm-up followed by dance sequences based on social dance forms of the 20th century, and discussion of their use in musical theatre choreography.

Dnce. 290-3. Beginning Composition. An understanding of the basic elements of dance composition through beginning studies, evolved from readings, discussion, and improvisation.

Dnce. 314-3. Movement Analysis. The basic elements of Laban Movement Analysis will be introduced as a framework for perceiving and understanding movement. Major body therapies and their implication for dance training and application to individual movement problems will be explored. Prer., anatomy.

Dnce. 380-2. Rhythmic Analysis and Accompaniment. The emphasis of this course is on the elements of rhythm in relation to dance. Experiences with rhythmic drills, rhythmic notation, and percussion accompaniment for the modern dance class comprise the body of the course. Prer., junior standing.

Dnce. 381-2. Musical Resources for Dance. This course surveys basic musical notation and terminology, the elements and forms of music, and historical styles, supported by guided listening to representative works. Special emphasis is placed on 20th-century techniques and on relationship of various musics to dance. Prer., junior standing.

Dnce. 390-3. Intermediate Dance Composition. An opportunity for the student to increase knowledge and understanding of the elements of dance composition as they relate to group forms, theme, development, and phrase manipulation. Prer., Dnce. 290 or consent of instructor.

Dnce. 413-3. Creative Dance for Children. This course is a methods course for prospective teachers of creative dance for children. Lectures, readings, and laboratory experiences are followed by observation and teaching in the primary grades. Prer., junior standing.

Dnce. 415-3. Methods of Teaching Dance. Practical experience in teaching modern dance to the young adult will follow theoretical grounding in specific teaching methods. Course will examine the values and goals of dance in education and fundamental movement principles as related to the teaching of technique and improvisation. Prer., Dnce. 214, 290, 314, 380.

Dnce. 479-1 to 3. Dance Practicum. Project in dance under supervision of senior faculty. Prer., junior standing.

Dnce. 489-2. Problems in Dance. This course explores current topics and research in relation to teaching methods, performance, and criticism which the normal sequence of offerings will not allow. Prer., written consent of instructor.

Dnce. 490-3. Advanced Dance Composition. An in-depth approach to composition with an emphasis on personal invention, solo and group forms; styles based on historical art forms; exploration of the evaluative process. Prer., Dnce. 290, 390, or consent of instructor.

Dnce. 491-3. History and Philosophy of Dance. *Fall.* The history and philosophy of dance from primitive times to 1900. Prer., junior standing.

Dnce. 492-3. Dance in the 20th Century. *Spring.* Development of modern dance from Isadora Duncan to the present through lectures, discussions, critical reviews, and films. Prer., junior standing.

Dnce. 493-2. Dance Production. Designed to provide the student with theoretical knowledge and practical experience in producing a dance event in a variety of performance settings ranging from the traditional dance concert and lecture demonstration format to more experimental forms. Areas of study include lighting, sound costuming, publicity, budget, and management. Prer., junior standing.

Dnce. 494-3. Dance Repertory. Learning and performing dances from the repertory of current faculty members, artists-in-residence, and upon occasion from the repertory of historic modern dancers. Prer., admission through auditions.

Dnce. 496-2. Composition/Repertory. Students will explore the improvisational and choreographic style of the artist-in-residence; repertory may also be taught.

Dnce. 513-3. Creative Dance for Children. Same as Dnce. 413 with the addition of book reports in related fields and a resource file of materials for children's classes.

Dnce. 515-3. Methods of Teaching Dance. Same as Dnce. 415 with the addition of a paper developed in consultation with the teacher.

Dnce. 530-2. Applied Labananalysis. The body, effort, space and shape components of the Laban Movement Analysis framework will be considered in relation to dance technique, composition, style analysis, individual movement styles. Emphasis is on application of theory.

Dnce. 579-2. Dance Practice. Modern dance technique for graduate students.

Dnce. 589-2. Problems in Dance. Exploration of current topics and research in relation to teaching methods, performance, and criticisms which the normal sequence of offerings will not allow.

Dnce. 590-3. Advanced Dance Composition. Same as Dnce. 490 with the addition of graduate papers and/or a project.

Dnce. 591-3. History and Philosophy of Dance. *Fall.* Same as Dnce. 491 with the addition of graduate papers and/or a project.

Dnce. 592-2. History of Dance in the 20th Century. *Spring.* Same as Dnce. 492 with the addition of graduate papers and/or a project.

Dnce. 593-2. Performance Events. Same as Dnce. 493 with a performance project researched, documented, and produced.

Dnce. 594-3. Dance Repertory. Same as Dnce. 494 except graduate students will be required to keep a log of learning process involved in repertory to document and analyze each work in terms of stylistic differences, musical/sound accompaniment and trends.

Dnce. 596-2. Composition/Repertory. Same as Dnce. 496 with an additional performance project approved by the artist-in-residence and the Academic Director of the summer dance program.

Dnce. 598-1 to 3. Studio Concert. Prer., consent of instructor.

Dnce. 600-2. Readings in Dance. A survey of dance literature including an opportunity for graduate students to familarize themselves with resources, current publications, theoretical materials, and professional organizations in the dance area.

Dnce. 610-2 to 4. Choreography. Advanced composition choreographed and presented for public performance and criticism.

Dnce. 615-3. Seminar: Dance. Intensive study of selected topics related to the art of dance, dance criticism, research in dance and dance in relationship to the other arts (performing and visual) with an emphasis on the avant-garde.

Dnce. 620-2. Problems in Dance Administration and Curriculum. Current problems in the administration of dance programs at the secondary and college levels. Curriculum development and trends in curriculum construction.

Dnce. 700-1 to 4. Master's Thesis.

Dnce. 930-1 to 3. Independent Study. Prer., written consent of instructor.

Dnce. 940-1 to 3. Independent Study. Prer., written consent of instructor.

Dnce. 950-1 to 3. Independent Study. Prer., written consent of instructor.

Dnce. 960-3. Research Project.

NONMAJOR DANCE COURSES

Not offered every year. Check current *Schedule of Courses.*

Dnce. 101-1, 102-1, 103-1, 104-1. Beginning Ballet.

Dnce. 105-1, 106-1. Intermediate Ballet.

Dnce. 107-1, 108-1. Advanced Ballet.

Dnce. 131-1, 132-1, 133-1, 134-1. Beginning Jazz Dance.

Dnce. 141-1, 142-1. Beginning Modern Dance.

Dnce. 143-2, 144-2. Intermediate Modern Dance.

WOMEN STUDIES

Wm.St. 126-3. Introduction to Women's Literature. See Engl. 126 for course description.

Wm.St. 200-3. Introduction to Women Studies. The variety of women's roles and statuses are examined from an interdisciplinary and cross-cultural perspective with the goal of generating and evaluating various theoretical explanations for the differential access to power of women and men. Includes consideration of psychology and physiology, sex roles and socialization, marriage and the family, work and economics, history and social change.

Wm.St. 201-3. Contemporary Issues. Examines current social, political, and economic issues related to women. Includes consideration of women of all social classes and ethnic backgrounds, primarily in the United States. Possible topics include violence against women, women in the labor force, reproductive freedom, women in poverty, sexuality, the women's movement. Prer., Wm.St. 200 or instructor's consent.

Wm.St. 202-3. Women, Culture and Society. (Same as Anthr. 208.) Offers a comparative analysis of gender-based status and social roles. It examines in cross-cultural context relations among women's subsistence and reproductive activities, the division of labor by sex, cultural forces, and societal technology level. Emphasis is on basic anthropological methods, perspectives, and knowledge base.

Wm.St. 205-3. The Social Construction of Sexualtiy. (See Soc. 205 for course description.)

Wm.St. 206-3. Sex Roles and Stratification I. (See Soc. 206 for course description.)

Wm.St. 210-3. Women in Antiquity. (See Clas. 210 for course description.)

Wm.St. 226-3. Images of Women in Literature. (See Engl. 226 for course description.)

Wm.St. 230 to 239-3. Topics in Women Studies. Courses are designed to examine, at an introductory level, selected topics in women studies. Content will vary by semester and reflect relevant contemporary issues in women studies scholarship, e.g., women and crime, women in film, sex and gender in futuristic literature, women and technology.

Wm.St. 270-3. The Psychology of Contemporary American Women. (See Psy. 270 for course description.)

Wm.St. 294-3. Philosophy and Women. (See Phil. 294 for course description.)

Wm.St. 298-3. History of Women in the U.S. (See Hist. 298 for course description.)

Wm.St. 300-4. Women Studies Practicum I. Students work on special projects in community agencies serving women. Work in the agencies, together with class discussions, lectures and reading, provides students with a way to integrate women studies theory with the practical experience of working with community women. Prer., Wm.St. 200 and 201.

Wm.St. 304-4. Women Studies Practicum II. (Formerly Curriculum Design) Course provides a conceptual framework for women studies curriculum development at educational levels from kindergarten through university. Emphasis is placed on women studies research topics and problems, and development of curriculum units based on this research. Purpose is to integrate women studies resources into traditional learning environments. Prer., Wm.St. 200 and 201 or 6 hours' education credit or instructor's consent.

Wm.St. 305-3. Computer-Based Studies of Sex and Gender in Literature, Language, and Ethnography. This is an interdisciplinary course in which students will use computers to examine the following basic issues in women studies: the question of gender-differentiated language in literary texts; the measurement of status by sex, both cross-culturally and historically, using revised ethnographic data banks; and the computer-based analysis of oral history, women's history, and sex-differentiated language. Prer., A.S. 110 or equivalent, at least one women's literature course; Wm.St. Soc. 206 or 406; or coreq., Introductory Statistics.

Wm.St. 313-3. Study of La Chicana. (See Ch.St. 319 for course description.)

Wm.St. 326-3. Women Writers. (See Engl. 326 for course description.)

Wm.St. 370/371-3. Topics in Women Studies. Designed to examine selected topics in women studies. Content will vary by semester and reflect relevant contemporary issues in women studies scholarship, e.g., women and public policy, women in film, etc.

Wm.St. 380-3. Women, Development, and Fertility. (See Soc. 370 for course description.)

Wm.St. 398-3. Women in Victorian England. (course description listed under Hist. 398.)

Wm.St. 400-3. Senior Seminar: Special Topics. Advanced interdisciplinary course, organized around a specific topic, problem, or issue relating to women in culture and society (such as women and public policy, women's role in world development, women and work). Course work includes discussion, reading, and written projects. Prer., Wm.St. 200 and 201.

Wm.St. 401-3. Women in Society in Industrial Europe. (See Hist. 401 for course description.)

Wm.St. 402-3. Research Seminar. Students work in groups on research projects related to women (such as oral histories of women in management). Projects are designed to introduce students to basic research techniques, to develop research skills, and to contribute to knowledge of contemporary and historical Rocky Mountain women. Prer., Wm.St. 200 and 201.

Wm.St. 409-3. Feminist Theory. Examines major theoretical writings on feminist theory, including both historical and contemporary works—e.g., Marx, Mill, de Beauvoir, etc. Major divisions within contemporary feminist thought (radical, liberal, psychoanalytic, etc.) are discussed. Topics include philosophical notions of equality, the development of feminist thought, and social historical analysis of feminism as a social movement.

Wm.St. 410-3. Women in Asian History. (See Hist. 400 for course description.)

Wm.St. 406-3. Sex Roles and Stratification II. (See Soc. 406 for course description.)

Wm.St. 427-3. Topics in Women's Literature. (See Engl. 427 for course description.)

Wm.St. 455-3. Sociology of the Family. (See Soc. 455 for course description.)

Wm.St. 456-3. Family and Society. (See Soc. 456 for course description.)

Wm.St. 470-3. Women and Mental Health. (See Psy. 470 for course description.)

Wm.St. 477-3. Women Artists From the Middle Ages to the Present. (See F.A.H. 477 for course description.)

Wm.St. 481-3. Family Planning in Population and Control. (See Soc. 481 for course description.)

Wm.St. 492-3. Women and the Law. (See P.Sci. 492 for course description.)

College of Business and Administration and Graduate School of Business Administration

Courses open to both undergraduate and graduate students are designed by slashes (e.g., Acct. 424/524).

ACCOUNTING

Acct. 200-3. Introduction to Financial Accounting. The preparation and interpretation of the principal financial statements of the business enterprise, with emphasis on asset and liability valuation problems and the determination of net income. Prer., sophomore standing.

Acct. 202-3. Introduction to Managerial Accounting. The analysis of cost behavior and the role of accounting in the planning and control of business enterprises, with emphasis on management decision-making uses of accounting information. *Note:* accounting majors must take this course. Prer., Acct. 200.

Acct. 322-3. Intermediate Financial Accounting I. Intensive analysis of generally accepted accounting principles, accounting theory and preparation of annual financial statements for public corporations. Prer., Acct. 202 or B.Ad. 501.

Acct. 323-3. Intermediate Financial Accounting II. Continuation of Acct. 322. Prer., Acct. 322.

Acct. 332-3. Cost Accounting. Cost accounting systems for business organizations; cost analysis for purposes of control and decision making. Prer., Acct. 202 or B.Ad. 501.

Acct. 424/524-3. Advanced Financial Accounting. Advanced financial accounting theory and practice with emphasis on accounting for partnerships, business combinations, and consolidations. Prer., Acct. 323.

Acct. 425/525-3. Financial Accounting Issues and Cases. In-depth analysis of contemporary accounting issues and problems, the development of accounting thought and principles, and critical review of generally accepted accounting principles. Prer., Acct. 322 and 323.

Acct. 433/533-3. Managerial Accounting Problems and Cases. Critical analysis of advanced topics in managerial accounting. Considerable use of cases and current readings. Prer., Acct. 332.

Acct. 441/541-3. Income Tax Accounting. Provisions and procedures of federal income tax laws and requirements affecting individuals and business organizations. Prer., Acct. 202 or B.Ad. 501.

Acct. 442/542-3. Advanced Income Tax Accounting. Continuation of Acct. 441, with special emphasis on the imcome tax problems of partnerships, corporations. Prer., Acct. 441 or 541.

Acct. 454/554-3. Accounting Systems and Data Processing. The design and analysis of management information systems, automated data processing methods with special emphasis on computers, computer programming, and the role of accounting in the management process. Prer., 9 sem. hrs. of accounting.

Acct. 462/562-3. Auditing. Generally accepted auditing standards and the philosophy supporting them; auditing techniques available to the independent public accountant. Pertinent publications of the AICPA reviewed. Prer., Acct. 323.

Acct. 480/580-3. Accounting for Government and Nonprofit Organizations. Planning and control of government and nonprofit organizations. Includes program budgets, responsibility accounting, and fund accounting. Prer., Acct. 202 or B.Ad. 501.

Acct. 625-3. Seminar: Accounting Theory. Nature and origin of accounting theory and the development of postulates, principles, and practices. Methodology appropriate to development and evaluation of accounting theory, with special emphasis on accepted research standards and procedures. Prer., Acct. 323 and Acct. 332.

Acct. 626-3. Seminar: Managerial Accounting. In-depth exploration of the broad professional field of managerial accounting, especially as related to organizational decision making, planning, and control. Development and current problems of the managerial accounting function analyzed. Prer., Acct. 332, 625, or consent of instructor.

Acct. 627-3. Seminar: Income Determination. Critical analysis of problems and theory of measurement and reporting of periodic net income of business organizations. Net income models, research efforts, and role of professional accounting organizations. Current issues and problems given special attention. Prer., Acct. 625.

Acct. 635-3. Current Issues in Professional Accounting. In-depth analysis of current issues in the accounting profession, including ethics, development and validity of standards, and regulation. Prer., Acct. 625 or consent of instructor.

Acct. 642-3. Research Problems in Income Tax Accounting. A study of the methodology used in tax research and in tax planning, together with a study of some aspects of tax administration and tax practice. Prer., Acct. 441 or 551 or consent of instructor.

Acct. 652-3. Controllership. Functions of the modern corporate controller. Topics and problems demonstrating the integrative nature of the controller's role are investigated. Prer., Acct. 322, 332, and 454 or 554 or equivalent.

Acct. 662-3. Advanced Auditing Theory. Development of auditing as a profession, including evolution of standards and audit reports. Historical and contemporary literature in the field reviewed. Prer., Acct. 462 or 562.

Acct. 700-4 to 6. Master's Thesis.

Acct. 730-3. Doctoral Seminar: Accounting. Examination and evaluation of current theories, issues, and problems relating to accounting. Primary emphasis on accounting theory and research. Open only to doctoral students. Prer., Acct. 625, 626, and 627 or equivalent.

Acct. 800-0. Doctor's Thesis.

Acct. 960-variable credit. Independent Study. With the consent of instructor under whose direction the study is undertaken.

BUSINESS ENVIRONMENT AND POLICY

B.Ad. 100-3. Introduction to Business. Nature of business enterprise; role of business in our society; problems confronting business management. Career opportunities in business. Business students are advised to take this course during freshman year. Open only to freshmen and sophomores.

B.Ad. 410-3. Business and Government. Study of government regulation of the business system. Topics include regulation of business concentration and of the markets for labor, money, other resources, and final products. Prer., Econ. 201 and 202. Completion of P.Sc. 110 is recommended before taking this course.

B.Ad. 411-3. Business and Society. An examination of interrelationships between business, society, and the environment. Topics will include perspectives on the socio-economic-business system, current public policy issues, and social responsibilities and ethics. Prer.,

Econ. 201 and 202. Completion of P.Sc. 110 and Soc. 211 is recommended before taking this course.

B.Ad. 440-3. International Business Seminar. Examines the international business environment as it affects company policy and procedures. Integrates all the functions undertaken in international operations through depth analysis and comprehensive case studies. Prer., any two of the following: Econ. 441, Fin. 440, Mk. 490, Tr.Mg. 458.

B.Ad. 450-3. Cases and Concepts in Business Policy. Emphasis is on integrating the economic, market, social-political, technological, and competition components of the external environment with the internal characteristics of the firm; and deriving through analysis the appropriate interaction between the firm and its environment to facilitate accomplishment of the firm's objectives. Priority for enrollment will be given to business seniors in their final semester prior to graduation. Prer., Fin. 305, Mk. 300, Pr.Mg. 300, Or.Mg. 330, and Q.M. 201.

B.Ad. 451-3. Management Game and Cases in Business Policy. Computerized management simulation is used as a means of giving the student practical, simulated experience in developing and analyzing business problems and building a framework for decision making, policy formulation, and plans of action. Priority for enrollment will be given to business seniors in their final semester prior to graduation. Prer., Fin. 305, Mk. 300, Pr.Mg. 300, Or.Mg. 330, and Q.M. 201.

B.Ad. 452-3. Small Business Strategy, Policy, and Entrepreneurship. Emphasis is on planning, organizing, and operating small business firms. The role of the entrepreneur is examined in the conception, organization, and development of firms. Extensive use is made of small business cases. Priority for enrollment will be given to business seniors in their final semester prior to graduation. Prer., Fin. 305, Mk. 300, Pr.Mg. 300, Or.Mg. 330, and Q.M. 201.

B.Ad. 470-3. Small Business Management and Operation. Analysis of managerial problems of the small businessman. Case studies, outside speakers, and individual reports on local small business enterprises supplement class discussions. Student must have an understanding of elementary accounting, finance, and business law, or have experience in small business operation. Prer., senior standing.

B.Ad. 490-3. Honors Seminar: Business I. Social responsibilities of the business executive, business ethics, business-government relations, business in literature. Open to seniors who have completed at least 30 semester hours of business courses, have obtained not less than a 3.3 grade point average over those hours, and have received consent of instructor. Does not carry graduate credit.

B.Ad. 495-variable credit. Topics in Business. Experimental course offered irregularly for purpose of presenting new subject matter in a particular business field. Prerequisites will vary, depending upon topics covered.

B.Ad. 930 to 949-variable credit. Independent Study. With the prior consent of the dean and instructor under whose direction study is undertaken. Intended only for exceptionally well-qualified business seniors.

The following graduate fundamentals courses (B.Ad. 500 to 508) do not carry graduate business degree credit, nor may they be used to satisfy requirements for the bachelor's degree in business. They are open only to business graduate students admitted on a regular or provisional status.

B.Ad. 500-1. Sources of Information and Research Methods. The objective of this course is to provide the M.B.A. student with the basic research techniques needed to locate, use, and evaluate secondary resource materials. The approach will be to emphasize techniques rather than actual titles.

B.Ad. 501-3. Fundamentals of Accounting. Provides basic understanding of accounting essential for graduate study of business.

B.Ad. 502-3. Fundamentals of Business Statistics. Provides basic understanding of business statistics essential for graduate study of business. Helpful to have Math. 107 and 108 or equivalent. (On the Boulder Campus B.Ad. 502 and 507 are taught as one 6-hour course. Students should register for both courses concurrently.)

B.Ad. 503-3. Fundamentals of Marketing. Provides basic understanding of marketing essential for graduate study of business.

B.Ad. 504-3. Fundamentals of Management and Organization. Provides basic understanding of organization theory, personnel management, labor relations, and organizational behavior essential for graduate study in business.

B.Ad. 505-3. Fundamentals of Finance. Provides basic understanding of business finance essential for graduate study of business. Prer., B.Ad. 501.

B.Ad. 506-3. Legal Environment of Business. Provides understanding of the private and public law essential for graduate study in business.

B.Ad. 507-3. Fundamentals of Management Science. A survey of the analytical methods of management science operations research as applied to decision problems in business. A major objective of the course is to develop an understanding of the power and the limitations of mathematical-statistical models and to develop skills in problem formulation. Prer., B.Ad. 502 or equivalent. (On the Boulder Campus, B.Ad. 502 and 507 are taught as one 6-hour course. Students should register for both courses concurrently.)

B.Ad. 508-3. Economic Theory and Application for Managers. An introduction to micro and macro theory for M.B.A. candidates. No credit for students with credit in Econ. 201 and 202.

B.Ad. 540-3. Seminar: International Business. Examines the international business environment as it affects company policy and procedures. Integrates all the functions undertaken in international operations through in-depth analysis and comprehensive case studies. Prer., any two of the following: Econ. 441, Fin. 440 or 540, Mk. 490 or 590, and Or.Mg. 458 or 558.

B.Ad. 570-3. Small Business—Management and Operation. Analysis of managerial problems of the small businessman. Case studies, outside speakers, and individual reports on local small business enterprises supplement class discussions. Student must have an understanding of elementary accounting, finance, and business law, or have experience in small business operation. Prer., graduate standing.

B.Ad. 595-variable credit. Topics in Business. Experimental course offered irregularly for purpose of presenting new subject matter in a particular business field. Prerequisites will vary, depending upon topics covered.

The following graduate courses are open only to admitted graduate students. Students should have completed all of the fundamental requirements or be currently registered for them before enrolling in any of the 600-level graduate courses.

B.Ad. 610-3. Business, Government, and Society. The interdependence of business with societal, governmental, and economic environments. Explores the firm's social and ethical responsibilities. Considers the relationship between business and government and the control and regulation of business. Prer., Econ. 201 and 202 or B.Ad. 508, by course work or waiver, and completion of at least half (12 hours) of the B.Ad. 500 series of fundamentals.

B.Ad. 615-3. Business and Economic Analysis. A presentation of the concepts, tools, and methods of economic analysis relevant to a broad cross section of decisions within the business firm. Particular attention will be given to market demands and the interrelationships between price policy, costs, and production. Prer., B.Ad. 502 and Introduction to Microeconomics.

B.Ad. 620-3. Administrative Controls. Nature and techniques of control in modern managerial context. Intensive case analysis to study theory and application of control methods. Prer., B.Ad. 501, 502, and 505.

B.Ad. 630-3. Business Research. Nature, scope, and importance of business research and research methodology. Emphasizes sources of information, methods of presentation, methods of analysis, and interpretation of statistical data. Involves individual investigation and re-

port writing on problems of current business interest. Prer., B.Ad. 502 or equivalent.

B.Ad. 640-3. Organizational Behavior. Application of behavioral science concepts and research to management of organizations. Prer., B.Ad. 504.

B.Ad. 650-3. Business Policy. Emphasizes problem analysis and decision making at integrative-management level. Devoted to internal policy making. Emphasis on integrated use of research, analysis, and control in policy decisions. This course *must* be taken in the candidate's final term of the program. B.Ad. 500-level fundamentals, by course completion or waiver, are firm prerequisites.

B.Ad. 660-3. Business Conditions. Analysis of the American economy; its development and present condition. The state of the economy and the underlying factors affecting the economy will be analyzed. Prer., 9 semester hours of economics.

B.Ad. 670-2. Advanced Problems in Small Business Operation. Advanced course. Research studies of conditions that make for success or failure by localities. Prer., B.Ad. 470 or 570.

B.Ad. 695-variable credit. Graduate Seminar: Business. Experimental seminar offered irregularly to provide opportunity for investigation of new frontiers in business knowledge. Prerequisites will vary, depending upon the topic to be covered.

B.Ad. 755-3. Doctoral Seminar: Administrative Policy I. Examination and evaluation of current theories, issues, and problems involved in the formulation, administration, and appraisal of administrative policies. Includes both study of relevant literature and examination of administrative policies in operation in business enterprises. Open to doctoral candidates only. Prer., B.Ad. 650.

B.Ad. 756-3. Doctoral Seminar: Administrative Policy II. Continuation of B.Ad. 755. Prer., B.Ad. 755.

B.Ad. 757-3. Directed Study and Research in Current Policy Issues. For D.B.A. candidates with primary interest in administrative policy. Directed intensive study of important policy issues, both on an individual basis and in small groups. Reading and research. Prer., B.Ad. 755 and B.Ad. 756 completed or taken concurrently.

B.Ad. 790-3. Doctoral Seminar: Dissertation Research. A seminar designed to assist the doctoral student in integrating his courses and fields of study in order to be able to apply knowledge and skills to problems in business. Special attention will be given to the development of thesis topics.

B.Ad. 800-16 to 24. Doctor's Thesis.

B.Ad. 960-variable credit. Independent Study. With the consent of instructor under whose direction study is undertaken.

BUSINESS EDUCATION

Courses numbered 500 and above generally are offered only during summer sessions.

B.Ed. 500-3. Improvement of Instruction in Business Education. This course is intended to update experienced teachers from both high schools and colleges in current materials and methods in the skills as well as general areas of business.

B.Ed. 630-2. Foundations of Business Education. Philosophy and objectives of business education; problems of curriculum and curriculum evaluation; contribution of business education to general education; business and economic history and trends.

B.Ed. 631-2. Problems in Business Education. General problems of current importance to the business teacher in high school or college.

B.Ed. 641-2. Seminar: Business Education. Basic business understanding necessary in an economic society; how this may be included in the high school curriculum in business education; resource materials.

B.Ed. 960-variable credit. Independent Study. With the consent of instructor under whose direction the study is undertaken.

BUSINESS LAW

B.Law 300-3. Business Law. To understand the legal significance of business transactions as part of the decision-making process in business. Coverage of text and statutes includes law and its enforcement and integration of the Uniform Commercial Code with the law of Contracts, Bailments, Warehousemen and Carriers, Documents of Title, Sales of Goods, and Commercial Paper. Prer., junior standing.

B.Law 412/512-3. Business Law. Property security transactions (UCC9), suretyship and guaranty, bankruptcy, agency, partnerships, and corporations (UCC8). Prer., B.Law 300 or B.Ad. 506.

FINANCE

Fin. 305-3. Basic Finance. Includes a study of the monetary system and other institutions comprising the money and capital markets. Also includes a study of the financial manager's role in business. The investment of capital in assets and financing the asset requirements of business firms. Prer., Econ. 201 and 202; Acct. 200.

Fin. 321-3. Personal Finance. Problems of personal financial management; use of credit, personal budgets, insurance, small investments in securities, buying a home, creating an estate, providing for old age, and making a will. Intended for nonbusiness students. No credit given toward business degree requirements.

Fin. 333-3. Investments. Study of the basic problems concerning development and implementing of a personal investment program. Includes analysis of investment risks, alternative investment media, designing and executing an investment program. No credit given toward business degree for finance majors. Prer., Fin. 305. Students may not receive credit for both Fin. 333 and 433.

Fin. 355-3. Financial Markets. Discusses major operating characteristics and problems of money and capital markets, both national and international. Emphasizes the sources and availability of money and capital for financing business and the market structure for the employment of savings. No credit given toward business degree for finance majors. Students may not receive credit for both Fin. 355 and 455. Prer., Fin. 305.

Fin. 401-3. Business Finance I. Basic principles and practices governing management of capital in the business firm constitute the core of this course. Determinants of capital requirements, methods of obtaining capital, problems of internal financial management, and methods of financial analysis. Financing the business corporation given primary emphasis. Prer., Fin. 305, Acct. 202 (formerly Acct. 214).

Fin. 402-3. Business Finance II. Develops analytical and decision-making skills of students in relation to problems that confront financial management. Areas include planning, control, and financing of current operations and longer-term capital commitments; management of income; evaluation of income-producing property; and expansion. Case method of instruction. Prer., Fin. 401.

Fin. 433-3. Investment and Portfolio Management. Discusses investment problems and policies and the methodology for implementing them. Includes portfolio analysis, selection of investment media, and measurement of performance. Prer., Fin. 401 and 455. Students may not receive credit for both Fin. 333 and 433.

Fin. 434/534-3. Security Analysis. An application of the theories and methodology for the selection of investment media for implementing an investment portfolio. Prer., Fin. 402 and 433 or Fin. 602 and 633.

Fin. 440-/540-3. International Financial Management. Considers international capital movements and balance of payments problems. Problems of international operations as they affect the financial functions. Reviews foreign and international institutions and the foreign exchange process. Considers financial requirements, problems, sources, and policies of firms doing business internationally. Prer., Fin 305 or B.Ad. 505.

Fin. 453/553-3. Bank Management. An analysis of structure, markets, regulation, and chartering commercial banks. Problems and policies of the internal management of funds, loan practices and procedures, investment behavior, deposit and capital adequacy, liquidity,

and solvency. Analytical methodology for these problems is developed. Prer., Fin. 401 or 601; coreq., Fin. 455 or 655.

Fin. 455-3. Monetary and Fiscal Policy. Analyzes the theoretical and practical problems concerning the use of monetary and fiscal devices for controlling national and international economic relationships. Emphasizes the major theories and analytical models for current monetary and fiscal policies. Prer., Fin. 305. Students may not receive credit for both Fin. 355 and 455.

Fin. 601-3. Problems and Policies in Financial Management I. Emphasizes analysis of financial condition, planning and control of current assets and current liabilities, and long-term financial arrangements. Specific topics include management of working capital, short, intermediate, and long-term financing, leasing, valuation, and capital structure policies. Theory and case studies. Prer., B.Ad. 505 or equivalent.

Fin. 602. Special Topics in Financial Management. Topics and emphasis will include capital budgeting, capital structure theory, valuation, dividend policy, mergers and divestitures, and financial distress. Theory and empirical analyses. Prer., Fin. 601.

Fin. 633-3. Investment Management and Analysis. The theory of investment management and security values; portfolio management including the analysis of investment risks and constraints on investment policies and objectives; the analysis and use of investment information; and the development and application of the tools for determining values. Prer., Fin. 601.

Fin. 655-3. Business Fluctuations and Monetary Policy. Theoretical and empirical study of forces governing business fluctuations in the U.S. and the effectiveness of monetary and fiscal policies. Develops the analytical tools essential for understanding business indicators and the various policy alternatives to attain stated economic goals and objectives. Prer., Fin. 601.

Fin. 960-variable credit. Independent Study. With the consent of instructor under whose direction the study is undertaken.

Fin. 700-4 to 6. Master's Thesis.

Fin. 720-3. Doctoral Seminar: Business Finance. Examination and evaluation of current theories, issues, and problems relating to the financial management of business. Emphasis on both internal and external environment forces affecting managerial policies and decisions. Includes study of relevant literature and of financial policies prevailing in business. Prer., Fin. 602 or equivalent.

Fin. 733-3. Doctoral Seminar: Investments. Advanced study and research in contemporary investment problems, including security markets. Prer., Fin. 633 or equivalent.

Fin. 755-3. Doctoral Seminar: Monetary Theory and Policy. Advanced study and research in selected contemporary monetary theory and credit problems. Prer., Fin. 655 or equivalent.

Fin. 800-16 to 24. Doctor's Thesis.

INFORMATION SYSTEMS

I.S. 200-3. Business Information Systems and the Computer. (Formerly B.Ad. 200.) A study of business information systems focusing upon computer hardware and software as they relate to business information. Includes computer modeling, computer systems, and computer applications. Purpose of the course is to introduce the students to the concepts, vocabulary, and functions of business information systems and the computer. Prer., Math. 107 and 108.

I.S. 220-3. Business Programming I: Structured COBOL. An introductory course intended to provide the student with a thorough programming foundation in COBOL using structured programming concepts and techniques. The basic elements of the language are discussed and demonstrated through applications in a business environment. Prer., I.S. 200 or instructor's consent.

I.S. 221-3. Business Programming II: Structured COBOL and Physical File Organization Techniques. Continuation of I.S. 220. Introduces the student to advanced topics in COBOL and their applications in business. Special emphasis on alternative physical data and file structures, their implementation in COBOL, and their use in a business setting. The use of system software and utilities will be integrated with the topics. Case studies may be used to illustrate applications of the material. Prer., I.S. 220 or instructor's consent; Q.M. 201 recommended.

I.S. 330-3. Operations Research for Decision Support. (Formerly Q.M. 330.) Objectives and models of operation research and their application in a managerial setting. Includes topics such as inventory models and control, simulation, linear programming topics, network models.

I.S. 350-3. Logical Data Structures and Database Management Systems. An introduction to database management systems, online query, and management control systems. Concerned with database structure and design and the integration of the logical view of the data with its physical storage. Extensive use may be made of a commercial DBMS in student projects to develop an appreciation of the use and organizational issues as well as the technical considerations. Prer., I.S. 221 or instructor's consent.

I.S. 465/565-3. Systems Analysis and Design I. Introduces the student to basic system analysis tools and the procedures for conducting a system analysis. Topics to be covered may include system requirements, the initial analysis, the general feasibility study, structured analysis, detailed analysis, logical design, and the general system proposal. The student will gain practical experience through projects and/or case studies. Prer., I.S. 221 or instructor's consent. (For graduate students, I.S. 220 or consent).

I.S. 466/566-3. System Analysis and Design II. Continuation of I.S. 465. Covers topics such as structured design, physical system design, detailed feasibility analysis, specification of input-output methods and formats, design of files, programs and procedures, system testing, implementation procedures, and system life cycle management. The student will implement these concepts through case studies and/or projects. Prer., I.S. 465 or instructor's consent. (For graduate students, I.S. 221 and 565, or consent).

I.S. 470/570-3. Computer and Information Technology. Provides the I.S. student with a conceptual foundation in the areas of computer architecture, operating systems, programming translators, and telecommunications. Intended to serve as a facilitating course to allow the student to communicate more readily with other technical members of the data processing community. Prer., I.S. 221 or instructor's consent.

I.S. 645-3. Information Systems and Management. Information processing, the analysis and design of information systems, management query systems, and data base design and management.

I.S. 650-3. Database Management Systems. Theory of data structures; implementation of database models. Comparative analysis of available systems and in-depth applications in conventional and innovative circumstances, especially in development of information for operations and control of administrative functions. Prer., I.S. 645 or equivalent and I.S. 220/221.

I.S. 680-3. Selected Topics in Information Systems. This course will vary from semester to semester, treating topics such as advanced concepts and research in information sciences, digital simulation and simulation languages, and other topics. May be repeated when topic changes. Prer., specified each semester.

INSURANCE

Ins. 484/584-3. Principles of Insurance. Fundamental principles of insurance and their application in life, disability, property, and liability insurance. Provides the basic knowledge for intelligent solution of personal and business insurance problems as well as for further specialized study of insurance. Prer., Fin. 305 or B.Ad. 505.

Ins. 487/587-3. Risk Control in the Corporate Enterprise. A systematic approach to risk control in industrial and commercial enterprises. Concerns the interworkings of human behavior, natural phenomena, and chance involved in situations of risk and the great variety of combinations of preventive measures, insurance provisions, and loss absorption arrangements. Prer., Ins. 484 or 584.

MANAGEMENT SCIENCE

Mg.Sc. 601-3. Deterministic Models. Linear programming and its application, network analysis, including scheduling models, dynamic programming, integer programming, nonlinear programming. Prer., B.Ad. 507.

Mg.Sc. 602-3. Stochastic Models. Probability theory, queueing theory, inventory theory, Markov decision processes, simulation, decision analysis. Prer., B.Ad. 502 and B.Ad. 507.

Mg.Sc. 675-3. Seminar: Management Science. Application of operations research methods to problems of business and industry, with emphasis on the functional fields of marketing, financial management, and production. Prer., Mg.Sc. 601 and Mg.Sc. 602., or instructor's consent. One of the prerequisite courses may be taken as a corequisite.

Mg.Sc. 685-3. Selected Topics in Decision Science. This course will vary from semester to semester, treating topics such as algorithmic developments in mathematical programming, decision analysis, stochastic processes, and other topics. May be repeated if topic changes. Prer., to be specified each semester.

Mg.Sc. 960-variable credit. Independent Study. With the consent of instructor under whose direction the study is undertaken.

Mg.Sc. 700-4 to 6. Master's Thesis.

Mg.Sc. 800-16 to 24. Doctor's Thesis.

MARKETING

Mk. 300 or B.Ad. 503 or an equivalent course in basic marketing is a prerequisite for all other marketing courses except Mk. 310.

Mk. 300-3. Principles of Marketing. Analytical survey of problems encountered in distributing goods and services. Takes a marketing-management approach in attacking problems related to product planning, channels of distribution, pricing, advertising, and selling. Emphasizes role of consumer and the social responsibility of marketer.

Mk. 310-3. Salesmanship. Principles and methods of personal salesmanship with attention to development and demonstration of effective sales presentation techniques.

Mk. 320-3. Consumer Behavior. Survey of contributions of behaviorial sciences to understanding and prediction of consumer behavior. Contributions of research techniques in social sciences to understanding of consumer purchasing and decision-making processes. Survey of consumer purchasing behavior, brand loyalty, and product cycles. Prer., Mk. 300.

Mk. 330-3. Marketing Research. Fundamental techniques. Practical experience in research methodology: planning an investigation, questionnaires, sampling, interpretation of results, report preparation. Research techniques for product analysis, motivation research, sales and distribution-costs analyses, and for advertising research. Student will incur project expenses. Prer., Mk. 300 and Q.M. 201. Not available in summer session.

Mk. 340-3. Marketing Institutions and Retailing. A study of the macroeconomic foundations of marketing intermediaries, middlemen, and institutional alignments. Emphasis placed on development and change of institutional structures and functions and roles played by participants in moving goods to ultimate consumer, focusing on retailing functions and strategies. Prer., Mk. 300.

Mk. 350-3. Principles of Advertising. Analysis of principles and practices in advertising from executive's viewpoint. Considers whether a firm should advertise; product and market analysis as planning phase of advertising program; media; survey of creation and production of advertisements; advertising budgets, copy testing, and organization. Prer., Mk. 300.

Mk. 430-3. Research Design and Experimental Methods in Marketing. Advanced course in marketing research. Stresses design of marketing research projects and application of statistical techniques. Collection, analysis, and interpretation of marketing information. Techniques of experimental design and application as basis for decision-making in marketing. Design and management of a planned marketing information system. Prer., Mk. 330.

Mk. 450/550-3. Advertising Management. Advertising problems from management point of view. Stimulating primary and selective demand; selection of media; building promotional programs; advertising appropriations and campaigns; evaluations of results; agency relations. Prer., Mk. 350.

Mk. 460/560-3. Industrial Marketing. Activities involved in marketing of industrial goods. Analysis of market structures; habits and motives of purchasers; types of industrial products; pricing problems; distribution channels. Problems in selling to agencies of government. Oriented to engineers and others entering the fields of industrial selling or marketing. Prer., Mk. 300.

Mk. 470/570-3. Sales Management. Problems involved in managing a sales force. Includes sales organization, operating a sales force (recruiting, selection, training, compensation, supervision, stimulation), sales planning (forecasting, budgeting, territories), sales analysis and control. Prer., Mk. 300 or B.Ad. 503.

Mk. 475/575-3. Pricing and Price Policies. Appraisal of price theory and limitations in actual business situations. Detailed study of impact of demand, costs, and prices upon revenues and profits through extensive use of actual case materials. Legal aspects of pricing decisions studied intensively. Prer., Mk. 300 or B.Ad. 503.

Mk. 480-3. Marketing Strategies and Policies. Detailed consideration of process of formulating and implementing marketing policies. Major emphasis on markets, distribution channels, and product analysis. Problem approach utilized to develop student's analytical ability and to integrate all major areas of marketing. Prer., Mk. 300, and 6 additional hours in marketing.

Mk. 485/585-3. Physical Distribution Management. Investigation and analysis of logistics of distribution systems for firms engaged in manufacturing and marketing. Component parts of each system are studied and analytical tools are presented for selecting alternatives which will attain distribution goals of the firm. Prer., Mk. 300 or B.Ad. 503.

Mk. 490/590-3. International Marketing. Studies managerial marketing policies and practices of firms marketing their products and services in foreign countries. An analytical survey of institutions, functions, policies, and practices in international marketing. Relates marketing activities to the market structure and marketing environment. Prer., Mk. 300 or consent of instructor or B.Ad. 503

Mk. 600-3. Marketing Management. An in-depth inquiry into marketing decision making. Emphasis is placed on strategic planning and analytical procedures for marketing decisions. The course integrates all areas of marketing management and relates marketing activities to the other functional areas of the firm. Prer., Mk. 300 or B.Ad. 503.

Mk. 605-3. M.B.A. Seminar: Marketing. Comprehensive survey of current problems and issues in marketing from the perspective of firm. Analysis of firm's process of adjustment to market changes. (Required of all M.B.A. students with an area of emphasis in marketing.) Prer., Mk. 600.

Mk. 610-3. Seminar: Marketing. *Summer.* Intensive analytical study of certain aspects of marketing principles, institutions, policies, and operations. Prer., Mk. 300 or B.Ad. 503.

Mk. 620-3. Seminar: Consumer Behavior. A study of the nature and determinants of consumer buying behavior. In-depth investigation of contributions of behavioral sciences (especially psychology, sociology, cultural anthropology) towards understanding consumer behavior. Influence of demographic factors, motivation, personality, culture, and purchasing behavior. Prer., Mk. 320 or consent of instructor.

Mk. 630-3. Multivariable Methods in Marketing. Multivariable methods applicable to basic research in marketing. Includes MANOVA designs, causal models, log-linear models, discriminant function analysis, factor analysis, conjoint analysis. Emphasis on computer applications. Prer., graduate course in regression and ANOVA.

Mk. 640-3. Seminar: Channel Policy and Structure. Analytical study and evaluation of structure and evolution of marketing channels. Relationship of channel policy to business policies is stressed. Cost and effectiveness of alternative distribution policies and practices are considered, and the relationship of channel policy to

physical distribution is studied. Prer., 6 semester hours of marketing courses.

Mk. 650-3. Seminar: Promotional Strategy. Principles, concepts, and problems involved in development and management of advertising, personal selling, and sales promotion program in an individual firm. Qualitative market analysis, social, ethical, and economic evaluation of the role of promotional activities in American economy. Prer., Mk. 350.

Mk. 660-3. Marketing Field Problem. Participants functioning as a research group are presented with opportunity of analyzing and making recommendations regarding a practical marketing problem presented by a cooperating business firm. Special emphasis placed upon developing effective methodology for problem-solving processes in marketing. Prer., Mk. 600.

Mk. 960-variable credit. Independent Study. With the consent of instructor under whose direction the study is undertaken.

Mk. 700-4 to 6. Master's Thesis.

Mk. 710-3. Doctoral Seminar: Marketing Management. Consideration of current problems and issues in marketing from the perspective of the individual firm. Analysis of the adjustment process of the firm in meeting changes in the market and marketing environment. New developments in techniques and procedures analyzed and evaluated. Prer., Mk. 600.

Mk. 720-3. Doctoral Seminar: Marketing Theory. Investigation of development and current state of theoretical and conceptual aspects of marketing principles, institutions, and processes. Course develops an understanding of functioning, measurement, and efficiency of total distribution process. Frontiers of marketing thought will be analyzed and evaluated. Prer., Mk. 710.

Mk. 800-16 to 24. Doctor's Thesis.

MINERALS LAND MANAGEMENT

M.L.Mg. 485-3. Minerals Landman Administration. A general overview of various aspects of land work in the petroleum and mining industries including federal oil and gas leases, federal coal leases, federal governmental leases, state and Indian leases, spacing and pooling, A.A.P.L. 610 operating agreements, federal exploratory units, secondary recovery units, farmout agreements, title curative procedures and instruments, and mineral leases. Prer., M.L.Mg. 495 and completion of 90 semester hours of work toward the major, including all lower division requirements, and M.L.Mg.

M.L.Mg. 495-3. Oil-Gas and Mineral Law. A review and examination of the legal relationships associated with mineral rights and properties. Topics include the mineral estate and the attributes of mineral ownership, conveyances and reservations of interests in the mineral estate—mineral or royalty, transgressions against the mineral estate, the fee oil and gas lease—a review of the legal consequences of typical provisions, and the federal mining law of 1872. Prer., completion of 90 semester hours of work toward the major, including all lower division requirements.

ORGANIZATION MANAGEMENT

Or.Mg. 330-3. Introduction to Management and Organization. An introductory study of management fundamentals and organizational behavior. How individuals adapt to organizations; how managers motivate and lead in work situations; how organizations are designed and managed. Students are urged to complete Psy. 100 and Soc. 211 before taking this course.

Or.Mg. 335-3. Managing Individuals and Work Groups. Examines leadership and supervision in small work groups in organizations. Focuses on how and why individuals act as they do in interpersonal relationships and in small groups. Develops interpersonal and small group skills. Prer., Or.Mg. 330.

Or.Mg. 437-3. Managing Complex Organizations. From the perspective of a general manager, explores organizational design and management processes for effective organizational performance. Prer., Or.Mg. 330.

Or.Mg. 602-3. Individual Behavior in Work Organizations. Explores the impact of key management and behavioral science theories, concepts, and practices on individual productivity, satisfaction, growth, and development. Prer., B.Ad. 640 or equivalent.

Or.Mg. 632-3. The Development of Groups and Organizations. An introductory study of the dynamics involved in managing and facilitating change in groups and organizations by application of behavioral science knowledge. Emphasis is placed on both cognitive and experiential learning. A background in organization theory and administrative behavior is required. Prer., B.Ad. 504 or equivalent.

Or.Mg. 633-3. Consultation Skills. A seminar for doctoral and advanced master's students, oriented toward the theoretical and experiential aspects of organizational entry, contracting, data gathering, and problem diagnosis in an organizational setting. A background in organization theory and administrative behavior and the introductory course in organization development are required. Prer., B.Ad. 504, Or.Mg. 632 or consent of instructor.

Or.Mg. 635-3. Dynamics of Interpersonal Behavior. Application of skills in problem diagnosis, empathy, and communications in group and interpersonal settings. A strong emphasis is placed on clear understanding of human behavior and interpersonal dynamics in a laboratory setting. Prer., B.Ad. 504, Or.Mg. 632, Or.Mg. 633, or consent of instructor.

Or.Mg. 636-3. Organization Design. Design of organization structure and its impact on organizational processes. Analysis of alternative organization patterns and factors affecting organization design. Prer., B.Ad. 640 or equivalent.

Or.Mg. 637-3. Process Consultation. Application of skills in the third party role in analysis and consultation of such processes as communication, decision making, problem solving, functional roles of group members and nonverbal behavior in the organizational setting. Prer., B.Ad. 504, Or.Mg. 632, Or.Mg. 633, or consent of instructor.

Or.Mg. 699-variable credit. Independent Study. With the consent of instructor under whose direction the study is undertaken.

Or.Mg. 700-4 to 6. Master's Thesis.

Or.Mg. 708-3. Seminar and Practicum in Organization Development. A doctoral level seminar emphasizing the intervention theory and method in effectuating organizational change in a client system. The course deals with group development, educational processes, conflict resolution, organizational interventions, change strategies, and the ethical and skill requirements of the consultative role. D.B.A. students. Prer., consent of instructor.

Or.Mg. 709-3. Seminar in Personnel/Human Resources Management. An intensive research-based survey of contemporary issues in personnel-human resources management. Students survey the literature and conduct research in PHR subject areas such as job analysis, job evaluation and compensation, human resource planning, recruitment, personnel selection, training and development, performance appraisal, labor relations, and safety. Prer., consent of instructor.

Or.Mg. 710-3. Seminar in Organization Theory. Critically investigates major issues in organization theory and provides students experience in comprehensively surveying the literature in subject areas such as organization design, structure, technology, environment, size, and strategy. Prer., consent of instructor.

Or.Mg. 800-16 to 24. Doctor's Thesis.

PERSONNEL-HUMAN RESOURCES MANAGEMENT

PHR 434/534-3. Labor and Employee Relations. Analysis of legal, political, social, and managerial aspects of collective bargaining and employee relations. Prer., Or.Mg. 330 or B.Ad. 504.

PHR 438/538-3. Personnel Administration: Employment. Study of development and implementation of personnel systems, with emphasis on job analysis, selection, and performance appraisal. Prer., Q.M. 201 and Or.Mg. 330 or B.Ad. 504.

PHR 439/539-3. Personnel Administration: Legal and Social Issues. Study of legal issues related to equal employment opportunity, affirmative action, occupational safety and health, and compensation,

with emphasis on program implementation and evaluation. Reviews legal questions, guidelines and procedures, and regulatory agencies. It is recommended that students take PHR 434 and 438 before this course. Prer., Or.Mg. 330 or B.Ad. 504.

PHR 441/541-3. Personnel Administration: Planning, Development, and Compensation. Study of human resource planning models, developing human resources, and compensation systems. Includes internal and external equity, budgeting, and analysis of employee benefit systems. Prer., PHR 438/538.

PHR 634-3. Seminar: Labor and Employee Relations. Issues in all areas of industrial, labor, and employee relations. Emphasis on research findings in industrial, labor, and employee relations through applied problems, NLRB and court decisions, arbitration cases, and conflict management models. Prer., PHR 534 or B.Ad. 640.

PHR 638-3. Seminar: Personnel Administration. Issues in all areas of personnel administration. Emphasis on research findings on human resources applications through applied models, survey methods, and other applied behavioral concepts. Prer., PHR 538 or B.Ad. 640.

PRODUCTION AND OPERATIONS MANAGEMENT

Pr.Mg. 300-3. Production and Operations Management. An introduction to the design and analysis of production systems in manufacturing, service, and public organizations. Topics include facility location and layout; job design, safety, and work standards; production and inventory planning and control; quality control; simulation; waiting line analysis; and linear programming. Prer., Acct. 200; open to juniors only.

Pr.Mg. 440/540-3. Production and Inventory Planning and Control. Study of the design, implementation, and control of integrated production and inventory planning and control systems. Topics include demand forecasting, capacity planning and master scheduling, inventory management, material requirements planning, and shop floor controls. Organizations studied include manufacturing, service (including urban services), and government. It is recommended graduate students take Pr.Mg. 640 in lieu of this course. Prer., Pr.Mg. 300 or B.Ad. 502 and 507.

Pr.Mg. 444/544-3. Work Design, Measurement, and Productivity Management. Study of the design of jobs in manufacturing, service, and public organizations. Topics include job specialization versus job enlargement, work measurement, determining job standards, job health and safety, the impact of automation on job design, and productivity measurement and management systems. Prer., Pr.Mg. 300 and Or.Mg. 330 or B.Ad. 504.

Pr.Mg. 447/547-3. Policy Analysis in Production and Operations Management. Study of production and operations management formulation and analysis. Emphasis is on developing decision-making skills through the use of case analysis, field study, consulting with local organizations, and other experiential activities. It is recommended that graduate students take Pr.Mg. 647 in lieu of this course. Prer., Pr.Mg. 440/540.

Pr.Mg. 460/560-3. Purchasing and Materials Management. Study of the purchasing function in manufacturing, service, and public organizations. Topics include source selection, make-buy analysis, inventory control, warehousing, material quality standards and specifications, transportation alternatives, bid systems, and legal aspects.

Pr.Mg. 640-3. Logistics, Production, and Inventory Management. Study of the total flow of resources to and through the production process to the ultimate consumer. Topics include integrated production, inventory, and logistics systems in manufacturing, service, and public organizations; demand forecasting; capacity planning; inventory management; material requirements planning (MRP); facility scheduling and control; and physical distribution management. Prer., B.Ad. 502 and B.Ad. 507 or equivalent.

Pr.Mg. 647-3. Policy Analysis in Production and Operating Systems. Advanced study of policy formulation and analysis in manufacturing, service, and public organizations. Emphasis is placed on developing decision-making skills through the use of case analysis, field study in local private and public organizations, and production/operations-oriented simulation exercises. Prer., B.Ad. 502 and B.Ad. 507, or equivalent.

Pr.Mg. 960-variable credit. Independent Study. With the consent of instructor under whose direction the study is undertaken.

Pr.Mg. 700-4 to 6. Master's Thesis.

PUBLIC AGENCY ADMINISTRATION

The program will encompass the subject areas of budgeting, personnel management, administration, and quantitative methods. For additional information refer to public agency administration area of emphasis.

QUANTITATIVE METHODS

Q.M. 201-3. Business Statistics. Statistical applications in business. Includes descriptive statistics, time series analysis, index numbers, probability and sampling distributions, statistical inference, simple regression, and decision analysis without sampling. Prer., Math. 107, 108, I.S. 200.

Q.M. 300-3. Intermediate Statistics. Intermediate treatment of regression and forecasting models in business and research, statistical quality control in manufacturing processes, sampling and analysis of variance, parametric and non-parametric statistical inferences, decision analysis with sampling. Prer., Q.M. 201.

Q.M. 430/530-3. Business Forecasting. Analysis of fluctuations in business activity, study of responsible factors, diffusion indices, and other forecasting techniques and models. Construction of models for planning and simulation. Prer., Q.M. 201 or B.Ad. 502.

Q.M. 620-3. Multivariate Analysis. Topics in multivariate data analysis of particular interest to those engaged in business research. Includes techniques such as multivariate discriminate analysis, factor analysis, and multiple regression, and the use of standard multivariate statistical packages such as the SPSS package. Prer., B.Ad. 502.

REAL ESTATE

All courses numbered 400 and above may be limited to real estate majors.

R.Es. 300-3. Principles of Real Estate Practice. Activities in the current field of real estate practice. Prer., upper division standing.

R.Es. 401/501-3. Real Estate Development. Methods of analyzing real estate investment opportunities are studied. These methods include urban economic, market and location analyses. Local government controls are studied from the developer's viewpoint. Managerial methods of controlling development are also studied. Prer., R.Es. 300.

R.Es. 430/530-3. Residential and Income Property Appraising. Principles and techniques of estimating the value of land, residences, and income property are studied. Principles and techniques are applied by a field problem in appraising. Prer., R.Es. 300.

R.Es. 433/533-3. Real Estate Investments. Emphasizes problems and methodology for making the real estate investment decision. Includes real estate versus other investments; real estate user and investor requirements; decision models; tax factors and syndication. Prer., R.Es. 300 and Fin. 305 for undergraduates; R.Es. 300 or equivalent and Fin. 305 or equivalent for graduate students, or consent of instructor.

R.Es. 454/554-3. Real Estate Finance. Functions and practices of various real estate financing institutions. Embraces mortgage lending, servicing, and mortgage banking relative to all types and uses of real estate. Prer., R.Es. 300, Fin. 305 or B.Ad. 505.

R.Es. 473/573-3. Legal Aspects of Real Estate Transactions. Business and legal aspects. Estates in land, purchase and sales contracts, conveyances, mortgage and trust deed transactions, property

taxes, landlord and tenant, wills and inheritance. Prer., B.Law 300 and R.Es. 300; or B.Ad. 506 and R.Es. 300.

SMALL BUSINESS MANAGEMENT AND ENTREPRENEURSHIP

B.Ad. 470/570-3. Small Business—Management and Operation. Analysis of managerial problems of the small businessman. Case studies, outside speakers, and individual reports on local small business enterprises supplement class discussions. Student must have an understanding of elementary accounting, finance, and business law, or have experience in small business operation. Prer., senior standing; for 570, graduate standing.

B.Ad. 670-2. Advanced Problems in Small Business Operation. Advanced course. Research studies of conditions that make for success or failure by localities. Prer., B.Ad. 470 or B.Ad. 570.

B.Ad. 960-variable credit. Independent Study. With the consent of instructor under whose direction the study is undertaken.

TRANSPORTATION AND DISTRIBUTION MANAGEMENT

Tr.Mg. 450/550-3. Transportation Operation and Management. Economics of transportation service and rates. History and patterns of regulation. Explanation of various forms in common use in freight and passenger transportation. Introduction to tariffs and their use. Service and management problems of industrial traffic managers. Prer., Econ. 201 and 202 or consent of instructor.

Tr.Mg. 451/551-3. Survey of Transportation Law and Freight Claims Procedures. An analysis of the legal aspects of the transportation systems. Issues include carrier liability, transportation contracts, damages, freight claim preparation, licensing, and practicing before regulatory agencies. Prer., Tr.Mg. 450, 550, or consent of instructor.

Tr.Mg. 452/552-3. Problems in Surface Transportation Management. Analysis of surface modes with emphasis on the motor carrier industry. Topics include carrier operations, regulatory structure, pricing, market structure, design of services, routes and terminals, equipment, and private fleets. Case analyses and field studies will be used to develop decision-making skills. Prer., Tr.Mg. 450/550 or consent of instructor.

Tr.Mg. 456/556-3. Air Transportation. Particular reference to operating costs and methods, passenger and cargo rates, air routes, schedules, safety, regulation, and airport management. Prer., Tr.Mg. 450/550 or consent of instructor, and senior or graduate standing.

Tr.Mg. 457/557-3. Urban Transportation. Analysis of the two aspects of urban transportation—freight and people. Issues in policy, modes, governmental actions and structure, investment and costs, and effect upon urban environment. Prer., Tr.Mg. 450/550 or consent of instructor.

Tr.Mg. 458/558-3. International Transportation. Analysis of international transportation (primarily sea and air) in the world economy. Detailed study of cargo documentation and freight rate patterns. Included are liability patterns, logistics, economics, and national policies of transportation. Prer., Tr.Mg. 450/550 or consent of instructor.

Tr.Mg. 650-3. Seminar: Issues in Transportation Policy and Management. Public policy issues affecting the transport sector including examination of regulation and public promotion of transportation in relation to efficient allocation of national resources, and interests of consumers, investors, and employees. Management issues include decision-making in a deregulated environment, collective bargaining, facilities location, financial planning, and problems/opportunities of intermodal transportation services. Prer., Tr.Mg. 550.

Tr.Mg. 960-variable credit. Independent Study. With consent of instructor under whose direction the study is undertaken.

College of Design and Planning

ENVIRONMENTAL DESIGN DIVISION

Env.D. 100-6. Environmental Design and Communication. An introductory course designed for those intending to major in environmental design. Focuses on the graphic representation of the physical world, specifically of the constructed environment, and on the ability to think graphically as the core of environmental design. The course is based on the philosophy that intervention in the constructed environment is based on the ability to think graphically and nonverbally, i.e., on the ability to represent and manipulate representations of the constructed environment.

Env.D. 105-3. Environmental Design Perspectives. A survey of the principles and concepts of creating the constructed environment: comparison and discussion of the theories of design, including the nature of design problems, issues confronting the designer of future physical environments, a historical review and analysis of the interaction of the design professions, and potential career options and opportunities.

Env.D. 200-6. Environmental Design Studio. Continuation of Env.D. 100 at a more advanced level. Introduction to design determinants through problems which deal with actual cultural, technical, natural, and contextual influences on the built environment; built form and site studies through cycles of analysis, programming, and conceptual design.

Env.D. 215-3. Introduction to Social Science Concepts and Theories. Critical evaluation of built environments at both the building and the urban scale. Considers how social and individual behavior is reflected in and influenced by the built environment.

Env.D. 220-3. Environmental Design Media. Development of graphics skills, emphasizing drawing as a means to design. Includes investigation of drawing types and methods; diagramming of ideas and systems; information, exploratory, and developmental sketching.

Env.D. 235-3. Introduction to Natural Science/Technology in Environmental Design. An introduction to basic NST principles and techniques requisite to an understanding of pertinent natural phenomena and the impacts of modern technology upon the natural and built environments. Lab sessions are used to supplement lectures.

Env.D. 275-3. History and Theory of Environmental Design. Introduction to the history of the cultural landscape with an emphasis on architecture and urbanism, and an introduction to the role of theory in the understanding of past and contemporary environments.

Env.D. 300-6. Advanced Environmental Design Studio. Design studio dealing with problems at an intermediate level of complexity; emphasis is on the interaction of form, use, and multiple values and technologies in conjunction with issues and techniques drawn from other content area courses of the curriculum. Prer., Env.D. 200, 215, 220, 235, and 275.

Env.D. 315-3. Research Issues and Methods in Environmental Design. A continuation of Env.D. 215, this course further develops the student's critical capacity to evaluate environments. Students are introduced to selected methods from the social sciences that can be used in the programming and evaluation of designs. Prer., Env.D. 215.

Env.D. 316-3. Issues in Urban Design. Explores a number of topics of current interest at the community and regional levels. Looks at the development and social consequences of the neighborhood movement, forms of municipal and regional governments, regional settlement patterns, and new communities. Discusses the methods and use of social impact assessment. Prer., Env.D. 215.

Env.D. 320-3. Advanced Environmental Design Media. Continuation of Env.D. 220 with emphasis on advanced presentation techniques and the use of graphics as a problem solving tool. This course is recommended for planners. Prer., Env.D. 200 and 220.

Env.D. 321-3. Advanced Modeling. Structured to introduce the student to the more detailed aspects of simulating space through model building. Each student will be required to build a scale model of an historic landmark building. Prer., Env.D. 200 and 220.

Env.D. 328-3. Graphics of Complex Forms. Exercises in the production of complex forms, i.e., spirals, cycloids, epicycloids, epitrochoids, platonic shadows, straight line curves, etc., leading to graphic solutions as a design tool. Prer., Env.D. 220.

Env.D. 329-3. Photography for Visual Communications. Designed to introduce the student to the technical and practical aspects of making photographic images: the workings of the camera, the lens, principles of depth of field, black and white film processing, printing, and basic darkroom procedures. Lectures will present a survey of historical and philosophical background of photography.

Env.D. 330-4. Introduction to Resource Management and Environmental Design. A survey of current and future impacts of human settlements on natural resources including water, air, wildlife, minerals, and land viewed from regional, national, and global persectives. Lab sessions are used to supplement lectures. Prer., Env.D. 230.

Env.D. 331-4. Introduction to Energy Principles in Environmental Design. An introduction to the physiology of thermal, visual, and acoustical comfort; to basic principles of heat transfer, light, and sound; and to methods of climatic evaluation, site planning, and the technical evaluation of the thermal, luminous, and acoustical character of natural and man-made environments. Lab sessions are used to supplement lectures. Prer., Env.D. 230, Math. 130, Phys. 301, or equivalent.

Env.D. 350-4. Introduction to Site and Building Materials Systems. A survey of methods and materials viewed as means of realizing design intentions at site and building level. Lab sessions are used to supplement lectures. Prer., Env.D. 230.

Env.D. 351-4. Introduction to Structual Systems and Behavior. A survey of basic structural systems and their behavior under the actions of loads and deformations with an introduction to methods of static structural analysis. Lab sessions are used to supplement lectures. Prer., Env.D. 230, Math. 130, Phys. 301, or equivalent.

Env.D. 360-3. Introduction to Computer Methods in Environmental Design. A survey of existing and emerging computer methods used in the environmental design professions with an introduction to computer programming. Prer., Math. 130 or statistics (Phys. 301 or equivalent recommended).

Env.D. 400-6, 401-6. Planning Studio I, II. A preprofessional studio in urban and regional planning. Prer., for Env.D. 400, Env.D. 300; for Env.D. 401, Env.D. 400.

Env.D. 402-6, 403-6. Architecture Studio I, II. A preprofessional studio in architectural design. Prer., for Env.D. 402, Env.D. 300; for Env.D. 403, Env.D. 402.

Env.D. 404-6. Historic Preservation Studio. A preprofessional studio in historic preservation design. Prer., Env.D. 300.

Env.D. 405-6. Urban Design Studio. A preprofessional studio in urban design. Prer., Env.D. 300.

Env.D. 406-6, 407-6. Landscape Architecture Studio I, II. A preprofessional studio in landscape architecture. Prer., for Env.D. 406, Env.D. 300; for Env.D. 407, Env.D. 406..

Env.D. 408-6, 409-6. Interior Design Studio I, II. A preprofessional studio in interior design. Prer., for Env.D. 408, Env.D. 300; for Env.D. 409, Env.D. 408.

Env.D. 410-3. Special Topics: Societal Factors in Planning and Design. Includes such topics as planning and design law, citizen participation in planning and design. See semester course listing for specific topic. Prer., upper division standing.

Env.D. 411-4. Comparative European Environments. A summer field semester seminar in Europe offered in alternate years to inspect new towns, satellite cities, and other forms of human settlement and cities of antiquity. Preference given to students with a planning emphasis. Prer., consent of instructor.

Env.D. 420-3, 421-3. Architectural Graphics I, II. Techniques of graphic communication and presentation for architectural design. Includes development of construction documents, advanced delineation and use of color. Prer., Env.D. 220.

Env.D. 429-3. Advanced Photography for Visual Communications. The structure of this course is thematic, offering the student the opportunity to work at an advanced level with theoretical, contextual, and practical issues. Lectures emphasize problematic concerns in picturing the built/natural environment and the social and political spectrum of the landscape. Students choose a particular issue and work extensively with it to incorporate information and contextual and photographic concerns. Prer., Env.D. 329, or the equivalent training and consent of instructor.

Env.D. 430-3. Environmental Impact Assessment. A field-oriented seminar in current environmental impact controversies. Attention is given to the history, theory, and application of impact analysis at state levels for designers, land-use planners, and others involved in resource decisions. Prer., consent of instructor.

Env.D. 431-3. Solar Technology. Introduces students to aspects of solar technology relevent to the environmental design profession, through readings and lectures on the nature of energy limitations, energy needs, and the potential role of solar energy in meeting these needs. Prer., Phys. 301 or equivalent.

Env.D. 450-3, 451-3. Environmental Systems for Architecture I, II. Fundamental systems considerations of water supply (management and treatment), waste water (treatment and reuse), power supply and consumption, transportation, land use planning.

Env.D. 452-3, 453-3. Architectural Structures I, II. Statics and strength of materials applied to basic structural systems in architecture.

Env.D. 454-3. Building Assemblies and Interfaces. A detailed view of building assembly situations; emphasis on study of systemic aspects of assemblies; design problems at a detailed level with performance criteria and coordination between multiple actors and systems. Prer., Env.D. 350.

Env.D. 455-3. Systems of Building and Fabrication. Deals with current state-of-the-art of systems and fabrication of buildings, locally and overseas. Coverage includes systems building and conventional on-site fabrication. Prer., Env.D. 350 or consent of instructor.

Env.D. 460-3. Computer Applications in Environmental Design. An introductory computer programming course designed to teach the capabilities of a computer, the elements of a programming language, and the development of numerical procedures to solve problems. Problems are selected from building climatology, energy analysis, and solar geometry areas.

Env.D. 461-3. Computer Graphic Applications. An introductory course which teaches the mechanics of entering 2-D images and 3-D objects into the computer. Once entered, they may be interactively rotated in space, walked-through, and repeatedly displayed in perspective from any position. The mechanics of how to use other computer programs that allow additional manipulation of the images and objects will also be covered. Two additional programs will be used the second half of the semester: PERSP and MOVIE.

Env.D. 472-3. History of American Architecture and Urbanism. Survey of American architecture and urbanism.

Env.D. 475/575-3. Special Topics: History and Historiography in Environmental Design. Advanced seminar treating current issues in the history and historiography of environmental design. Open to seniors and graduate students with permission of the instructor.

Env.D. 476/576-3. Special Topics: Theory and Criticism in Environmental Design. Advanced seminar treating issues in theory and criticism in Environmental Design.

Env.D. 510-3. Improving Imaging Ability. An advanced societal course dealing with theories of imagining and methods of improving imaging in the design process.

Env.D. 500-6. Special Honors Studio. See current announcements for the specific content. Prer., any 400-level design studio.

Env.D. 513-3. Imagination and Creativity. A seminar on imagination and creativity in environmental design. Students research some aspect of a topic of interest to them and acceptable to the instructor and prepare a class presentation and research paper on that topic.

Open to advanced undergraduates and graduate students, irrespective of major.

Env.D. 530-3. Special Topics in Natural Resources and Energy. Includes such topics as appropriate technology, practicum in appropriate technology, practicum in solar technology, and public policy and natural hazards.

Env.D. 550-3. Special Topics in Structures and Construction. Includes such topics as the organization of the design/build process and long span and exotic structures.

Env.D. 560-3. Special Topics in Computer Methods. Includes such topics as animation and environmental simulation, computational methods of technical evaluation and optimization, and computational mapping and analysis.

Env.D 570-3. Special Topics in History and Theory. Includes such topics as contemporary design, planning theory, and new approaches to design criticism and evaluation.

Env.D. 920-1 to 6. Independent Study. By special arrangement with instructor.

Arch. 420-6. Architectural Appreciation and Design. Introduction to basic problems and priniciples of architectural design to provide the student with a basis for understanding and evaluating architecture. Open to Arch.E. seniors only.

Arch. 470-3, 471-3. History/Theory I, II. Survey of architecture and urbanism stressing the many factors that influence the formation and transformation of the cultural landscape. Courses focus on developments in the Western world.

School of Education

UNDERGRADUATE TEACHER EDUCATION

Educ. 310-2. Educational Psychology for Elementary School. Psychological bases of teaching and learning with applications at the elementary school level. Concurrent lab experience in schools.

Educ. 311-2. Child Growth and Development. Review of developing physical, mental, social, and emotional characteristics of elementary school children and implications for instructional intervention.

Educ. 400-1. Educational Media Laboratory. An introduction to educational media used in schools, including the production of educational materials and the instructional uses of equipment.

Educ. 401-3. Educational-Social Problems of Mexican/Americans. A study of the educational social problems of the Spanish-speaking in the United States as interpreted through professional literature.

Educ. 402-3/502-3. Development of Educational Measures. See Educ. 502 for description.

Educ. 403-3. Methodology for Bilingual-ESL Education. A survey of current diagnostic and instructional methods and materials being used in bilingual-multicultural and English as a second language programs.

Educ. 410-3. Foundations of American Education. A study of American education in its cultural setting and its nature, role, and function in society, including political, historical, philosophical, sociological, economic, religious, multicultural, and other foundation aspects. Includes school-based tutorial experience.

Educ. 411-3. Educational Psychology and Adolescent Development. Analyzes the fundamental psychological concepts underlying classroom instruction, as well as adolescent growth and development.

Educ. 412-3. Principles and Methods of Secondary Education. Emphasis on objectives, functions, modern philosophy, curriculum, discipline, planning, learning styles, educational media, etc. For junior and senior high school levels. Concurrent experience in schools required. Admission to Teacher Education required.

Educ. 415-2/515-2. Kindergarten Education. The kindergarten movement, characteristics of young children, curriculum, testing, evaluation, and parent-teacher relations.

Educ. 416-2/516-3. Children's Literature. Reading and evaluation of books, children's interests, authors and illustrators, folk literature, multicultural literature, modern fanciful tales, and trends.

Educ. 418-2/518-3. Methods in Elementary Social Studies. Familiarization with the social studies curriculum as it pertains to elementary public schools. Emphasizes organization (lesson plans and units), new trends, textbooks, new programs and materials, and concepts in teaching the social sciences. Required of all students in elementary program. Prer. for student teaching.

Educ. 419-2. Methods in Elementary Reading. Understanding and acquisition of basic methods in the teaching of reading at the elementary school level. Includes teaching basic reading programs, language experience, individualized reading, content reading, study skills, diagnosis, and remediation. Prer., for student teaching.

Educ. 420-2/520-3. Methods in Elementary Mathematics. Preparation in the teaching and content of mathematics at the elementary school level. Required of all students in the elementary program. Prer. for student teaching. Concurrent experience in schools.

Educ. 421-2/521-3. Methods in Elementary Science. Covers the methods and materials available for teaching science in the elementary school. Required of all students in elementary program. Prer. for student teaching.

Educ. 422-2/522-3. Methods in Elementary Language Arts. Creative writing, spelling, language development, handwriting, listening, choral speaking, questioning, nonverbal communication, creative dramatics, and evaluation of language learning. Required of all students in elementary program. Prer. for student teaching. Concurrent experience in schools.

Educ. 423-2/523-3. Teaching Reading in the Content Areas. See Educ. 523 for description.

Educ. 432-2/532-3. Literature for Adolescents. Reading and evaluation of books for junior and senior high school pupils. Emphasis on modern literature.

Educ. 434-3/534-3. Composition for Teachers. Strategies for evaluating and teaching written composition in the secondary schools. Emphasis on structure of prose, invention, motivation, audience, and other rhetorical considerations, as well as on teaching methodologies.

Educ. 435-2/535-3. Methods and Materials in Social Studies. Curriculum, materials, methods, evaluation, and related aspects of instruction. Integration of content and methodology. Secondary level.

Educ. 436-3/536-3. Methods and Materials in English. Curriculum, materials, methods, evaluation, and related aspects of instruction. Integration of content and methodology. Secondary level.

Educ. 437-3/537-3. Methods and Materials in Mathematics. Curriculum, materials, methods, evaluation, and related subjects of instruction. Integration of content and methodology. Secondary level.

Educ. 438-3/538-3. Methods and Materials in Science. Curriculum, materials, methods, evaluation, and related aspects of instruction. Integration of content and methodology. Secondary level.

Educ. 441-3. Teaching Reading and Writing in the Content Areas. Presents diagnostic, remedial, and developmental techniques in reading and composition especially adapted to uses in subject matter areas. Primarily for students preparing to teach in the secondary schools.

Educ. 442-3. Developing Reading Skills in the Secondary School. Format variations from content area to content area, materials, equipment, readability of content materials, vocabulary, variations in comprehension, and variations in study procedures.

Educ. 446-2 to 3. Teaching Exceptional Children in the Regular Classroom. Meets Colorado exceptional child certification require-

ment. Focus on knowledge about exceptional children, attitudes toward human variability, instructional methods, and strategies necessary for meeting the special needs of children in the public schools.

Educ. 460-4. Instructional Assistant Laboratory—Elementary. A variety of experiences and assignments in the public schools.

Educ. 470-4 or 8. Student Teaching—Elementary School. Kindergarten and grades one through six.

Educ. 471-4 or 8. Student Teaching—Secondary School. Student teacher attends a senior or junior high school in Boulder-Denver metropolitan area.

Educ. 472-4. Elective Assignment, Secondary. This is the final experience in the secondary professional year. It involves a wide number of possibilities for the students, and arrangements are made on an individual student basis. Prer., admission to secondary professional year.

Educ. 480-1 to 4. Special Topics. Designed to meet needs of students with topics of pertinent interest.

Educ. 481-1 to 4. Special Topics.

Educ. 482-1 to 4. Workshop in Curricular and Instructional Development. Consideration given to current trends in curriculum development and in organization for instruction. Depth study of one or more specific plans for classroom procedure.

Educ. 483-1 to 4. Instructional Workshop. Current instructional approaches are considered. Focus is upon classroom applications with in-depth study of selected topics. Advanced-level work but credited toward graduate degrees only as a minor.

Educ. 484-1 to 4. Workshop.

Educ. 485-1 to 4. Workshop.

Educ. 940-1 to 6. Independent Study.

EDUCATION

Educ. 500-3. Social Foundations of Education. An evaluation of the social values and forces in American society that shape or influence the aims, philosophies, methods, content, issues, and problems of the American educational enterprise.

Educ. 501-3. Psychological Foundations of Education. A survey of results of psychological inquiry with emphasis on applications to educational practices. Major topics include motivation, behavior, learning, development, and individual differences.

Educ. 502-3/402-3. Development of Educational Measures. The construction, interpretation, and evaluation of achievement tests, attitude measures, questionnaires, and sociometric measures. Item analysis, validity, reliability, and norming considerations. Interpretation and use of standardized intelligence and achievement tests.

Educ. 503-3. Basic Statistical Methods. Introduction to descriptive statistics including graphic presentation of data, measures of central tendency and variability; correlation and prediction; and basic inferential statistics, including the t-test.

Educ. 504-3. Introduction to Disciplined Inquiry. Consideration of various research approaches and methodologies including experimental and quasi-experimental methods; anthropological and case study methods; evaluative research and field studies; correlational and ex post facto research; and sociological, historical, and philosophical research. Topics will include information retrieval and library research, the role of the computer, research criticism, and proposal writing.

Educ. 505-3. Computer Applications to Educational Management. A preliminary course in microcomputer applications in the field of educational leadership. Students should be familiar with basic micro commands and system operation.

Educ. 506-3. Mirrors and Models. Investigation and development of systems for analyzing the teaching-learning process.

Educ. 507-3. Elementary School Curriculum. An integrating course dealing with the history, development, problems, and practices of the curriculum of the elementary school.

Educ. 508-3. Modern Trends in Teaching. Recent developments and trends in philosophy and techniques of teaching.

Educ. 509-3. Junior and Senior High School Curriculum. Principles, trends, problems, and practices in the curriculum of the junior and senior high school.

Educ. 510-3. Curriculum/Program Development. Fundamentals of curriculum and program development, including theoretical foundations of U.S. curriculum, practical criteria to guide decision-making, specific models and processes for curriculum/program development and appraisal, emerging issues, problems and trends.

Educ. 511-3. Advanced Child Growth and Educational Development. Emphasis on developmental theories and educational implications thereof.

Educ. 512-3. Cognitive Processes in Education. A review of the methods and results of the experimental investigation of memory and cognition with implications for instruction and other educational practices. Prer., Educ. 501.

Educ. 513-3. The Student in Higher Education. Consideration of research and theory pertaining to the college student as a learner and the effects of environmental differences on changing behavior of the student.

Educ. 514-3. Supervision of Student Teachers. Designed to develop competency in the supervision of student teachers, including attention to various modern and new approaches. For cooperating teachers as well as supervisors.

Educ. 515-2/415-2. Kindergarten Education. The kindergarten movement, characteristics of young children, curriculum, testing, evaluation, and parent-teacher relations. Graduate: additional work required.

Educ. 516-3/416-2. Children's Literature. Reading and evaluation of books, children's interests, authors and illustrators, folk literature, multicultural literature, modern fanciful tales and trends. Graduate: additional class time and work required.

Educ. 517-2 or 3. Current Literature for Children. Current books and media material in children's literature. For people who have not had a course in this area within the past five years. Prer., course in children's literature or consent of instructor.

Educ. 518-3/418-2. Advanced Social Studies in Elementary School. Review and analysis of current innovations and concept formation in the social studies. Involves student development and implementation of materials for trial in classroom instruction. Graduate: additional class time and work required.

Educ. 519-3. Elementary Mathematics Curriculum. An in-depth study of curriculum building in mathematics at the elementary school level (K-8). Particular attention will be given to selection of instructional materials, establishment of content, and evaluation of programs.

Educ. 520-3/420-2. Contemporary Mathematics for Elementary Schools. Deals with contemporary mathematical content and teaching techniques. More emphasis is placed on mathematical background for the teacher and experimental projects. Prer., Methods in Elementary Mathematics or its equivalent and elementary teaching experience. Graduate: additional class time and work required.

Educ. 521-3/421-2. Advanced Science in Elementary Schools. Emphasis on experimental programs and implementation of these newer programs. Supervision and curriculum development considered. Graduate: additional class time and work required.

Educ. 522-3/422-2. Advanced Language Arts in Elementary School. Current thought, as determined by research findings, in the various areas of the language arts: oral and written communication, spelling, handwriting, usage, grammar, foreign languages, and bilingual education. Graduate: additional class time and work required.

Educ. 523-3/423-3. Teaching Reading in Content Areas. Format variations from content area to content area, materials, equipment, readability of content materials, vocabulary, variations in comprehension, and variations in study procedures. Graduate: additional class time and work required.

Educ. 524-3. Processes Involved in Reading. Concepts needed for understanding and critically evaluating the competencies involved in learning how to read. Examining and dealing with child and adolescent development and linguistic orientation.

Educ. 525-3. Foundations of Reading Instruction K-12. Comparative analysis of current and emerging philosophies, programs in K-12 with focus on teaching reading and thinking skills.

Educ. 526-3. Processes in Writing. Investigates processes writers from early ages to maturity use as they compose prose. Several process models are considered; current research is surveyed; research designs are proposed and evaluated.

Educ. 527-3. Diagnostic and Remedial Techniques of Reading. Causes of low reading ability and techniques employed in teaching the poor reader; diagnosis, motivation, and skills.

Educ. 528-1 or 2. Reading Conference. Visiting authorities in reading, lectures, demonstrations, discussion groups, films, exhibits, field trips, etc.

Educ. 531-3. Proseminar in Reading, English, and Language Arts, K-12. With a different focus each semester, this course may be taken more than once by M.A. students who wish to study various aspects of reading, children's literature, adolescent literature, language skills, and oral and written composition.

Educ. 532-3/432-3. Literature for Adolescents. Reading and evaluation of books for junior and senior high school pupils. Emphasis on modern literature. Graduate: additional work required.

Educ. 533-3. Proseminar in Teaching Written Composition. This advanced-level course provides opportunities for inquiry into processes of written composition. Special topics: rhetoric, style, language, evaluation, assessment, invention, grouping techniques, editing techniques, and individual teaching/learning analysis.

Educ. 534-3/434-3. Composition for Teachers. Strategies for evaluating and teaching written composition in the secondary schools. Emphasis on structure of prose, invention, motivation, audience, and other rhetorical considerations, as well as on teaching methodologies. Graduate: additional work required.

Educ. 535/435-3. Advanced Methods in Social Studies Education. Designed to meet the needs of experienced teachers and of those who will teach in public schools. Recent developments in theory and materials in the social studies examined and present practices analyzed for their contribution to general goals of social studies education. Appropriate for teachers in grades 7-12, but also profitable for elementary teachers with a specialization in social studies. Graduate: additional work required.

Educ. 536-3. Curriculum in Secondary Mathematics. Investigation of curriculum projects in secondary school mathematics, program development, history and trends, program and course objectives, and pertinent research.

Educ. 537-3/437-3. Advanced Methods and Strategies in Secondary Mathematics. In-depth investigation of specific methods and strategies suitable for teaching mathematics from the middle school through senior high school levels. Participants actively involved in the process of instruction by utilizing methods and strategies being considered.

Educ. 538-3/438-3. Advanced Methods and Strategies for Teaching Secondary Science. Studies of methods, techniques, and strategies for teaching science from middle school through high school. Participation and demonstration required. Consideration of desired competencies expected. Evaluation of outcomes. Graduate: additional work required.

Educ. 539-3. Simulation Games for Education. *Alternate years.* An introduction to the use of simulation games as they pertain to social studies instruction in the public schools. Introduction to available simulations and attention to various types of game design. Students required to attempt game design for particular social studies courses.

Educ. 540-3. Special Topics. Designed to meet needs of graduate students with topics of pertinent interest.

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Educ. 543-3. Skill Development in Experiential Education. A field-based course designed to upgrade the outdoor skills and the ability to use alternative living environments for the outdoor educator, the traditional classroom teacher, and the alternative educator. Colorado's mountains, rivers, and urban environment are utilized in the class.

Educ. 544-3. Theory and Practice of Experiential Education. An introduction to the theoretical underpinnings in philosophy, psychology, and the natural and social sciences of the experiential and alternative education movements. Practical applications in schools and public and private agencies are observed and analyzed.

Educ. 545-3. Bilingual and Multicultural Education. Includes various components of bilingual education curricula methodology. It includes various bilingual education models for non-English speaking children as well as provision for the development of fluency in bilingualism among all children.

Educ. 546-3. Materials and Methods in Bilingual/Multicultural Education. A survey of testing instruments used in Spanish-English bilingual/bicultural programs. In-depth investigation of specific methods and materials used in bilingual/bicultural programs.

Educ. 547-3. Curriculum for Multicultural Education. An analysis of curriculum programs and the application of principles and innovation for the education of ethnic-racial students at all levels of school.

Educ. 548-3. The Teaching of Reading in Bilingual and Multicultural Education. Comparative analysis of current and emerging philosophies, programs, materials, and instructional practices for the teaching of reading in the bilingual classroom.

Educ. 549-3. Research and Evaluation in Social and Multicultural Foundations. A course designed to meet the evaluation and research needs of practicing educators, with an emphasis on statistical and naturalistic observational techniques, and designing and constructing evaluation instruments. It is specifically geared to the needs of those working in such nontraditional settings as the bilingual classroom, alternative school, or outdoor educational environment, in addition to the needs of the traditional classroom teacher.

Educ. 551-3. Foundations of Personnel Services. Introduction to the field of guidance and personnel services. Topics include objectives of guidance, counseling, and human services; theoretical bases of counseling, roles and functions of counselors, ethics, and professional issues.

Educ. 552-3. Laboratory in Personal Appraisal. Taken in conjunction with Educ. 551, this course provides the student with experience designed to stimulate self-appraisal vis-à-vis the field of guidance. Focused field experiences will be employed in addition to group interaction and didactic instruction.

Educ. 553-3. Theory and Techniques of Counseling. Theories of counseling and skills needed to facilitate interpersonal relationships. Interviewing techniques and other specific helping relationship skills. Twenty hours of microcounseling in a laboratory required in addition to classroom instruction. Prer., Educ. 551 and 552.

Educ. 554-3. Advanced Theory and Techniques of Counseling. The application of counseling techniques in group counseling. Emphasis on group dynamics and group process. Twenty hours of participation in an intensive group experience required in addition to classroom instruction. Prer., Educ. 551, 552, and 553.

Educ. 555-3. Professional Seminar: Counseling. Provides in-depth attention to a limited number of special interest topics to be determined by the interests of the students and instructor. Prer., completion of Educ. 551, 552, and 553, and either completion or concurrent enrollment in Educ. 554 and instructor consent.

Educ. 556-3. Counseling Strategies in Agency Settings. Explores the role and function of the counselor in agency settings with emphasis on the underlying historical and theoretical concepts. Explores the use of DSM III.

Educ. 557-3. Problem Solving in Logo. Examines Logo's educational and programming principles; addresses teaching Logo to children, adolsecents, and adults; includes turtle geometry, recursive

functions, dynamic models, list processes, and interactive programming. Prer., familiarity with microcomputers.

Educ. 558-3. Introduction to Educational Technology and Instructional Design. Introduces major facets of instructional systems of educational technology and theory, research, and applications of instructional design.

Educ. 559-3. Production of Educational Materials. Focuses on the planning, production, and evaluation of audiovisual materials for use in instructional settings. Instructional graphics, display materials, photographic slides, tape recordings, and overhead transparencies are produced using instructional design concepts.

Educ. 561-3. Videosystems in Education. Provides the opportunity for students to plan, produce, and evaluate a studio and a single camera system (SCS) instructional TV program using instructional development principles. Also examines ways by which television can be used to support instructional systems.

Educ. 562-3. Problems in Instructional Computing I. Investigation into problems encountered in developing and integrating instructional computing in education. Hardware, software, and logistical problems included. Knowledge of BASIC is presumed.

Educ. 563-3. Problems in Instructional Computing II. Continuation of Problems in Instructional Computing I, however, some knowledge of the PASCAL language is presumed.

Educ. 564-3. Computers in Education. Designed to provide educators, preservice and in-service, with literacy in modern educational computing technology. Content will focus upon instructional and administrative computing applications with hands-on experiences stressed.

Educ. 565-3. Survey of Exceptional Children. Types of physically, mentally, and socially handicapped children; methods of diagnosis; suggested educational adjustments; and teaching techniques.

Educ. 566-3. Introduction to the Gifted Student. Assists the teacher in identifying, understanding, and challenging children with unusual abilities.

Educ. 567-3. Teaching Exceptional Children in the Regular Classroom. Develops knowledge about exceptional children and the ways they are served in the public schools; appropriate attitudes toward human variability and individual differences; and appropriate instructional methods and strategies necessary for meeting the special needs of children with visual, auditory, and physical impairments; mental retardation; learning disabilities; emotional disturbance; and giftedness. For graduate students and certified educators.

Educ. 568-3. Education of the Mentally Retarded. Study of characteristics, methods, and materials for teaching mildly and moderately retarded children.

Educ. 569-3. Introduction to Educating Emotionally Disturbed Children. Focuses on developing understandings about children and adolescents with emotional or behavioral disturbances and knowledge of educational approaches developed for these children. Surveys current research, theory, and school practices in the field of emotional disturbances; addresses major issues of identification and treatment. One 2-hr. lab. per wk. requiring observations in various school programs.

Educ. 570-3. Introduction to Learning Disabilities. Survey of current theory and practice in the area of learning disabilities. Emphasis is on developing a systems model for diagnosis, programming, and remediation. One two-hr. lab. per wk. Observation and tutoring required.

Educ. 571-3. Diagnosis and Treatment of Alcoholism. Course work includes current issues in diagnosis of persons abusing alcohol and other drugs as well as consideration of treatment approaches.

Educ. 572-3. Methods for the Emotionally Disturbed Child. Emphasizes developing skills for teaching emotionally or behaviorally disordered children, designing a classroom and curriculum, applying a variety of behavior management and crisis intervention strategies, and using affective materials for socio-emotional behavior change. One 2-hr. lab. per wk. requiring a practicum in a classroom for emotionally disturbed children.

Educ. 573-3. Research and Evaluation in Special Education. One two-hr. lab. per wk. Students critique research and evaluation studies in special education. Prer., consent of instructor.

Educ. 574-3. Diagnostic Testing in Special Education. Preparation for the diagnostic-prescriptive facet of the special educator's role. Includes tests and measurement concepts, demonstration and administration of tests, staffing and the IEP process, major issues, and critical review. Prer., consent of the instructor.

Educ. 575-3. Methods and Materials for the Learning Disabled. Teaching strategies and materials in psychomotor, perception, memory, cognition, language, and academic areas for the learning disabled.

Educ. 576-3. Consulting with Preservice Student Teachers. Working with and supervising preservice education student teachers who are doing case studies with mildly handicapped learners.

Educ. 577-3. International and Comparative Education. A comparative study of education in other countries, with an emphasis on the role of education in developing nations. Political, social, and economic policies and ideologies are analyzed for their relevance to the development process.

Educ. 579-3. Adolescent Psychology for the Teacher. A review of selected topics in adolescent behavior of special concern to educators and parents.

Educ. 580-3. Children's Thinking. The experimental psychology of thinking with emphasis on differences between children and adults in modes of thought. Topics include memory, concept acquisition, strategies, problem solving, and originality. Prer., Educ. 501.

Educ. 581-3. Instructional Psychology. A systematic survey of current theory in instructional design psychology with emphasis on analysis of classroom behavior. Prer., Educ. 501.

Educ. 582-3. Images of the Future. A study of the future: implications for global society, for U.S. society, and for education; dealing with several ways of imagining the future, with value dimensions, with schools and curricula of the future, and with future studies and global studies as school subjects.

Educ. 583-3. Sociological Perspectives of Education. A sociological appraisal of the school in American society with reference to the status, role, activities, and relationships within the school, and of the school to other social institutions.

Educ. 584-3. Proseminar in the Social Foundations of Education. Special studies in the history and philosophy of education, comparative education, educational sociology, and the broad area of education and society. Prer., consent of instructor.

Educ. 585-3. Governance and Administration of Education. Development of governance structures and of administration as a field of study in education. Influence of governance and view of administration on educational organizations' goals, functions, and personnel. Required for Masters and Type D Certification students.

Educ. 586-3. School Law. Recent developments including administrative implications of significant court decisions pertaining to school operations generally. For superintendents, principals, school board members, and prospective administrators.

Educ. 587-3. Individual and Group Behavior in Organizations. Organizational theory and practice for school leadership personnel with emphasis on group development, group problem identification and solutions, and conflict management skills and processes.

Educ. 588-3. School Finance. For advanced students and school superintendents. Problems of educational finance; theory, practice, and control; equalization funds, federal-state-local relations in finance, budgeting, salary schedules, retirement, and school bonds.

Educ. 589-2. Seminar: School Administration. Students develop and analyze case studies using organizational behavior concepts.

Educ. 590-3. Administration of Special Programs. A course designed to meet the needs of persons administering special programs in such areas as bilingual education, experiential/alternative and outdoor institutions, and special education.

Educ. 591-3. Educational Supervision. Stimulation and guiding the in-service professional growth of teachers. Evaluation of teacher ac-

tivities in relation to pupil growth. Supervisory procedures and techniques.

Educ. 592-3. Organization and Administration of Reading Programs. Identifying, selecting, and organizing classroom procedures and materials for general and remedial instruction, K-12.

Note: The five workshop numbers below are designed to provide areas where the unique needs and interests of teachers and educational leaders may be presented. The length of the workshop may vary from one to five weeks.

Educ. 593-1-4. Workshop in Educational Administration, Supervision, and Curriculum.

Educ. 594-1-4. Workshop in Research and Evaluation Methodology.

Educ. 595-1-4. Workshop in Instruction and Curriculum in Content Areas.

Educ. 596-1-4. Workshop in Social, Multicultural, and Bilingual Foundations.

Educ. 597-1-4. Workshop in Educational and Psychological Studies.

Educ. 600-3. Intermediate Statistical Methods. Sampling theory and inferential statistics; advanced applications for the testing of hypotheses regarding central tendency, variability, proportion, correlation, and normality; Chi-square and the analysis of frequency data; multiple regression and prediction; introduction to the analysis of variance; and related computer programs for statistical analysis. Required of all doctoral candidates. Prer., Educ. 503.

Educ. 601-3. Experimental Design and Analysis I. Required of all Ph.D. candidates. Experimental and quasi-experimental designs in educational research; selecting an appropriate statistical test; power and statistical efficiency; randomization and control; multiple comparisons; factorial experiments and interaction with fixed-factor and mixed designs; analysis of covariance; effects of assumption violations; related computer programs for statistical analysis. Prer., Educ. 504 and 600.

Educ. 602-3. Experimental Design and Analysis II. *Offered alternate years.* Intensive study of advanced experimental design and analysis. Topics to include general linear model; fixed, random, and mixed-effects analysis of variance (ANOVA) models; multiple comparisons techniques; ANOVA robustness; analysis of covariance; nested and hierarchical designs. Prer., Educ. 601; some proficiency in matrix algebra and calculus.

Educ. 603-3. Methods of Survey Research and Assessments. Theory and techniques involved in each stage of survey research, including problem formulation, questionnaire development, interview surveys, assessing reliability and validity, sampling plans, data reduction (e.g., factor analysis), and analysis of continuous and categorical data. Prer., Educ. 504 and 600.

Educ. 604-3. Methods of Naturalistic Research. Psychological and philosophical basis of naturalistic inquiry (i.e., ethnography, case study, field work) in educational research. Methods of observation, in-depth interviewing, documentary analysis, data analysis, confirmation and narration. Reading of exemplary works and completion of field work project. Prer., Educ. 504 and 600 and instructor consent.

Educ. 605-3. Psycho-Educational Diagnostics I. Individual appraisal of human abilities; interpretation and application of individual intelligence data in the school setting. Prer., Educ. 503.

Educ. 606-3. Psycho-Educational Diagnostics II. Personal appraisal of the individual with emphasis upon educational application of projective personality data. Prer., consent of instructor.

Educ. 607-3. Test Theory and Application. Reliability and validity theory, empirical estimation of reliability and validity; standardization and norming, item analysis, problems in assessing intelligence, achievement, interest, and personality. Prer., Educ. 504, 600, or consent of instructor.

Educ. 608-3. Educational Evaluation. Study of models and methods for the evaluation of educational programs. Evaluation models proposed by curriculum and instructional researchers are critically examined. Application of methods of measurement and experimentation to evaluation problems is studied. Exemplary evaluation projects are studied in detail. Prer., Educ. 502, 504 or consent of instructor.

Educ. 609-3. Time Series and Multivariate Analysis. *Offered alternate years.* An introduction to the theory of advanced multivariate techniques and their application in educational research. Topics include the analysis of time-series experiments, MANOVA, discriminant function analysis, and multiple regression.

Educ. 610-3. Theory of Measurement and Scaling. *Offered alternate years.* Concentrated study of special problems in the mathematical theory of behavioral measurement and scaling. Topics include generalizability theory, factor analysis applied to test development, unidimensional and multidimensional scaling.

Educ. 612-3. Curriculum of Middle Level School. Stimulation and direction of constructive activities of adolescent early youth. Problems of management, curriculum, school life, guidance, and community relations.

Educ. 614-2. Student Activities Curriculum. Principles, problems, and procedures for improvement of extra-class activities, student councils, home rooms in the secondary school, etc.

Educ. 615-3. Curricular Theories. Intensive study of current theories of public school curriculum related to trends in actual practices in elementary and secondary schools.

Educ. 616-3. Processes and Materials in Curriculum Appraisal. Designed to provide curriculum workers with skills in the process of assessment of curriculum programs and skill in the appraisal of curriculum materials. Includes work in the theory of evaluation, the methodology of evaluation, and practicum in evaluation of curricula. Prer., one course in curriculum.

Educ. 617-4. Teaching Methods—Counselor Education.

Educ. 619-3, 620-3, 621-3. Special Topics. Designed to meet needs of graduate students with topics of pertinent interest.

Educ. 622-3. Research Analysis in Reading, English, and Language Arts. Required of all doctoral candidates. Critical analysis and evaluation of published research studies in reading, English, and language arts; principles of internal and external validity; and preparation of critique abstracts.

Educ. 623-4. Computer-Assisted Instruction. Development of techniques used to provide instruction via computer. Micro-computer instructional applications, computer management of instruction, computer authoring systems for the design of computer-assisted instruction, and the interface between computers and other technologies are emphasized.

Educ. 624-3. Advanced Computer-Assisted Instruction. Focus is on the design of interactive video, interactive slide-tape, micro and mainframe authoring systems, and advanced CAI design techniques. Applications in both educational and training settings are emphasized. Prer., Educ. 623 or equivalent.

Educ. 625-3. Instructional Systems Design I. Systematic design of instruction in traditional settings using a variety of models. Instructional needs assessment, instructional objectives, appropriate tests and assessment procedures, selection of appropriate media, design of systematic instruction, and instructional product evaluation.

Educ. 626-3. Instructional Systems Design II. Focus on the applications of systematic instructional design skills and models to a variety of instructional problems. Emphasis on management, design and development, evaluation, and implementation of instructional products. Prer., Educ. 625.

Educ. 627-3. Instructional Systems Research and Evaluation. Practical experience in conceptualizing, planning, conducting, and writing evaluation and research manuscripts related to instructional design and educational technology. Students pursue and develop an area of research for subsequent exploration during thesis, dissertation, or other research activities.

Educ. 628-3. History and Philosophy of Education. Traces the development of educational theory and practice from ancient times to the present day with an emphasis on contemporary philosophies and trends.

Educ. 629-3. Proseminar: Research in Social and Multicultural Foundations. An analysis of research in the social and multicultural foundations, with an emphasis on bilingual, multicultural, sociological, experiential, and philosophical research.

Educ. 630-3. Teaching Internship in Teacher Education. A one-semester teaching internship in undergraduate or graduate foundations course.

Educ. 631-3. Advanced Practicum in Counseling. Supervised counseling experience, report writing, and case staffing procedures with emphasis on professional staff collaboration.

Educ. 634-2. Problems and Trends in Education. A broad overview of current problems in schools and school systems and consideration of practices and policies in U.S. schools for solution of such problems. Evaluates procedures for solving educational problems.

Educ. 635-2. Elementary Principalship Intensive. *Offered even summers only.* Two-week in-depth examination of the elementary school principalship. Required for Type D administrative certification, elementary school. Consent of instructor required.

Educ. 636-3. Administration and Supervision of the Elementary School. For administrators and teachers. Purposes, practices, and trends in administration and educational leadership.

Educ. 637-3. Administration and Supervision of Senior High School. Current administrative principles and practices essential to effective organization and management, with emphasis on the educational leadership of the principal.

Educ. 638-2. Theory of Educational Administration. Study of organizational models, theories, and communication patterns; leadership roles and behavior; and organizational change. Attention to recent research in administrative theory.

Educ. 639-3. Supervision of Reading Clinic K-12. Planning and supervising clinical procedures and course tutoring functions among college students. Case study preparation and evaluation report writing included.

Educ. 640-3. School Business Management. Study and experience in the management of a school. Includes instruction in planning, budgeting, evaluation, and management.

Educ. 641-3. Educational Facilities Planning. *Alternate years.* Determination of school plant needs; relation of educational and architectural services; criteria of adequate school plants, site development, building operation and management; financial problems.

Educ. 642-3. Personnel Management. Management of human resources in educational organizations. Deals with shared roles between site and central administration. Major topics include selection, staffing, evaluation, development, and collective bargaining in education.

Educ. 643-3. School-Community Relations. Examines interactions of schools and their communities: citizen role/involvement in governance of education, internal and external communication concepts and practices, politics of education, and community power and pressure groups.

Educ. 647-3. Marriage and Family Counseling. Designed for students with counseling training and experience interested in acquiring a specialized body of knowledge and skills concerning marital and family therapy.

Educ. 649-3. Organization Development in Schools. Organization development in theory and practice with special attention to organization development in schools. Requires organization development project for course completion.

Educ. 650-3. Career Development. Provides students with competencies in career development and career counseling. Topics include theories of career development, information systems, decision making, and awareness of self and the world of work.

Educ. 651-3. Measurement and Appraisal. Basic fundamentals of tests and measurement and their interpretation. Topics include standardization, correlation, reliability, validity, norms, scoring, standard error of measurement, restriction of range, and use of test data in counseling.

Educ. 653-3. Proseminar in Research in Instruction and Curriculum. Weekly discussion of current research.

Educ. 654-3. Research Seminar for Doctoral Candidates. The development of the thesis prospectus, including problem development, hypothesis formulation, literature review, research design, statistical analysis, related measurement, and computer considerations. Prer., Educ. 600 and instructor consent.

Educ. 655-3. Seminar: Research Methodology. Selected topics for advanced study in educational research, statistics, measurement, and evaluation. Prer., Educ. 601.

Educ. 656-3. Administration and Supervision of the Junior High School/Middle School. Purposes, practices, and trends in administration of the middle level school. Current administrative principles and practices essential to effective organization and management. Emphasis is on leadership of the principal of the middle level school.

Educ. 661-3. ProSeminar: Educational Technology. Course focus rotates among issues in instructional computing, problems in training, dealing with individual differences in instructional design and training, and other timely topics and issues of importance in instructional technology.

Educ. 662-3. Seminar: Educational Technology. Designed as an intensive, advanced level course in the study of the many facets of educational technology. Permits students opportunities for individual, in-depth study in areas of individual interest.

Educ. 663-2. Seminar: Junior and Senior High School Education. For advanced students. Problems, theories, and trends in secondary education. Includes field work and individual projects.

Note: Prerequisite for enrollment in Educ. 667, 668, 669, 670, 671, and 672 is admission to a doctoral program in the School of Education.

Educ. 667-3. Seminar: Counseling. Specific topics will depend on needs and interests of students in any particular class.

Educ. 668-3. Seminar: Advanced Counseling Theory. Comparative evaluation of differing theoretical systems and constructs relevant to counseling application.

Educ. 669-3. Seminar: Counseling Research. In-depth study and analysis of published research in counseling.

Educ. 670-3. Seminar: Group Counseling. The implications of small group and psychotherapy theory and research are considered in regards to group counseling.

Educ. 671-3. Seminar: Leadership Skills and Human Behavior. An advanced course for doctoral students preparing for teaching, consulting, and leadership roles in counseling and the facilitation of behavior change.

Educ. 672-3. Seminar: Human Behavior. Explores the cognitive, affective, and psychomotor aspects of human behavior. It will emphasize both causation and the consequences of various modes of human behavior.

Educ. 673-3. Seminar: Instructional Psychology. Intensive study of small sample research designs and analysis of selected topics in instructional psychology. Prer., Educ. 581 and consent of instructor.

Educ. 674-3. Seminar: Human Learning. A limited number of currently active topics in cognitive psychology are reviewed in depth to reveal unresolved research problems. Each participant is responsible for presenting a research proposal and for being an informed critic of presentations of others.

Educ. 675-3. Seminar: Human Development. Intensive study of selected topics in growth and development, with applications to educational situations. Prer., Educ. 511 and consent of instructor.

Educ. 676-3. Seminar: Special Education. Examination of issues in consultation, working with parents, interdisciplinary cooperation, program design and managment in relationship to practicum experiences with educationally handicapped children.

Educ. 678-3. Seminar: School Psychology. Selected topics in the field of school psychology including consideration of current practice and literature. Prer., consent of instructor.

Educ. 679-3. Research Seminar: Educational Psychology. Intensive review of special topics in the application of psychological science to educational practice. Prer., Educ. 501.

Educ. 680-3. Research Seminar: Curriculum, Administration and Supervision. A required seminar in educational research for all Ed.D. and Ph.D. students in curriculum, administration, and supervision. The seminar focuses on doctoral research study in these areas of educational research.

Educ. 681-3. Advanced Seminar: School Law. An in-depth examination of the American legal process as it pertains to administration, planning, and delivery of educational programs. Involves self-selected research followed by individual or group presentations.

Educ. 682-2. Doctoral Seminar: Curriculum. Advanced course relating to theory and practice in curriculum building. Includes both elementary and secondary levels.

Educ. 684-2. Seminar: Educational Supervision. Students work on individual topics and report orally and in writing.

Educ. 685-2. Seminar: Educational Leadership. Seminar dealing with processes and patterns of educational leadership in the schools. Graduate students from various specialties interact with faculty members in preparing for leadership roles. May be taken more than one semester for credit with advisor's approval.

Educ. 700-4. Master's Thesis.

Educ. 701-2. Master of Education Report.

Educ. 750-1 to 4. Readings in Administration, Supervision, and Curriculum.

Educ. 751-1 to 4. Readings in Research and Evaluation Methodology.

Educ. 752-1 to 4. Readings in Instruction and Curriculum in Content Areas.

Educ. 753-1 to 4. Readings in Social, Multicultural, and Bilingual Foundations.

Educ. 754-1 to 4. Readings in Educational and Psychological Studies.

Educ. 755-1 to 4. Practicum in Administration, Supervision, and Curriculum.

Educ. 756-1 to 4. Practicum in Research and Evaluation Methodology.

Educ. 757-1 to 4. Practicum in Instruction and Curriculum in Content Areas.

Educ. 758-1 to 4. Practicum in Social, Multicultural, and Bilingual Foundations.

Educ. 759-1 to 4. Practicum in Educational and Psychological Studies.

Educ. 760-1 to 4. Educ. 761-1 to 4. Practicum I and II: The Educationally Handicapped. Supervised field experiences with learning-disordered children (emotionally disturbed and/or learning disabled). Full time for eight weeks, minimum 320 clock hours. Prer., consent of instructor.

Note: Prerequisite for enrollment in Educ. 762, 763, and 764 is the completion of Educ. 551, 552, and 553 and either completion or concurrent enrollment in Educ. 554 and instructor consent.

Educ. 762-3. Field Work in Guidance. Primary emphasis is directed observational experience in various counseling and personnel service settings. The experiences will help students familiarize themselves with the counseling techniques used in these settings. Ten hours in field setting in addition to class sessions.

Educ. 763-3. Field Work in Agency Counseling. Directed observational experience in a variety of agency counseling settings, including rehabilitation agencies, employment services, mental health clinics, etc. Helps students familiarize themselves with the techniques used in agencies. Ten hours in field setting in addition to class sessions.

Educ. 764-3. Field Work in College Student Personnel. Orientation experiences in each of several student personnel services including financial aid, admissions, career development and placement, and veterans' advising. Ten hours in field setting in addition to class sessions.

Educ. 765-4, 766-4. Reading Clinic Procedures I, II. Supervised diagnosis of reading problems; evaluation instruments; pertinent research; case study approach. Prer., Educ. 527 or consent of instructor.

Educ. 785-6. Practicum in Secondary Guidance. Provides in-depth practical experience in counseling in secondary schools. Prer. or coreq., Educ. 649, 650, and 651.

Educ. 786-6. Practicum in Agency Counseling. In-depth, supervised practical experience in counseling in agency settings. Prer. or coreq., Educ. 649, 650, and 651.

Educ. 787-6. Practicum in College Student Personnel. Supervised practice in college student personnel work. Prer. or coreq., Educ. 649, 650, and 651.

Educ. 800-1 to 10. Doctor's Thesis.

Educ. 801-1 to 10. Doctor of Education Dissertation.

Educ. 950-1 to 4. Independent Study.

Educ. 951-1 to 4. Independent Study in Administration, Supervision, and Curriculum—Master's.

Educ. 952-1 to 4. Independent Study in Instruction and Curriculum in Content Areas—Master's.

Educ. 953-1 to 4. Independent Study in Social, Multicultural, and Bilingual Foundations—Master's.

Educ. 954-1 to 4. Independent Study in Educational and Psychological Studies—Master's.

Educ. 960-1 to 4. Independent Study.

Educ. 961-1 to 4. Independent Study in Administration, Supervision, and Curriculum—Doctor's.

Educ. 962-1 to 4. Independent Study in Research and Evaluation Methodology—Doctor's.

Educ. 963-1 to 4. Independent Study in Instruction and Curriculum in Content Areas—Doctor's.

Educ. 964-1 to 4. Independent Study in Social, Multicultural, and Bilingual Foundations—Doctor's.

Educ. 965-1 to 4. Independent Study in Educational and Psychological Studies—Doctor's.

Permission of instructor required on all internships.

Educ. 980-1 to 6. Internship in Administration and Supervision.

Educ. 981-1 to 6. Internship in Research and Evaluation Methodology.

Educ. 982-1 to 6. Internship in Instruction and Curriculum in Content Areas.

Educ. 983-1 to 6. Internship in Social, Multicultural, and Bilingual Foundations.

Educ. 984-1 to 6. Internship in Educational and Psychological Studies.

Educ. 985-1 to 6. Internship in Curriculum.

Educ. 999-0. Candidate for Degree.

College of Engineering and Applied Science

AEROSPACE ENGINEERING SCIENCES

Note: Courses not having a semester designated may be offered in alternate years.

Aero. 130-3. Introduction to Science of Flight. Science of flight, its history and fundamental engineering concepts. Basic understanding of lift and drag, airfoils, and aerodynamic shapes. Elements of aircraft performance, stability, and control.

Aero. 132-2. Introduction to Space Science. *Spring.* An introduction to space science including Earth, the moon, and the solar system. Orbits and trajectories, launch systems, satellites. Engineering aspects of mankind's exploration of space.

Aero. 151-1. Freshman Aero Laboratory. *Fall.* Laboratory designed to accompany Aero. 130. Introduction to aerodynamic, fluid mechanic, and aircraft design research efforts. Review of current research topics in aerospace engineering. Introduction to basic instrumentation and measurement methodologies. Introduction to technical writing.

Aero. 195-1 to 3. Special Topics. Specialized aspects of the aerospace engineering sciences or innovative treatment of required subject matter at the lower division level. Course content will be indicated in *Schedule of Courses* and on the transcripts of those taking the course. Prer., variable.

Aero. 203-3. Mechanics I. (M.E. 281.) Elements of vector algebra, abstract statics of a system of bound vectors, equilibrium of rigid bodies, dynamics of a particle. Prer., sophomore standing.

Aero. 204-3. Mechanics II. (M.E. 282.) Kinematics of rigid bodies, principle of virtual work, kinetics of a system of particles. Prer., Aero. 203.

Aero. 222-3. Materials Science and Engineering. *Spring.* Applications of the principles of physics, chemistry, and thermodynamics to the understanding of the relationships between atomic structures, engineering processes, and engineering properties of materials and to the selection and design of engineering materials. Prer., Chem. 103 or equivalent.

Aero. 232-4. Thermodynamics and Heat Transfer. *Fall, Spring.* Introduction to energy and its transformation from a macroscopic approach. First and second laws of thermodynamics, entropy, cycles, psychrometrics, heat transfer, and applications. Prer., A.Math. 235 and Phys. 112; coreq. A.Math. 236.

Aero. 295 to 299-1 to 3. Special Topics. Specialized aspects of the aerospace engineering sciences or innovative treatment of required subject matter at the lower division level. Course content will be indicated in *Schedule of Courses* and on the transcripts of those taking the course. Prer., variable.

Aero. 303-3. Aerospace Dynamics. *Fall.* Applications of the principles of Newtonian and Lagrangian dynamics to basic aerospace vehicle motions. Prer., Aero. 204, A.Math. 236.

Aero. 311-3. Fluid Dynamics I. *Fall.* Elementary theoretical approach to the problems of fluid mechanics. Includes statics theorem, stream function, velocity potential, and the Laplace equation. Prer., A.Math. 236 and Aero. 204.

Aero. 312-3. Fluid Dynamics II. *Spring.* Dynamics of compressible flow; expansion and shock waves; airfoils and wings at subsonic, transonic, and supersonic speeds; dynamics of viscous fluids; laminar and turbulent boundary layers. Prer., Aero. 311.

Aero. 323-3. Structures I. *Fall.* Basic methods of stress and deformation analysis of simple elements of flight structures. Prer., Aero. 203, A.Math. 236.

Aero. 324-3. Structures II. *Spring.* Stress and deformation analysis of flight structures. Prer., Aero. 323.

Aero. 341-3. Systems Analysis I. (M.E. 371.) Representation of mechanical and electrical lumped parameter elements and systems, steady-state sinusoidal analysis, integral transform theory. Prer., junior standing.

Aero. 342-3. Systems Analysis II. (M.E. 372.) Mathematical theory of control with application to mechanical, electrical, and hydraulic systems; modeling; feedback design; specifications; stability tests; root locus methods; and frequency response. Prer., Aero. 341 or M.E. 371.

Aero. 352-3. Flight Mechanics. *Spring.* Airfoil design, performance of propeller-driven and jet-driven aircraft, static stability and control, design trade-offs of stability and control, maneuvering flight. Prer., Aero. 311; coreq., Aero. 312.

Aero. 363-3. Introduction to Acoustics and Noise. (Arch.E. 363.) Engineering and physiological foundations of acoustics. Individual and social response to sound. Environmental noise problems. Engineering and legal control of noise. Prer., junior standing or consent of instructor.

Aero. 380-3. Bioengineering I. *Spring.* Human response to environment and physical stimuli. Use of engineering and physical principles in the study of human dynamics. Prer., MCDB 106, Phys. 213, and Aero. 232, or consent of instructor.

Aero. 395 to 399-1 to 3. Special Topics. Specialized aspects of the aerospace engineering sciences or innovative treatment of required subject matter at the upper class level. Course content will be indicated in *Schedule of Courses* and on the transcripts of those taking the course. Prer., variable.

Aero. 400-1 to 6. Independent Study.

Aero. 406-3. Introduction to Space Dynamics. *Fall.* Central force fields and satellite orbits. Orbital transfer problems. Rigid body dynamics of space vehicles. Prer., Aero. 303.

Aero. 413-3. Foundations of Propulsion. *Fall.* The aerothermodynamics of air-breathing engines including ram jets, turbo jets, turbo fans and turbo prop engines. Prer., Aero. 232 and 312.

Aero. 417-2. Aerospace Laboratory I. *Fall.* One lab. and one rec. per wk. Fundamental measurements in experimental study of aeronautics and astronautics. Prer., Aero. 222, 303, 312, and 323.

Aero. 422-2. Aerospace Laboratory II. *Spring.* One lab. and one rec. per wk. Fundamental measurements in experimental study of aeronautics and astronautics, including technical report writing. Prer., Aero. 342 and 413.

Aero. 430-3. Nuclear Energy Systems. (M.E. 450.) Foundations of nuclear energy systems; review of reactor theory; design and operation; nuclear electric power plants; systems for nuclear auxiliary power; analysis of nuclear energy systems for various applications. Prer., senior standing.

Aero. 447-3. Computational Fluid Mechanics. *Fall.* Numerical solution of fluid mechanics problems involving ordinary and partial differential equations of various types. Prer., C.S. 110 or consent of instructor.

Aero. 456-3. Aircraft Design. *Fall.* One rec. and two lab. per wk. Principles of aircraft layout to meet a given specification, taking account of both aerodynamic and structural considerations. Design of major elements of an aircraft. Coreq., Aero. 403 and 413.

Aero. 460-0. Senior Seminar. *Fall.* Discussion of problems an engineer will face in selecting a job and what is expected of him by his employer. Prer., senior standing.

Aero. 461-1 to 3. Undergraduate Research. *Fall.* Assignment of a research problem on an individual basis.

Aero. 462-1 to 3. Undergraduate Research. *Spring.* Assignment of a research problem on an individual basis.

Aero. 495-1 to 3. Special Topics. Specialized aspects of the aerospace engineering sciences or innovative treatment of required subject matter at the upper class level. Course content will be indicated in *Schedule of Courses* and on the transcripts of those taking the course. Prer., variable.

Aero. 500-1 to 6. Independent Study. Study of special projects.

Aero. 501-3. Atmospheric Entry. Atmospheric effects on satellites; atmospheric entry from orbit using several classical theories; the entry corridor; orbit contraction due to atmospheric drag; flight path control during and after entry. Prer., Aero. 403 and 406 or 505 or consent of instructor.

Aero. 505-3. Space Flight Dynamics. Celestial mechanics, space navigation, orbit determination; trajectory design and mission analysis trajectory requirements; orbital transfer and rendezvous. Prer., Aero. 406 or consent of instructor.

Aero. 511-3. Ideal Fluids. Applicability of ideal flow theory, equations of motion, potential flow, circulation and vorticity, axially symmetric flow, review of complex variables and potential theory, conformed mappings, airfoil theory, stratified fluids, and gravity wave mechanics. Prer., Aero. 312.

Aero. 512-3. Viscous Flow. (M.E. 534.) Low Reynolds number flows, incompressible and compressible laminar boundary layer theory; similarity theory; separation, transition, and turbulent boundary layers. Prer., Aero. 517 or equivalent, or consent of instructor.

Aero 513-3. Compressible Fluids. Dynamics of nonviscous, compressible, subsonic, and supersonic fluid flow; theory of characterhistics, shock waves; slender body and wing theory. Prer., Aero. 413.

Aero. 514-3. Introduction to Turbulence. Physical properties of turbulence, shearflows, heat transfer, homogeneous turbulence, diffusion and turbulence in compressible and electrically conducting fluids. Prer., Aero. 517 or equivalent and consent of instructor.

Aero. 517-3. Macroscopic Physics of Fluids. (M.E. 532.) Physical properties of gases and liquids; kinematics of flow fields; equations describing viscous, heat conducting Newtonian fluids. Exact solutions and rational approximations for low and high speed dissipative flows, surface and internal waves, acoustics, stability, and potential flows. Coreq., M.E. 521, M.E. 575, or equivalent.

Aero. 518-3. Microscopic Physics of Fluids. Physics of particles, physics of uniform fluids, kinetic description of fluids; transport phenomena, radiation transport. Prer., Aero. 413 or consent of instructor.

Aero. 525-3. Air Pollution. Effect of air pollution on materials, plants, animals, humans, and ecological changes. Sources of air pollution. Chemistry, diffusion, and dispersal of pollutants. Prer., graduate standing or consent of instructor.

Aero. 527-3. Noise Pollution and Abatement. Advanced course in the basic physics and physiology of sound. Study of determinants of sound leading to noise. Identification of noise sources and characterization of the detrimental physiological effects of such noise. Promotion of principles governing noise control and the application of such controls. Prer., Aero. 363 or Arch.E. 363 or consent of instructor.

Aero. 535-3. Advanced Propulsion. Chemical combustion calculations for multicomponent gases and application to air-breathing and rocket propulsion systems; performance criteria and scaling laws; introduction to chemical reaction rates; combustion instability and nozzle heat transfer; ion propulsion and MHD generators. Prer., Aero. 413 or consent of instructor.

Aero. 541-3. Linear Control Design—Systems Analysis III. A continuation of Aero. 342. The design of linear systems, using frequency methods, other methods of design, and introduction to sampled data systems. Prer., Aero. 342.

Aero. 542-3. Optimal Control Design—Systems Analysis IV. A continuation of Aero. 541. Introduction to nonlinear systems; generalized Lagrangian mechanics; Liapunov methods, calculus of variations; Pontryagin methods, and general optimal control; Hamilton-Jacobi optimization, Kalman equation. Prer., Aero. 541.

Aero. 547-3. Computational Fluid Mechanics. (Similar to Aero. 447 but involves term project.) Numerical solution of fluid mechanics problems involving ordinary and partial differential equations of various types. Prer., C.S. 115 and Aero. 312 or consent of instructor.

Aero. 548-3. Advanced Computational Fluid Mechanics. Continuation of Aero. 447/547. Advanced computational methods are introduced for solving fluid mechanics problems on the computer, with emphasis on nonlinear flow phenomena. Prer., Aero. 447/547 or consent of instructor.

Aero. 553-3. Experimental Space Science. *Fall.* Design of instruments to achieve scientific objectives in a space environment, including mechanical and electrical design, fabrication, test, and calibration. Examination of past and future NASA missions - spacecraft, subsystems, and experiment payloads.

Aero. 556-3. Spacecraft Design. A systems approach to the design of an unmanned spacecraft, including guest lectures from specialists in each of the disciplines which make up a spacecraft design team. Topics include mission design, payload, launch systems, tracking and data systems, communications, structures, guidance and control. Prer., Aero. 505 or consent of instructor.

Aero. 565-3. Introduction to Magnetohydrodynamics. Electromagnetism, equations of motion, magnetostatics, wave motion, exact solutions, instability, dynamo theories, and solutions of linearized equations. Prer., graduate standing or consent of instructor.

Aero. 566-3. Plasma Dynamics and Plasma Physics. Plasma kinetic theory, including charged particle and neutral collisions, ionization, electronic excitation and recombination; motion of charged particles, macroscopic equations; transport coefficients, gas discharge, instabilities, shock waves; low conductivity flow, sheaths and oscillations, electromagnetic waves and radiation, man-made applications and natural phenomena. Prer., graduate standing or consent of instructor.

Aero. 572-3. The Sun. (APAS 533.) Physical processes of the sun, including the interior, photosphere, chromosphere, and corona. Topics covered include properties of the electromagnetic spectrum (X-ray, UV, visible and radio wave-length), magnetic fields, velocity fields, and flare phenomena and interpretation. Prer., graduate standing or consent of instructor.

Aero. 573-3. Introduction to Magnetospheres. (APAS 530.) Introduction to solar and stellar winds, planetary and stellar magnetospheres. Guiding center theory for particle motion, magnetospheric topology, convection, radiation belts, magnetic storms and substorms, auroras. Prer., graduate standing or consent of instructor.

Aero. 578-3. Oceanography. Fundamentals of biological, physical, and dynamic oceanography. Influence of the sea on worldwide weather and ecology. Prer., Aero. 312 or consent of instructor.

Aero. 581-3. Bioengineering II—Neurophysiology. *Fall.* Review of the organization and cell morphology of nervous tissue; electrical and physiological properties of cell membranes; intracellular recordings from single nerve cells; transmission at synapses; muscle contraction; receptor mechanisms; the human nervous system; central and autonomic systems. Prer., Aero. 380.

Aero. 582-3. Neural Control Systems. *Spring.* Survey course dealing with behavioral, neurophysiological, and biochemical controls manifested by the central nervous system. Biological background material prerequisite to application of formal control theory. Prer., Aero. 380 or consent of instructor.

Aero. 583-3. Membrane Transport: Biological and Artificial. *Fall.* The dynamics of membranes in regulating the chemical environment of biological systems, energy use associated with biological membranes, transport characteristics of organic and inorganic substances, theoretical and physical membrane models, and integration of membrane transport with other biological functions. Prer., Aero. 380 or consent of instructor.

Aero. 584-3. Neural Modeling. *Fall.* An integrated introductory survey of physical theories of bioelectric processes, and of models of the electrical operations of nervous systems. The physical basis of neurological signals and information processing in neurons and neural networks are discussed. Prer., consent of instructor or senior standing.

Aero. 585-3. Mammalian Neuroanatomy. (Psych. 608.) Covers the structure of the mammalian CNS with respect to functional organization and emphasis on synaptology. Includes description of neuroanatomical and neurohistological techniques and an introduction to CNS ultrastructure with demonstration of electron micrographs. Prer., Psych. 405 or Aero. 583, or consent of instructor.

Aero. 591-1. Seminar. *Fall.* Required of all aerospace engineering sciences graduate students. Provides reports on research activities and special current topics. Prer., graduate standing.

Aero. 592-1. Seminar. *Spring.* Required of all aerospace engineering sciences graduate students. Provides reports on research activities and special current topics. Prer., graduate standing.

Aero. 595-599-0 to 3. Selected Topics in Aerospace Engineering Sciences. Treatment of specialized aspects of the aerospace engineering sciences by staff or visiting lecturers. Course content will be indicated in *Schedule of Courses* and on transcripts of those taking the course. Prer., variable.

Aero. 600-1 to 6. Independent Study. Study of special projects agreed upon by student and instructor.

Aero. 606-3. Advanced Space Flight Dynamics. Continuation of Aero. 505. Topics include perturbations of orbital motion due to asphericity of gravitational field, third bodies, solar radiation pressures, and atmospheric drag; classical orbit determination from angles-only observation; modern orbit determination using range and range-rate data; orbit transfer using impulses or continuous thrust; others to be chosen. Prer., Aero. 505 or consent of instructor.

Aero. 609-3. Mathematical Theory of Hydrodynamic Stability. Mathematical and physical study of laminar flow instability. Topics include derivation of general disturbance equation, study of linear disturbance equations for curved and parallel viscid and inviscid flows, and nonlinear theory. Prer., Math. 431 and Aero. 512 or consent of instructor.

Aero. 613-3. Advanced Compressible Flow. Advanced topics in dynamics and thermodynamics of compressible fluid flow. Prer., Aero. 513.

Aero. 695-699-0 to 3. Selected Topics in Aerospace Engineering Sciences. Treatment of specialized aspects of the aerospace engineering sciences by staff or visiting lecturers. Course content will be indicated in *Schedule of Courses* and on transcripts of those taking the course. Prer., variable.

Aero. 700-variable credit. Master's Thesis.

Aero. 800-0 to 8 (16 to 24 maximum). Doctor's Thesis.

The following courses, now inactive, may be offered on demand: Aero. 408 (Aerodynamic Heating), Aero. 458 (Spacecraft Design), Aero. 521 (Aeroelasticity), Aero. 522 (Advanced Aerospace Materials), Aero. 544 (Optimal Control), Aero. 545 (Advanced Linear Control Systems), Aero. 546 (Theory of Automata), Aero. 549 (Numerical and Simulation Techniques Applicable to Guidance and Control System Design), Aero. 563 (Stochastic Processes), Aero. 576 (Atmospheric Turbulence), Aero. 586 (Selected Topics in Macromolecular Biophysics), Aero. 608 (Optimal Trajectories in Space Flight), Aero. 611 (Plasma Spectroscopy), Aero. 614 (Hypersonic Aerodynamics), Aero. 616 (Quantum Fluid Dynamics), Aero. 617/M.E. 514 (Statistical Thermodynamics), Aero. 618 (Dynamics of Real Gases), Aero. 621/622 (Structural Thermomechanics I, II), Aero. 632 (Aeronautical Heat Transfer), Aero. 641 (Guidance Systems), Aero. 644 (Advanced Nonlinear Stability Theory), and Aero. 674 (Cosmic Gasdynamics).

Special topics which have been offered in the past include Aero. 295-299 (Engineering Science as Natural Philosophy, Implications of Rapid Transportation and Communication, Computing in Engineering, Aerospace Computer Applications), Aero. 595-599, and 695-699 (Advanced Bioengineering Seminar, Advanced Mechanics, Advanced Thermodynamics, Aircraft Dynamics and Stability, The Boltzmann Equation, Cosmic Plasma Dynamics, General Theory of Relativity, Graduate Experimental Techniques, Kinetic Theory of Gases, Musical Acoustics, Mathematical Methods in Engineering Problems, Quantum Statistical Mechanics, Superfluid Dynamics, Turbine Aerothermodynamics).

APPLIED MATHEMATICS

A.Math. 135-4. Calculus for Engineers 1. Selected topics in analytical geometry and calculus. Rates of change of functions, limits, derivatives of algebraic functions, applications of derivatives, and integration and applications of the definite integral. Prer., two years of high school algebra, one year of geometry, one-half year of trigonometry, and satisfactory math index on green engineering card, or *C* or better in Math. 110.

A.Math. 136-4. Calculus for Engineers 2. Continuation of A.Math. 135. Transcendental functions, methods of integration, plane analytic geometry, polar coordinates, vectors, and parametric equations. Prer., Calculus 1.

A.Math. 137-4. Honors Calculus for Engineers 1. Differential and integral calculus. Theory of limits, continuity, derivatives, and integral. Analysis of standard functions through hyperbolic and gamma functions, techniques in integration. Application to physics and geometry. Prer., two years of high school algebra, one year of geometry, one-half year of trigonometry, one year of calculus, and recommendations by the Office of the Dean of Engineering.

A.Math. 138-4. Honors Calculus for Engineers 2. Continuation of A.Math. 137. Differential equations; plane and solid analytic geometry; Newtonian dynamics; Taylor's series. Prer., A.Math. 137.

A.Math. 235-4. Calculus for Engineers 3. Continuation of A.Math 136. Completion of required work in the differential and integral calculus. Solid analytic geometry. Vector functions and derivatives, partial differentiation, multiple integrals, infinite series. Prer., Calculus 2.

A.Math. 236-3. Introduction to Linear Algebra and Differential Equations. Vector spaces, matrices, determinants, systems of linear equations. Introduction to differential equations. (No credit to students having previous credit in both Math. 313 and Math. 443.) Students with credit in A.Math. 236 may not receive credit in A.Math. 238. Prer., Calculus 3.

A.Math. 237-4. Honors Calculus for Engineers 3. Multivariable calculus; vector analysis; theorems of Gauss, Green, and Stokes; introduction to Fourier series. Prer., A.Math. 138.

Math. 435-3. Advanced Mathematics for Engineers 1. *Not offered every year.* Selected topics in ordinary differential equations, including linear equations with constant coefficients, matrix methods, power series solutions, Bessel functions, Legendre functions, and Laplace transforms. Prer., A.Math. 236. Will not apply toward the B.A. degree in mathematics; may be used toward the B.S. (A.Math.) degree.

Math. 436-3. Advanced Mathematics for Engineers 2. *Not offered every year.* Selected topics in partial differential equations and complex variables; the divergence theorem in two and three dimensions, Fourier series, eigen function expansions, and the method of separation of variables. Prer., A.Math. 236. Will not apply toward the B.A. degree in mathematics; may be used toward the B.S. (A.Math.) degree.

ARCHITECTURAL ENGINEERING

Arch.E. 102-2. Descriptive Geometry. Two 3-hr. labs per wk. Orthographic projection: point, line, and plane problems; angle problems, intersection, developments, perspective, shades and shadows, and graphic statics. Prer., Engr. 101 or equivalent.

Arch.E. 130-3. Introduction to Architectural Engineering. Three lect. per wk. A survey of the broad subject of civil and architectural engineering and professional practice emphasizing a study of construction methods including foundations, structural systems, building materials, and systems applications in building construction.

Arch.E. 201-3. Introduction to Solar Utilization. Three lect. per wk. Course material includes coverage of heat transfer fundamentals, solar radiation, and characterization of flat plate collectors, heat exchangers, and storage systems. This material is applied to the long-term performance analysis of space and water heating systems.

Arch.E. 202-3. Energy Fundamentals. Three lect. per wk. Basic principles of heat transfer and thermodynamics are presented in a unified course. Emphasis directed toward building energy applications.

Arch.E. 240-3. Introduction to Building Construction. Three lect. per wk. A survey of the broad subject of civil and architectural engineering and professional practice emphasizing a study of construction methods including foundations, structural systems, building materials, and systems applications in building construction. Note: no credit for students who have taken C.E. or Arch.E. 103-3. May not be taken by upper division students.

Arch.E. 301-3. Mechanical Systems for Buildings. Three lect. per wk. Psychrometrics, thermal comfort, building heating and cooling loads, HVAC components and systems, fire protection. Prer., Phys. 302 or E.Phys. 112, Arch.E. 202.

Arch.E. 302-3. Energy Conservation Analysis. Three lect. per wk. Thermal network methods applied to design sizing, energy loads, and comfort conditions in buildings. Numerical methods for analyzing dynamic thermal behavior of buildings and use of microcomputer/mainframe network simulation with emphasis on energy conserving and passive solar buildings. Prer., Arch.E. 202.

Arch.E. 303-2. Energy Laboratory. One lect., one 3-hr. lab per wk. Lab course including measurements of solar collector performance, solar radiation, flow and insitu solar system performance measurements. Prer., Arch.E. 302.

Arch.E. 354-3. Illumination I. Three lect. per wk. A study of the fundamentals of illumination and the application of these principles to the illumination of buildings. Prer., E.Phys. 112. (For Arch.E. students only except by consent of instructor.)

Arch.E. 363-3. Introduction to Acoustics and Noise. (Aero. 363.) Three lect. per wk. Engineering and physiological foundations of acoustics. Individual and social response to sound. Environmental noise problems. Engineering and legal control of noise. Prer., junior standing or consent of instructor.

Arch.E. 400-1 to 6. Independent Study.

Arch.E. 401-3. Solar Design. Three lect. per wk. A design-oriented course devoted to solar heating of buildings. Subject coverage includes solar radiation prediction, methods of solar collection and thermal conversion, solar system analysis, economic analysis of solar systems, and solar design optimization.

Arch.E. 403-3. Structures I. (Env.D. 452.) Three lect. per wk. Analysis of basic structural systems. Principles of mechanics and mechanical properties of materials, analysis and design of trusses, arches, and cable structures. This course is for nonengineering students and will not apply toward an engineering degree. Prer., senior standing or consent of instructor.

Arch.E. 404-3. Structures II. (Env.D. 453.) Three lect. per wk. Analysis of basic structural systems. Principles of mechanics as applied to the design of flexural members, columns, continuous beams, and rigid frames. This course is for nonengineering students and will not apply toward an engineering degree. Prer., Arch.E. 403.

Arch.E. 431-2. Design of Masonry Structures. Two lect. per wk. Design of reinforced and unreinforced masonry walls, beams, and columns, static and dynamic loading resistance, connections, and joints. Prer., C.E. 350.

Arch.E. 441-3. Construction Costs, Estimating, and Prices. Three lect. per wk. Introduction to building construction costs accounting and controls, analysis of direct and indirect cost fundamentals and collecting systems, methods engineering and value engineering. Also included is a study of the types of estimates, quantity take-off techniques and pricing applications, and the preparation of a detailed estimate for a building project including all cost analyses, a complete quantity survey, development of unit prices, and the final assembly of the bid proposal. Prer., senior standing, or consent of instructor.

Arch.E. 446-3. Construction Planning and Scheduling. (C.E. 523.) Three lect. per wk. A comprehensive study of construction management including the contractor's role in preconstruction activities; the construction contract; bonds and insurance; purchasing and subcontracts; contractor's central office and job organization; plant, tools, and equipment; methods engineering; value engineering; labor relations and hiring; and the particular application of CPM/PERT techniques to the planning, scheduling, and control of a construction project. Prer., Arch.E. 441.

Arch.E. 455-3. Illumination II. Three lect.-rec. per wk. Application of principles of Illumination I. Develop and apply methods for special problems in interior and exterior illumination. A study of photometry including laboratory experiments. Prer., Arch.E. 354.

Arch.E. 456-3. Luminous Radiative Transfer. Three lect.-rec. per wk. Numerical methods in lighting design and analysis; luminous flux interchange and transfer. Prer., Arch.E. 455.

Arch.E. 457-3. Building Electrical Systems Design I. Three lect.-rec. per wk. Design of the secondary electrical distribution systems for buildings. Application of the N.E.C. Prer., E.E. 214 or 303. (For Arch.E. students only except by consent of instructor.)

Arch.E. 458-3. Building Electrical Systems Design II. Three lect.-rec. per wk. Analysis and design of electrical systems for special equipment in commercial buildings such as motor controllers, elevators, sound and signal systems. Prer., Arch.E. 457.

Arch.E. 459-3. Computer Applications in Lighting. Three lect.-rec. per wk. Solution of lighting problems by computerized techniques; lighting research and projects. Prer., Arch.E. 455.

C.E. 501-3. HVAC System Controls. Three lect. per wk. Treats the theoretical and practical design of control systems for heating, ventilating, and air conditioning of both residential and commercial buildings. In addition, computer energy management system design is discussed. Prer., Arch.E. 302 or equivalent.

C.E. 502-3. Building Energy Measurements and Audits. Three lect. per wk. Analysis and measurement of performance of HVAC systems, envelopes, lighting and hot water systems, and modifications to reduce energy use. Emphasis on existing buildings. Prer., Arch.E. 302 or equivalent.

C.E. 505-3. Advanced Solar Design. Three lect. per wk. Performance prediction and economic analysis of high temperature and other innovative solar systems; performance prediction methods for medium and high temperature solar processes; treatment of various solar cooling technologies, solar total energy systems, solar thermal electric systems, industrial process heat systems. Prer., Arch.E. 201 or equivalent.

C.E. 506-3. Advanced Passive Solar Design. Three lect. per wk. Design-oriented treatment of passive solar systems will be emphasized. The generic types of systems and their performance and cost are treated. In addition, passive system construction and daylighting will be covered. Prer., C.E. 505.

C.E. 507-3. Thermal Analysis of Buildings. Three lect. per wk. Response factors, conduction transfer functions, and weighting factors for dynamic analysis of building envelopes. Radiative and convective exchange in buildings, internal gains, and infiltration analysis as modeled in hourly simulations. Prer., C.E. 502.

CHEMICAL ENGINEERING

Ch.E. 130-2. Introduction to Chemical Engineering. Develops principles for using concepts of chemistry and physics to conceive feasible processes for chemical change. Introduction to the chemical engineering profession. Prer., high school chemistry or equivalent.

Ch.E. 201-3. Introduction to Chemical Engineering Calculations. An introduction to computation of chemical engineering problems. Emphasis is placed on use of digital computers to solve numerical tasks and in the treatment of engineering data. The FORTRAN language is introduced and used as a major programming tool. Prer., C.S. 120.

Ch.E. 210-4. Physical and Chemical Properties of Matter. Three lect. and two rec. per wk. Emphasis is on the principles of chemistry

as they relate to engineering materials and systems. (Not for Ch.E. majors.) Prer., high school chemistry.

Ch.E. 212-3. Chemical Engineering Material and Energy Balances. Three lect. periods per wk. Introduction to the quantitative aspects of chemical engineering. Concepts of material and energy balances with and without chemical reactions. Prer., Chem. 106 or 108, or equivalent, and Ch.E. 201 or as coreq.

Ch.E. 241-2. Chemical Engineering Materials and Industrial Chemicals. Two lect. rec. hrs., three to six field (plant inspection) trips, introduction to the chemical process industry. The production, ecnomics, and use of the top fifty industrial chemicals. Prer., Chem. 106 or 108 or equivalent; coreq., Chem 331 or equivalent.

Ch.E. 321-4. Chemical Engineering Principles I. Three lect. and two rec. or calc. hrs. per wk. Study of the theory and application of the principles of heat and momentum transfer in chemical engineering systems. Prer., A.Math. 235 or Math. 240, and Ch.E. 212.

Ch.E. 322-4. Chemical Engineering Principles II. Three lect. and two rec. or calc. hrs. per wk. Study of the mechanisms of mass transfer including molecular diffusion, eddy diffusion, and convective mass transfer. Application of the theory of mass transfer to the design of chemical equipment. Prer., Ch.E. 321.

Ch.E. 370-3. Animal Engineering. An introduction to molecular biophysics dealing principally with questions related to the structure and function of biological macromolecules. The course concludes by considering a variety of biological systems that interface between the physical and engineering sciences. Prer., MCDB 106 and Chem. 332.

Ch.E. 403-4. Chemical Engineering Laboratory. Experimental work and reports in unit operations. Planning and analysis of chemical engineering experiments. Heavy emphasis on preparation of formal technical reports. One lect.-rec. and two 4-hr. labs. per wk. Prer., Ch.E. 201 and 322.

Ch.E. 432-3. Chemical Engineering Thermodynamics. Three lect. per wk. Thermodynamic principles of chemical and physical equilibrium, and application to chemical process problems. Prer., Engr. 301 or Chem. 451.

Ch.E. 433-3. Chemical Engineering Reaction Kinetics. Three lect. per wk. Introduction to chemical kinetics and chemical reactor design. Prer., Ch.E. 201, 321, and 432.

Ch.E. 442-3. Organic and Polymeric Technology. Three rec. per wk. Manufacturing operations of the more important organic chemical and plastics industries with emphasis on the properties and applications of plastics. Prer., organic chemistry: Chem. 332 or 336.

Ch.E. 452-4. Chemical Process Synthesis. Two. lect., two rec. or calc. hrs. per wk. Solution of selected comprehensive problems dealing with development, equipment, process design, process control systems, materials, product allocations, and chemical proces optimization. Prer., Ch.E. 322, 432, and 433.

Ch.E. 457-3. Instrumentation and Process Control. Two lect. and one lab. per wk. Principles of operation and applications of industrial instruments. Process control system synthesis, design, and implementation. Additional projects required for graduate credit. Prer., E.E. 303.

Ch.E. 458-3. Chemical Engineering Process Dynamics. Three lect. per wk. Study of the theory of process dynamics and its application to many of the systems encountered in large-scale chemical processing. Prer., Ch.E. 201 and 322.

Ch.E. 466-3/566-3. Cryogenic Engineering. Investigation of modern cryogenic systems and processes involving mechanical, thermodynamic, heat, and mass transfer considerations. Provides insight into refrigeration, liquefaction, separation, and purification processes. Covers equipment, instrumentation and storage systems. Emphasizes safety aspects in cryogenic processing. A special term report will be required of students taking this course as Ch.E. 566. Prer., undergraduate thermodynamics and heat transfer.

Ch.E. 490 to 499-1 to 4. Special Topics in Chemical Engineering. Senior selected topics courses to be offered upon demand. Prer., senior standing or consent of instructor.

Ch.E. 501-3. Environmental Modeling. Mathematical modeling of the natural and man-made environment as an aid in making national decisions which are politically enforceable, socially accepted, economically feasible, and technically possible. Prer., C.S. 201, E.E. 201, or Ch.E. 201.

Ch.E. 521-3. Transport Phenomena. Fundamental relationships for transfer of heat, mass, and momentum, and their application to engineering problems. Prer., senior or graduate standing.

Ch.E. 522-3. Mass Transport. Diffusive and convective mass transfer in binary and multi-component systems; scaling conservation equations for multicomponent systems; dimensional analysis in mass transfer; macroscopic species balance; mass transfer with chemical reaction; mass transport in porous media. Prer., Ch.E. 521 or consent of instructor.

Ch.E. 528-3. Statistical Thermodynamics. (M.E. 514.) Introduction to the molecular interpretation and calculation of thermodynamic properties of matter. Thermodynamic probability, distribution functions, Schrodinger Wave Equation and solutions, and ensemble theory. Applications to ideal and real gases, solids, liquids, radiation, conduction electrons, and chemical equilibrium. Prer., M.E. 313 or equivalent.

Ch.E. 536-3. Catalysis and Kinetics. Study of the principles of chemical kinetics and catalytic reactions, with emphasis on heterogeneous catalysis. Coreq., Ch.E. 433, or prer., Chem. 453 and consent of instructor, or graduate standing in Ch.E. or Chem.

Ch.E. 537-3. Intermediate Chemical Engineering Thermodynamics. Review of the fundamentals of thermodynamics. Application to pure fluids and mixtures. Physical equilibrium and changes of state. The equation of state and computation of fluid properties for pure fluids, mixtures, and solutions. Relations between thermodynamics and statistical mechanics. Prer., undergraduate thermodynamics (Ch.E. 432 or equivalent).

Ch.E. 538-3. Macroscopic Thermodynamics. (M.E. 513.) Axiomatic presentation of fundamentals of classical thermodynamics. Energy, heat, work and the first law. Equilibrium, reversible and irreversible processes, entropy production, and the second law. Applications to stability, phase equilibrium, electric and magnetic work. Irreversible thermodynamics and the Onsager Reciprocal Relations. Prer., M.E. 313 or equivalent.

Ch.E. 539-3. Reaction Kinetics. Advanced study of ideal and nonideal chemical reactors including unsteady state behavior, mixing effects, reactor stability, residence time distribution, and modeling of nonideal reactors. Additional topics covered include fluidized beds, diffusion in porous catalysts and chemical kinetics. Prer., undergraduate reaction kinetics and consent of instructor.

Ch.E. 542-3. The Physical Chemistry and Fluid Mechanics of Interfaces. The principal topics covered in this course are the thermotension measurement; adsorption at liquid-gas, liquid-liquid, and solid-gas interfaces; monolayers; conservation equations for a fluid interface; rheology of interfaces; surface tension driven flows; contact angle and wettability; double layer phenomena. Prer., Ch.E. 321 or equivalent.

Ch.E. 549-3. Chemical Technology of High Polymers. Engineering aspects of preparation, fabrication, and utilization of natural and synthetic polymers. Prer., organic chemistry: Ch.E. 332 or 336.

Ch.E. 557-3. Computer-Aided Control System Design. The design of controllers for multivariable systems is studied. Computer aids including graphic displays are utilized. Primary emphasis is on the frequency-based techniques of the inverse Nyquist array and multivariable root locus. Prer., Ch.E. 457 or E.E. 413.

Ch.E. 558-3. Optimization and Control of Chemical Processes. Optimization and control of chemical processes using differential calculus, calculus of variations, and Pontryagin's minimum principle. Mini-computer and real-time programming covered for on-line implementation of optimal control policies. Prer., senior or graduate standing.

Ch.E. 566-3/466-3. Cryogenic Engineering. Investigation of modern cryogenic systems and processes involving mechanical, thermodynamic, heat and mass transfer considerations. Provides insight into refrigeration, liquefaction, separation and purification processes. Covers equipment, instrumentation and storage systems. Emphasizes safety aspects in cryogenic processing. A special term report will be

required of students taking this course as Ch.E. 566. Prer., undergraduate thermodynamics and heat transfer.

Ch.E. 569-3. Industrial Water and Solid Waste Pollution Control. The chemical and physical nature of water pollutants and solid wastes from industrial processes. Methods of reducing pollutant generation and treatment for pollutant disposal. Prer., senior standing in Ch.E. and consent of instructor.

Ch.E. 570-3. Biomedical Engineering. Mathematical analysis of biomedical systems via material, energy, and momentum balances. Systems to be studied include neural transmission, renal function, circulation, and special senses. Prer., consent of instructor.

Ch.E. 571-3. Molecular Basis of Behavior. A problems approach to neurobiology. A variety of model behavior systems will be discussed, unicellular and multicellular, in an attempt to trace the molecular steps that occurred during the evolution of simple behavioral systems to more complex ones. Prer., Ch.E. 370, Chem. 332, and Chem. 453.

Ch.E. 574-3. Analytical Methods in Chemical Engineering. Applied analytical mathematical methods are presented in the context of chemical engineering research problems. Topics include vector analysis, linear algebra, modeling techniques, ordinary and partial differential equations. Prer., graduate standing or consent of instructor.

Ch.E. 575-3. Numerical Methods in Chemical Engineering. Applied numerical methods commonly used to solve chemical engineering problems are studied. They are applied via digital computer programming assignments. Topics include numerical solution of ordinary and partial differential equations, design of experiments, and treatment of data. Prer., graduate standing or consent of instructor.

Ch.E. 576-3. Engineering Aspects of Animal Locomotion.[1] A survey course dealing with animal locomotion. In general, all animals swim, fly, or run. Each of these modes presents a unique physical situation to the biological system in terms of physiology, analytical mechanics, and fluid mechanics. Prer., Ch.E. 370 or consent of instructor.

Ch.E. 580-3. Recent Advances in Biotechnology. This course will review the recent developments in the fields of microbiology, molecular genetics, and genetic engineering which are of commerical value and benefit to mankind. The course will, in addition, cover the engineering implementation of such biological processes. Prer., graduate standing in Ch.E., Chem., or MCDB, or consent of one of the instructors.

Ch.E. 590-0. Seminar in Chemical Engineering. Required of all chemical engineering graduate students. Reports on research activities and on special current topics.

Ch.E. 591-599-0 to 3. Selected Topics. Credit and subject matter to be arranged.

Ch.E. 627-3. Heat Transfer I. (M.E. 563.) Review of equations governing transport of heat by conduction and radiation. Analytical and numerical solution of boundary value problems representative of heat conduction in solids. Radiation properties of solids, liquids, and gases and transport of heat by radiation. Prer., M.E. 362 or equivalent.

Ch.E. 628-3. Heat Transfer II. (M.E. 564.) Review of equations governing transport of heat in fluids in motion. Description of heat transfer in free and forced convection including laminar and turbulent flow. Dimensional analysis and heat transfer correlations, numerical methods, combined heat transfer mechanisms. Prer., M.E. 532 or consent of instructor.

Ch.E. 639-3. Advanced Reaction Kinetics.[1] Fundamental laws pertaining to chemical reaction rates and their application to industrial operations. Prer., Ch.E. 539 or equivalent.

Ch.E. 640-3. Advanced Fluid Dynamics.[1] Conservation equations and similarity. Navier-Stokes equations and solutions for small and large Reynolds numbers. Boundary layer flow and transition phenomena. Phenomenological theories of turbulent flow. Prer., Ch.E. 521 or equivalent.

Ch.E. 657-3. Optimal Control of Chemical Processes.[1] Study of stability and optimal control as applied to chemical processes. Topics to be discussed include Liapunov stability, application to the maximum principle and variational calculus to the control of linear and nonlinear chemical systems. Prer., Ch.E. 558 or equivalent.

Ch.E. 691-699-0 to 3. Selected Topics. Credit and subject matter to be arranged.

Ch.E. 700-variable credit. Master's Thesis.

Ch.E. 800-1 to 10. Doctor's Thesis.

Ch.E. 920-1 to 6. Independent Study. Available to freshmen and sophomores with approval of Chemical Engineering Department. Subject arranged to fit needs of the particular student.

Ch.E. 940-1 to 6. Independent Study. Available to juniors and seniors. Subjects arranged to fit needs of particular student.

Ch.E. 950/960-1 to 6. Independent Study. Available to graduate students.

CIVIL, ENVIRONMENTAL, AND ARCHITECTURAL ENGINEERING

C.E. 130-3. Introduction to Civil Engineering. Three lect. per wk. A survey of the broad subject of civil and architectural engineering and professional practice, emphasizing a study of construction methods including foundations, structural systems, building materials, and systems applications in building construction.

C.E. 212-3. Analytical Mechanics I. Three lect. per wk. A vector treatment of force systems and their resultants; equilibrium of frames and machines, including internal forces and three-dimensional configurations; static friction; properties of surfaces, including first and second moments; hydrostatics; minimum potential energy and stability. Prer. or coreq., Phys. 111, A.Math. 235.

C.E. 221-3. Plane Surveying. Two lect., one 3-hr. lab per wk. Observation, analysis, and presentation of basic linear, angular, area, and volume field measurements common to civil engineering endeavors. Prer., A.Math. 135 or equivalent.

C.E. 222-3. Engineering Measurements. Two lect., one 3-hr. lab. per wk. Principles of measurements; methodology, instrumentation, and analysis of data. Prer., C.E. 221.

C.E. 311-3. Analytical Mechanics II. Three lect. per wk. A vector treatment of dynamics of particles and rigid bodies including rectilinear translation, central-force, free and forced vibration, and general motion of particles; kinematics of rigid bodies; the inertia tensor; Euler's equations of motion; energy and momentum methods for particles, systems of particles, and rigid bodies. Prer., C.E. 212, A.Math. 236.

C.E. 312-3. Mechanics of Materials. Three lect. per wk. Mechanical properties of materials; stresses and strains in members subjected to tension, compression, and shear; flexural and shearing stresses in beams; deflections of beams; column analysis; stress transformation and principal stresses, impact, fatigue under fluctuating loadings. Prer., C.E. 212, prer. or coreq., A.Math. 236.

C.E. 313-3. Applied Mechanics. Three lect. per wk. A limited study of particle and rigid body mechanics. Subject coverage introduces vector concepts of force, moment, and equilibrium, then concentrates on kinematics and kinetics of particles in motion, including oscillatory and orbital, and finally discusses rigid body motion with emphasis on energy and momentum methods. Prer., Phys. 111, A.Math. 236. Not for C.E. or Arch.E. majors.

C.E. 314-2. Engineering Materials Laboratory. One lect.-rec. and one 3-hr. lab. per wk. Lecture sessions devoted to development and explanation of the necessary background and operations required to conduct the experiments in the lab. Lab sessions devoted to hands on performance of a sequence of experiments which determine properties of materials of importance to engineers, verify principles from the mechanics of materials, or incorporate the requirements of ASTM Standards. Prer., C.E. 312.

C.E. 315-2. Engineering Materials Laboratory—Water Quality.[1] One lect. and one 3-hr. lab. per wk. Discussing techniques for making and evaluating measurements of water quality and pollution parameters. Measurements of these parameters on local streams, drinking

[1] Offered occasionally.

water, and municipal wastes. Prer. or coreq., C.E. 344 or consent of instructor.

C.E. 318-2. Engineering Materials Laboratory—Geotechnical Engineering.[1] Physical characterization of unconsolidated geologic materials. Evaluation of constants and parameters used in the design and construction of earth structures. Sampling and testing of soils. Coreq., C.E. 380 or consent of instructor.

C.E. 323-3. Photogrammetry and Control Surveys. Two lect., one 3-hr. lab. per wk. Characteristics of aerial photographs; measuring and interpreting from aerial photos for planimetric, topographic, hydrological, soil, and land use surveys; analysis and presentation of field measurements over extensive reaches. Prer., C.E. 222.

C.E. 324-3. Introduction to Construction.[1] Three lect. per wk. A broad view of the concerns, activities, and objectives of the people involved in construction: the owner, architect/engineer, contractor, labor, and inspector. Interactive gaming situation relates these people to the construction contract, plans/specifications, estimates/bids, scheduling, law, and financial management. Prer., junior level standing or consent of instructor.

C.E. 331-3. Theoretical Fluid Mechanics. Three lect. per wk. Basic principles of fluid mechanics. Fluid properties, hydrostatics, fluid flow concepts, including continuity, energy, momentum, boundary-layer theory, and flow in closed conduits. Prer. C.E. 212.

C.E. 332-3. Applied Fluid Mechanics. Two lect., one 3-hr. lab. per wk. Application of principles of fluid mechanics and dimensional analysis to problems in open channel flow, pipe systems, hydraulic machinery, fluid flow measurement, and hydraulic models. Includes laboratory demonstrations and experiments. Prer., C.E. 331.

C.E. 340-2. City Planning. Two lect. per wk. Essential principles of city planning, with particular emphasis on the contribution that can be made by civil engineers. Includes detailed discussion of land use, land use boundaries, transportation, street systems, public buildings, parks and recreation, utility design, and zoning. Two or more problems in individual design will be included. Prer., junior standing.

C.E. 344-3. Introduction to Environmental Engineering.[1] Three lect. per wk. An introduction to environmental protection legislation and various water, air, and hazardous waste problems. Basic geochemical, ecological, mass conservation, and environmental chemistry concepts will be stressed in relation to solving environmental engineering problems. Prer., Chem. 103, A.Math. 235.

C.E. 345-3. Water and Wastewater Treatment.[1] Three lect. per. wk. Introduction to the design and operation of facilities for treatment of municipal water supplies and wastewater. Engineering application of physical, chemical, and biological unit processes and operations for removal of impurities and pollutants. Integrated design of whole treatment systems combining process elements. Prer., C.E. 344.

C.E. 350-3. Structural Analysis. Three lect. and one optional 2-hr. computational lab. per wk. Principles of structural analysis applied to statically determinate and indeterminate structures. Emphasis is on the conventional virtual work, flexibility, and stiffness methods of analysis with introduction to matrix structural analysis. Prer., C.E. 312.

C.E. 351-3. Structural Design I. Three lect. and one optional 2-hr. computational lab per week. Introduction to structural design: design philosophies and approaches, structural materials, loadings. Behavior of structural members and connections, and elementary applications to the design of members and systems. Prer., C.E. 350.

C.E. 360-3. Transportation Engineering. Three lect. per wk. Introduction to the technology, operating characteristics, and relative merits of highway, airway, waterway, railroad, pipeline, and conveyor transportation systems. Evaluation of urban transportation systems. Recent transportation system innovations. Prer., consent of instructor.

C.E. 380-3. Geotechnical Engineering I. Three lect. per wk. Basic characteristics of geological materials; soil and rock classifications; physical, mechanical and hydraulic properties; the effective stress principle; soil and rock improvement; seepage; consolidation; stress distribution; settlement analysis. Prer., C.E. 312.

C.E. 381-3. Geotechnical Engineering II.[1] Three lect. per wk. Shear strength; bearing capacity of shallow and deep foundations; lateral earth pressures; retaining walls; slope stability; underground construction; earth and rock structures. Prer., C.E. 380.

C.E. 389-3. Engineering Geology. Three lect. per wk. Role of geology in engineering; minerals; rocks; superficial deposits; rocks and soils as engineering materials; distribution of rocks at and below the surface; hydrologic influences; geologic exploration of engineering sites; mapping; geology of underground excavations, slopes, reservoirs, and dam sites; field trip.

C.E. 391-3. Civil Engineering Systems. Three lect. per wk. An introduction to systems analysis concepts and applications in Civil Engineering with emphasis on quantitative optimization techniques. Specific topics include probability theory, decision analysis, network models, linear and dynamic programming, differential optimization, gradient search, deterministic and stochastic simulation. Prer., A.Math. 236 and junior level standing.

C.E. 400-1 to 6. Independent Study.

C.E. 433-3. Applied Hydrology. Three lect. per wk. Engineering applications of principles of hydrology. Hydrologic cycle, rainfall and runoff, groundwater, storm frequency and duration studies, stream hydrograph, flood frequency, and flood routing. Prer., consent of instructor.

C.E. 434-3. Open Channel Hydraulics. Three lect. per wk. Study of flow in open channels both natural and man-made. Topics include application of energy equation and momentum relationships, tractive force on erodible boundaries, water surface profiles theory and calculations, design of transitions. Prer., C.E. 331.

C.E. 440-3. Environmental Engineering Application of Chemistry.[1] Three lect. per wk. A quantitative treatment of the factors that determine the composition of natural waters, wastewaters and drinking water, including mechanisms for transport, transformation, and attenuation of pollutants in various environments. Prer., C.E. 315, 344.

C.E. 442-3. Environmental Engineering Design. Two lect. and one 3-hr. lab. per wk. Design of wastewater and stormwater collection systems, pumping stations, and water distribution systems. Design of water and wastewater treatment plants. Prer., C.E. 345, C.E. 331.

C.E. 444-3. Environmental Engineering Chemistry.[2] Three lect. per wk. A comprehensive analysis of the chemistry of natural and polluted waters and the application to environmental engineering problems. Topics include energetic principles, chemical equilibrium, coordination chemistry, adsorption phenomena, solid phase interactions, redox phenomena, natural water models, metal pollution, dynamics in aquatic ecosystems and biogeochemical and nutrient cycling. Computer simulations will be used to illustrate more complex chemical systems. Prer., C.E. 344, 345, or instructor's consent.

C.E. 446-3. Wastewater Treatment Systems for Small Communities.[2] Three lect. per wk. Design and evaluation of wastewater treatment systems ranging from individual home systems to those for small communities. Prer., C.E. 345.

C.E. 447-3. Hazardous and Industrial Waste Management.[2] Three lect. per wk. Evaluation of processes used for treatment of wastes requiring special handling and disposal: toxic organic chemicals, heavy metals, acidic, caustic and radioactive waste material. Techniques for destruction, immobilization, and resource recovery; assessment of environmental impact of treatment process end products. Prer., C.E. 444 or equivalent.

C.E. 451-3. Matrix Structural Analysis. Three lect. per wk. Matrix formulation of the principles of structural analysis. Development of direct stiffness and flexibility methods for the analysis of frame and truss structures. Topics include support settlements, thermal loads, and energy formulations of force-displacement relationships. Prer., C.E. 350.

C.E. 454-3. Steel Design. Two lect. and one 2-hr. computation lab. per wk. Application of basic principles to the design of steel structures; design of tension members, columns, beams, beam-columns and connections; continuous beams and frames; elastic and plastic design methods. Prer., C.E. 351.

[1]Offered occasionally.
[2]Courses usually offered at Boulder Campus only.

C.E. 455-3. Reinforced Concrete Design. Applications to the design of reinforced concrete structures: design of beams, columns and slabs; prestressed concrete; footings; continuous beams and frames; buildings; and bridges. Prer., C.E. 351, 454.

C.E. 456-2. Design of Timber Structures. Two lect. per week. Design methods applied to beams, columns, trusses, and connections using timber. Use of panels and glued laminated members. Prer., C.E. 350.

C.E. 460-3. Highway Engineering.[1] Three lect. per wk. Evaluation of alternate highway routes. Discussion of highway drainage, finance, maintenance, pavement design, traffic operations, and principles of economic analysis. Impact of the highway on the environment. Prer., C.E. 360 and 380.

C.E. 461-3. Municipal Traffic Engineering.[1] Three lect. per wk. Analysis of traffic engineering problems commonly found in urbanized areas and design of alternative solutions. Prer., C.E. 360 or consent of instructor.

C.E. 494-3. Senior Projects. Entire semester is devoted to work on a project of the student's choice and the preparation of a report. Projects may include laboratory, analysis, or design efforts and may be done by individual students or by groups. The idea for the project can be generated by the student or suggested by a faculty member. A list of projects will be available in the departmental office at preregistration. The student is not permitted to register for this course during the last semester in residence and the student must obtain registration approval for a particular project from the faculty director. Prer., senior standing.

C.E. 495-1 to 6. Special Topics for Seniors. Supervised study of special topics of interest to students under guidance of instructor. Prer., consent of instructor.

I.E. 497-3. Engineering Economy. Three lect. per wk. Application of economic and financial principles to engineering alternatives. Calculation of annual costs, present worth, and prospective rates of return on investment. Depreciation and replacement studies. Economic aspects of public works. Preparation of engineering reports on economy studies. Prer., senior standing.

C.E. 498-3. Engineering Contracts. (C.E. 524.) Three lect. per wk. Application of law in engineering practice: contracts, construction contract documents, construction specification writing, agency, partnership, and property: types of construction contract; legal responsibilities and ethical requirements of the professional engineer. Prer., senior standing in civil or architectural engineering or permission of instructor.

C.E. 499-1. Senior Seminar. One lect. per wk. A series of lectures by outstanding university faculty members in the humanities, and eminent professional engineers in special fields of practice, particularly on subjects with new developments. Also emphasis on the EIT examination. Prer., senior standing.

C.E. 500-1 to 6. Independent Study. Available only through approval of graduate advisor. Subjects arranged to fit needs of the particular student.

C.E. 501-3. HVAC System Controls.[2] Three lect. per wk. Treats the theoretical and practical design of control systems for heating, ventilating, and air conditioning of both residential and commercial buildings. In addition, computer energy management system design is discussed. Prer., Arch.E. 302 or equivalent.

C.E. 502-3. Building Energy Measurements and Audits.[2] Three lect. per wk. Analysis and measurement of performance of HVAC systems, envelopes, lighting and hot water systems, and modifications to reduce energy use. Emphasis on existing buildings. Prer., Arch.E. 302 or equivalent.

C.E. 505-3. Advanced Solar Design. Three lect. per wk. Performance prediction and economic analysis of high temperature and other innovative solar systems; performance prediction methods for medium and high temperature solar processes; treatment of various solar cooling technologies, solar total energy systems, solar thermal electric systems, industrial process heat systems. Prer., Arch.E. 201 or equivalent.

C.E. 506-3. Advanced Passive Solar Design.[2] Three lect. per wk. Design-oriented treatment of passive solar systems will be emphasized. The generic types of systems and their performance and cost are treated. In addition, passive system construction and daylighting will be covered. Prer., C.E. 505.

C.E. 507-3. Thermal Analysis of Buildings.[2] Three lect. per wk. Response factors, conduction transfer functions and weighting factors for dynamic analysis of building envelopes. Radiative and convective exchange in buildings, internal gains, and infiltration analysis as modeled in hourly simulations. Prer., C.E. 502.

C.E. 508-3. Computer Simulation of Building Energy Systems. Three lect. per wk. Introduction to use of major simulation programs for analysis of building energy loads and system performance. One or more programs will be used to develop capability for analysis of multizone structures. Prer., C.E. 507.

C.E. 511-3. Introduction to Structural Dynamics. Three lect. per wk. Introduction to the dynamic response of structural systems, both linear and nonlinear. Prer., consent of instructor.

C.E. 512-3. Mechanics of Materials II. Three lect. per wk. Intermediate level course in the mechanics of deformable bodies. Stress and strain transformation, stress-strain relations, with emphasis on elastic and inelastic behavior of members, and theories of failure. Discussion of basic methods of structural mechanics, with applications to unsymmetric and curved beams, thick-walled pressure vessels, torsion of members of noncircular sections, and other selected problems in stress analysis. Prer., C.E. 312 and differential equations.

C.E. 513-3. Theory of Elasticity. Three lect. per wk. Mathematical theory of elasticity and its applications to engineering problems. Discussion of the basic analytical and numerical methods of solution. Prer., Math. 443, basic or equivalent course in differential equations.

C.E. 514-3. Cement and Concrete Technology. Three lect. per wk. Constituents of Portland cement, types of cements, cement chemistry, additives and admixtures, types and properties of aggregates, properties of fresh concrete, properties of hardened concrete, topics from current literature. Prer., C.E. 314.

C.E. 523-3. Construction Planning and Scheduling.[2] A comprehensive study of construction management including the contractor's role in preconstruction activities; the construction contract; bonds and insurance; purchasing and subcontracts; contractor's central office and job organization; plant, tools, and equipment; methods engineering; value engineering; labor relations and hiring; and the particular application of CPM/PERT techniques to the planning, scheduling, and control of a construction project. Students will be required to apply the techniques of the course to a term project. Prer., Arch.E. 441 or equivalent.

C.E. 524-3. Engineering Contracts.[2] Three lect. per week. Applications of law in engineering practice; contracts, construction contract documents, construction specification writing, agency, partnership, and property; types of construction contracts; legal responsibilities and ethical requirements of the professional engineer. Students will be required to complete a comprehensive term paper on a course topic of their choice and present the paper.

C.E. 525-3. Construction Management.[2] Three lect. per wk. The advanced study and analysis of construction top- and upper-middle management responsibilities, particularly relating to union craft labor, on- and off-site production and workmanship, construction financing, construction safety, inspection and quality control, and disputes and claims. Investigations to improve construction management efficiency and to lower construction costs will be stressed. Prer., senior standing, with Arch.E. 441, 446, C.E. 498, or consent of instructor.

C.E. 526-3. Industrialized Building Techniques and Systems.[2] Three lect.-rec periods per wk., including factory on-site inspections of industrialized building techniques and systems. The advanced study, investigations, and analysis to effect change and innovation in industrializing the construction process from product development through manufacture and transportation to assembly. Prer., graduate standing, or consent of instructor.

C.E. 528-3. Construction Engineering I.[2] Three lect. per wk. Introduction to the economics, utilization and limitations of large-scale horizontal construction methods. The advanced study of planning,

[1]Courses usually offered at Denver Campus only.
[2]Courses usually offered at Boulder Campus only.

analysis, and methods improvement techniques as applied to public works and energy facilities construction. Emphasis is placed on computer simulation of construction operations and time lapse analysis. Prer., garaduate standing with I.E. 347, C.E. 380, or consent of instructor.

C.E. 529-3. Construction Engineering II.[1] Three lect. per wk. Continuation of C.E. 528. Advanced study of the application and analysis of construction equipment and methods. Topics include drilling, blasting, tunneling, dewatering foundations, formwork design, and construction aspects of Portland Cement concrete. The course is applicable to both building and public works construction. Prer., graduate standing; Arch.E. 441, or consent of instructor.

C.E. 533-3. Applied Hydrology. Three lect. per wk. Engineering applications of principles of hydrology. Hydrologic cycle, rainfall and runoff, groundwater, storm frequency and duration studies, stream hydrograph, flood frequency, and flood routing. Prer., consent of instructor.

C.E. 534-3. Hydraulics of Open Channels. Three lect. per wk. Flow in natural and artificial channels, water surface profiles, critical depth, hydraulic jump, applications of energy and momentum principles, unsteady flow, flow in alluvial channels. Prer., graduate standing and C.E. 331.

C.E. 537-3. Water Law, Policy, and Institutions. Three lect. per wk. Contemporary issues in water management based on legal doctrine. Legal issues in water resources problems are identified and discussed in close relationship with technical, economic, and political considerations. Prer., senior or graduate standing.

C.E. 539-3. Seminar in Water Resources Development and Management. (Econ 691.) Three lect. per wk. A multidisciplinary exploration of the principles governing water resources planning and development. Emphasis is on the sciences of water—physical, engineering, chemical, biological, and social—and their interrelationships. Prer., senior or graduate standing.

C.E. 540-3. Environmental Engineering Chemistry.[1] Three lect. per wk. A comprehensive analysis of the chemistry of natural and polluted waters and the application to environmental engineering problems. Topics include energetic principles, chemical equilibrium, coordination chemistry, absorption phenomena, solid phase interactions, redox phenomena, natural water models, metal pollution, dynamics in aquatic ecosystems, and biogeochemical and nutrient cycling. Computer simulations will be used to illustrate more complex chemical systems. Prer., C.E. 344, 345, or instructor's consent.

C.E. 541-4. Pilot Plant Laboratory.[1] Two lect. per wk., two 3-hr labs per wk. Advanced lab techniques for environmental engineering. Course work includes test operation of pilot-scale models of treatment processes applied to water and wastewater, extrapolation of experimental results to prototype design, sampling techniques, use of analytical instruments employed in water and wastewater characterization. Prer., graduate standing or consent of instructor.

C.E. 542-3. Advanced Water Treatment.[1] Three lect. per wk. Advanced studies on theory of treatment, design and operation of domestic and industrial water supplies. Graduate standing or consent of instructor.

C.E. 543-3. Advanced Wastewater Treatment.[1] Three lect. per wk. Advanced analysis of wastewater treatment systems. Design and operation of treatment process reactors. Factors affecting performance of facilities used for physical separation, and chemical and biological conversion of wastewater compounds, including nitrogen and phosphorus. Prer., graduate standing or consent of instructor.

C.E. 544-3. Environmental Engineering Design.[1] Two lect. and one 3-hr. lab per wk. Design of water and wastewater treatment plants, sewage and stormwater collection systems, water distribution systems and pumping stations. Prer., graduate standing.

C.E. 545-3. Simulation Methods in Environmental Engineering.[1] One three hr. lect. per wk. An introduction to the use of digital simulation in the analysis of water resources and environmental systems. Computer programs for the simulation of reservoir operations, watershed's runoff, stream quality and lake quality will be developed and existing software will be utilized for the analysis of more complex problems. Prer., consent of instructor and computer background.

C.E. 546-3. Wastewater Treatment Systems for Small Communities.[1] Three lect. per wk. Design and evaluation of wastewater treatment systems ranging from individual home systems to those for small communities. Prer., graduate standing.

C.E. 547-3. Hazardous and Industrial Waste Management.[1] Three lect. per wk. Evaluation of processes used for treatment of wastes requiring special handling and disposal: toxic organic chemicals, heavy metals, acidic, caustic and radioactive waste material. Techniques for destruction, immobilization, and resource recovery; assessment of environmental impact of treatment process end products. Prer., graduate standing.

C.E. 548-3. Processing and Disposal of Wastewater Concentrates. Three lect. per wk. Principles and methods of stabilization dewatering and disposal of sludges generated from the removal of pollutants from water and wastewater treatment. Prer., graduate standing or consent of instructor.

C.E. 549-3. Fate and Effects of Pollutants in the Environment.[1] Three lect. per wk. A water quality management course in which the relationships among air, water, and land pollution, water quality, and beneficial uses will be examined. The major objectives are to develop the ability to recognze the consequences and impacts of pollutants in the aquatic environment and to learn how to correct or minimize the unfavorable water quality conditions. Prer., consent of instructor.

C.E. 551-3. Introduction to Finite Element Analysis. Three lect. per wk. Systematic formulation of finite element approximation and isoparametric interpolation (weighted residual and energy methods, triangular and quadrilateral elements). Computation applications to the solution of one- and two-dimensional stress-deformation problems, steady and transient heat conduction as well as viscous flow. Graduate standing or consent of instructor.

C.E. 552-3. Finite Element Analysis of Structures. Three lect. per wk. Review of membrane, plate and shell elements: Displacement and mixed models; Kirchoff and Mindlin bending formulations; reduced integration techniques. Introduction to nonlinear problems. Application to buckling and vibration of structures. Prer., C.E. 451 and consent of instructor, or C.E. 551.

C.E. 553-3. Numerical Methods in Civil Engineering. Three lect. per wk. Introduction to the use of numerical methods in the solution of civil engineering problems with emphasis on obtaining solutions with high-speed electronic computers. Applies methods to all types of civil engineering problems. Prer., senior or graduate standing.

C.E. 554-3. Theory of Structural Design. Three lect. per wk. Fundamental propositions for the design of skeletal structures, automatic design of optimal structures, problem-oriented computer languages, linear and nonlinear programming methods for structural design. Prer., C.E. 451 or equivalent.

C.E. 555-3. Structural Reliability. Three lect. per wk. The purpose of the course is to review and develop the principles and methods of structural reliability, and formulate the bases for design to insure adequate safety and performance of elements and structural systems. Prer., C.E. 351, 451, or consent of instructor.

C.E. 557-3. Advanced Topics in Steel. Three lect. per wk. Advanced topics relating to design and analysis of steel structures. Includes plate girders, moment connections for beams, design of multistory frames, and other topics determined by class interest. Prer., C.E. 454 or equivalent.

C.E. 558-3. Advanced Topics in Reinforced Concrete. Three lect. per wk. Advanced topics relating to design and analysis of reinforced concrete structures. Includes review of the current ACI design code, slabs, prestressed concrete, seismic design, folded plates and shells, finite element analysis, and other topics determined by class interest. Prer., C.E. 455 or equivalent.

C.E. 560-3. Advanced Highway Design.[2] Three lect. per wk. Design and location of various classes of rural and urban highways. Development of theory as a rational basis of design for highway alignment, cross-section, intersections, and interchanges is stressed. Prer., C.E. 360.

[1]Courses usually offered at Boulder Campus only.
[2]Courses usually offered at Denver Campus only.

C.E. 561-3. Quantitative Techniques in Urban Transportation Engineering.[1] Three lect. per wk. Probability—events, sets, independence, distributions. Measures of dispersion—means, standard deviation, variance, confidence intervals. Statistical decision making—statistical hypothesis, level of significance (a), second type of error (b), tests of statistical hypotheses. Simple and multiple regression—scatter diagrams, least squares estimates, simple and multiple regression forecasting models. Queueing theory—arrivals and service distributions, queue lengths, and waiting times for single and multiple channel facilities. Prer., C.E. 360 or consent of instructor.

C.E. 562-3. Urban Transportation Planning.[1] Three lect. per wk. Definition of the urban transportation problem, sociology of urban regions, history of urban growth, models of urban growth, population forecasts, land use surveys and planning, trip generation, characteristics, distribution and assignment, modal split, system evaluation, CBD transportation planning. Prer., C.E. 561.

C.E. 563-3. Airport Planning and Design.[1] Three lect. per wk. National airport system plan, air travel demand, geometric design of airport facilities, design of airport pavement and drainage structures, airport capacity, coordination with other modes, airport environmental impact. Prer., consent of instructor.

C.E. 564-3. Urban Traffic—Characteristics.[1] Three lect. per wk. Human and vehicular characteristics, speed and volume studies, origin and destination studies, traffic flow theory, stream characteristics, intersection characteristics, signalized intersections, accident characteristics, parking characteristics, highway lighting, and miscellaneous topics. Prer., C.E. 360 or consent of instructor.

C.E. 565-3. Urban Traffic—Operations.[1] Three lect. per wk. Traffic control devices, traffic signal timing and equipment, signal systems, computer application to traffic control, urban operations, freeway operations, traffic applications of linear programming. Markov chains, transportation problem, dynamic programming, surveillance, and control. Prer., C.E. 564.

C.E. 566-3. Transportation System Safety.[1] Three lect. per wk. Safety aspects of highway, railroad, and airway transportation systems. Accident analysis; accident prevention; economic consequences of accidents. Prer., C.E. 360.

C.E. 568-3. Pavement Design.[1] Three lect. per wk. Design of flexible and rigid pavements for highways and airports; stress analysis in flexible and rigid pavements; design of joints and reinforcing steel for rigid pavements; principles of subgrade stabilization. Prer., C.E. 360 and 481.

C.E. 569-3. Urban Traffic—Workshop.[1] Lect. and lab. Selected laboratory problems related to urban traffic. Prer., C.E. 564 or equivalent.

C.E. 580-3. Soil Mechanics. Three lect. per wk. An advanced course in the principles of soil mechanics. Coverage includes topics in continuum mechanics; elasticity, viscoelasticity, and plasticity theories applied to soils; the effective stress principle; consolidation; shear strength; critical state concepts; constitutive, numerical, and centrifuge modeling. Prer., C.E. 380 and 381.

C.E. 581-3. Engineering Properties of Soils. Three lect. per wk. Constitutive behavior of cohesive and cohesionless soils including stress-strain, strength, pore water pressure, and volume change behavior under drained and undrained loading conditions. Linear and nonlinear analysis techniques. Determination of constitutive properties in the laboratory. Prer., C.E. 580 or consent of instructor.

C.E. 582-3. Foundation Engineering. Three lect. per wk. Geotechnical design of shallow and deep foundations including spread footings, mats, driven piles, and drilled piers. Coverage includes bearing capacity; settlement; group effects; and lateral load capacity of the various foundation types. Additional topics include subsurface exploration, construction of deep foundations, and analysis of pile behavior using wave equation and dynamic monitoring methods. Prer., C.E. 380 and 381 or consent of instructor.

C.E. 583-3. Applied Geotechnical Analysis. Three lect. per wk. Applications of limiting equilibrium and limit plasticity analysis methods to stability problems in geotechnical engineering, such as slopes, lateral earth pressures on retaining structures, and bearing capacities of foundations. Elastic and consolidation analyses of deformations in soil structures. Prer., C.E., 580 or consent of instructor.

C.E. 584-3. Design of Earth Structures. Three lect. per wk. Theory, design, and construction of earth embankments. Use of published data, field exploration, and laboratory tests on soils and rock in investigating foundations and construction materials. Principles of compaction and settlement. Slope stability analysis, landslide recognition and control, use of benches and beams. Prer., C.E. 580 or consent of instructor.

C.E. 585-3. Seepage and Consolidation.[1] Three lect. per wk. Principles of steady and transcient flow in geologic materials; problems of unconfined flow; analytical and numerical analysis of continued and uncontinued flow; one-dimensional nonlinear finite strain consolidation theory; the consolidation of loaded clay layers; the use of consolidation theory to analyze and interpret laboratory and field tests; the coupled theory of consolidation; the consolidation of partly saturated soils; thaw consolidation; application of principles to the analysis and design of constructed facilities and natural pheonomena. Prer., C.E. 380 and 381, or consent of instructor.

C.E. 586-3. Introduction to Rock Mechanics. Three lect. per wk. Nature of rocks and rock masses; index properties, rock and rock mass classifications, deformability and strength, rock hydraulics, mechanical behavior of planes of weakness in rock, laboratory and in-situ testing. Prer., C.E. 380 and 381, or consent of instructor.

C.E. 587-3. Applied Rock Mechanics. Three lect. per wk. In-situ stresses in rocks and their measurement—application of rock mechanics to rock slope engineering, engineering for underground openings and foundation engineering; numerical methods in rock mechanics. Prer., C.E. 586.

C.E. 588-3. Soil Behavior.[1] Three lect. per wk. Soil minerology, formation of soils through sedimentary processes and weathering, determination of soil composition, soil water, colloidal phenomena in soils, fabric property relationships, analysis of mechanical behavior including compressibility, strength and deformation, and conduction phenomena in terms of physiochemical principles. Applications to stabilization and improvement of soils, and disposal of waste materials. Prer., C.E. 380, 381, or consent of the instructor.

C.E. 589-3. Dynamics of Soils and Foundations. Three lect. per wk. Behavior of soils and foundations subjected to self excited vibrations and earthquake ground motions. Principles of wave propagation in geologic media; in-situ and laboratory determination of engineering properties for dynamic analysis; applications of these principles and properties in design and analysis of foundations and earth structures subjected to dynamic loading. Prer., C.E. 580 and 581, or consent of instructor.

C.E. 590-3. Offshore Engineering.[1] Three lect. per wk. Analysis, design, and construction of offshore facilities. Types of offshore facilities; offshore environmental forces; marine geology; marine soil exploration; marine soil properties; pile foundations; gravity structures; tension leg platforms; guyed towers; sea bottom completion structures; pipe lines, anchors; gravel islands; dynamics of offshore structures; stability of marine slopes. Prer., C.E. 380 and 381 or consent of instructor.

C.E. 591-2. Seminar: Urban Problems. Two lect. per wk. Topics of current interest in the field of urban development with particular emphasis on engineering aspects. Prer., C.E. 340 and 442.

C.E. 592-1. Graduate Environmental Research Seminar. One lect. per wk. A seminar in environmental engineering research methods with emphasis on conducting studies and preparing presentations and publications. Prer., graduate status in environmental engineering.

C.E. 595-599-0 to 3. Selected Topics. Credit and subject matter to be arranged.

C.E. 600-1 to 6. Independent Study. Available only through the approval of the graduate advisor. Subjects arranged to fit needs of particular student.

C.E. 611-3. Dynamics of Structures. Three lect. per wk. General vibrations of civil engineering structures and their response to various types of time-dependent loads. Prer., C.E. 511.

C.E. 614-3. Plates and Shells. Three lect. per wk. Mathematical theories of plate and shell structures and their applications. Numerical

[1]Courses usually offered at Denver Campus only.

finite element solutions of plates and shells of various shapes under static and dynamic loadings. Prer., C.E. 512 or 613.

C.E. 616-3. Buckling in Structures. Three lect. per wk. Buckling of columns, beams, frames, plates, and shells in the elastic and plastic range. Postbuckling strength of plates. Beam-columns. Analysis by exact and approximate methods with special emphasis on practical implications and application of solutions. Prer., C.E. 312.

C.E. 635-3. Hydraulic Design I. Three lect. per wk. Design of dams, spillways, stilling pools, transitions, and penstocks; flood prediction and control, detention reservoirs, and river control structures. Prer., C.E. 534.

C.E. 651-3. Computational Mechanics of Solids and Structures. Three lect. per wk. Finite element methodology for geometric and material nonlinearities. Incremental formulations and iterative solution strategies for truly finite increments. Quasistatic and dynamic applications to large deformation and inelastic problems. Prer., C.E. 551 or 552.

C.E. 656-3. Inelastic Theory of Structures. Three lect. per wk. Inelastic behavior of materials. Calculation of ultimate capacity of perfectly plastic structures by use of upper and lower bound theorems. Theories of inelastic action as applied to structural design in steel and concrete. Elements of theory of plasticity with applications in ultimate analysis of plates, shells, and continuous bodies.

C.E. 680-3. Selected Topics in Analytical Soil Mechanics. Three lect. per wk. Selected advanced topics in soil mechanics and geotechnical engineering. Coverage depends upon the curriculum needs of that year. Such topics as seepage, clay mineralogy, finite elements, analysis of geotechnical problems, rheology of soils, plasticity applied to soil mechanics, soil dynamics, computational methods in geotechnical engineering, etc., are possible choices. This course may be taken more than once for additional credit. Prer., C.E. 580 or consent of instructor.

C.E. 695-699-0 to 3. Selected Topics. Credit and subject matter to be arranged. Prer., consent of instructor.

C.E. 700-variable credit. Master's Thesis.

C.E. 800-0 to 8 (16 to 24 maximum). Doctor's Thesis.

COMPUTER SCIENCE

C.S. 115-3. Introduction to Scientific Programming. Intended for students whose primary interest in computing is the solution of numerical problems in science and engineering. Provides skills in designing, writing, and debugging Fortran programs of moderate complexity. Some common algorithms and data structures are introduced. Prer., coregistration in Math. 130, 132, 108, or A.Math 135, or consent of instructor.

C.S. 120-3. Introduction to Programming I. A course presenting good engineering practices for constructing, documenting, testing, and debugging computer programs. Provides an introduction to common algorithms and data structures and the major characteristics of modern computers. Programming projects use the department's principal teaching language. Prer., three years of high school mathematics, including trigonometry, or Math. 110 or 102, or consent of instructor.

C.S. 121-3. Introduction to Programming II. Emphasis on problems encountered in building larger, more complex programs. Experience is gained in using existing software modules as building blocks for larger programs. Prer., C.S. 120.

C.S. 130-4. Introduction to Computing for Majors. This is an intensive first programming course. Students learn to analyze problems and synthesize programs for their solution, emphasizing good engineering practices for program construction, documentation, testing, and debugging. Programming projects give students experience with the department's principal teaching language. Prer., admission to a major in computer science or consent of instructor, and coregistration in C.S. 140.

C.S. 140-2. Discrete Methods for Computer Science. Introduces the basic abstractions and formal structures used in computer science, including elementary set theory, relations and functions, propositional and predicate calculi, formal reasoning, mathematical induction, graph theory, combinatorics, enumeration, and recurrence relations. Applications are drawn from computer science. Prer., coregistration in C.S. 130.

C.S. 220-3. Discrete Structures I. The first of two courses preparing students for a fundamental understanding of computing. Set thoery, Boolean algebra, relations, functions, graph theory, and techniques for formal reasoning including propositional and predicate calculus, proof techniques, induction, and program logics are studied. Prer., C.S. 121.

C.S. 221-3. Discrete Structures II. The second of two courses preparing students for a fundamental understanding of computing. Combinatorics, enumeration, recurrence relations, complexity of algorithms, discrete probability, automata and languages, and computability are studied. Prer., C.S. 220.

C.S. 225-3. Data Structures and Algorithms. A study of data abstractions (e.g. stacks, queues, lists, trees) and representation techniques (e.g. linking, arrays). The distinction between abstract concerns and implementation concerns. Memory management. Sorting and searching. Analysis of algorithms. Algorithm design technqiues (e.g., divide-and-conquer). Prer. or coreq., C.S. 221 and Math. 414; or Prer., C.S. 123, E.C.E. 381, and E.C.E. 470.

C.S. 453-3. (D) Software Systems Development. (E.C.E. 453.) Lectures deal with techniques for design, documentation, coding, testing, debugging, performance evaluation and maintenance of medium-scale (2-3000 line) systems. Primary emphasis is on practical application of these techniques to a specified project. Students are required to code to detailed specifications initially, and receive progressively greater design responsibility during the semester. Teamwork is encouraged, and strict deadlines are maintained on all assignments. Prer., E.C.E. 222 or consent of instructor.

C.S. 459-3. (D) Computer Organization. (E.C.E. 459.) This course is concerned with computer arithmetic units, memory systems, control systems, and input-output systems. This emphasis is completely on logic structure rather than electronic circuitry. Prer., E.C.E. 130/257 and E.C.E. 222.

C.S. 465-3. Intermediate Numerical Analysis I. Math 465.) Development, computer implementation, and analysis of numerical methods for applied mathematical problems. Topics include floating point arithmetic, numerical solution of linear and nonlinear systems of equations, numerical interpolation, integration, and approximation. Prer., introductory programming, two semesters of calculus, linear algebra (e.g., C.S. 120, Math. 230 and 313).

C.S. 466-3. Intermediate Numerical Analysis II. (Math. 466.) Continuation of C.S. 465. Further development of same topics and introduction of new topics, such as numerical solution of matrix eigenvalue, least squares, ordinary differential equations, and optimization problems. Prer., C.S. 465.

C.S. 514-3. Advanced Finite Mathematics II. More advanced techniques in enumeration theory and graph theory. Finite groups, Polya's theory of counting, digraphs, finite rings and fields. Application in computer science switching theory, coding theory, etc. Prer., C.S. 140 or 221.

C.S. 531-3. Formal Languages. Context-free languages and grammars. Theoretic properties-pumping lemma, ambiguity, representations (e.g., Dyck sets), decidable questions. Parsing algorithms for general and special (e.g., L.R) grammars. Prer., C.S. 546 or consent of instructor.

C.S. 540-3. Computer Decision Modeling. (Mg.Sci. 625.) Application of the methods of computer science to problems in management decision making. Emphasis is placed on simulation as a method for studying the behavior of dynamic systems and the use of optimization models for their control. Prer., course in statistics.

C.S. 545-3. Algorithms. Techniques for designing algorithms, proving correctness, computing time and space needs. Examples from sorting, set manipulation, graphs, multiplication. NP-complete problems. Prer., C.S. 225 and 546, or equivalent.

C.S. 546-3. Theory of Automata. (Math. 546.) Finite-state machines, regular expressions, paths on graphs, and the relations among these. Turing machines, some equivalent machines, and the idea of computability. Machines between the preceding ones in computa-

tional power and the elements of their relation to formal languages. Proving correctness of programs.

C.S. 553-3. (D) Fundamental Concepts of Programming Languages. (E.C.E. 553.) Focuses on programming language models, including denotational and algebraic semantics, and their relationship to attribute grammars. The modeling theory is used to develop both a mathematical model and an attribute grammar for a significant fragment of a programming language. Prer., E.C.E. 222 and 401, or consent of instructor.

C.E. 556-3. (D) Translation of Programming Languages. (E.C.E. 556.) A study of practical techniques for translating text generated by humans into programs understood by machines: lexical, syntactic and semantic analysis, code generation, assembly and optimization, error reporting and recovery. Prer., E.C.E. 222 or 553; or consent of instructor.

C.S. 557-3. Operating Systems. (E.C.E. 557.) A study of the supervisory programs within a computer system which interact most closely with the hardware, and which allow efficient and shared access to the computer. Topics covered include processes (communication implementation, synchronization), memory management (storage allocation, virtual memory), and processor management (multiprogramming, timesharing, scheduling). Prer., C.S. 401 or 553, C.S. 225 or equivalent.

C.S. 558-3. Artificial Intelligence. (E.C.E. 558.) The design of machines and systems that have been created to perform tasks that are considered to require intelligence. Prer., C.S. 401.

C.S. 560-3. Numerical Analysis I. (Math. 560.) Solution of linear systems, least squares approximations, nonlinear algebraic equations, interpolation, and quadrature. Prer., Math 442, 313, and introductory programming (e.g., C.S. 120).

C.S. 561-3. Numercial Analysis II. (Math. 561.) Solution of ordinary and partial differential equations, matrix eigenvalue eigenvector problems. Prer., C.S. 560.

C.S. 562-3. Numerical Solution of Initial Value Problems. (Math. 562.) Multi-step and single-step methods for ODE. Stability. Stiff equations. Difference schemes for heat and wave equations. Applications. Prer., C.S. 465 or 560.

C.S. 563-3. Numerical Solution of Boundary Value Problems. (Math. 563.) Finite difference solution of two point boundary problems and elliptic problems. Methods of SOR, ADI, conjugate gradients. Finite element method. Nonlinear problems. Applications. Prer., C.S. 465.

C.S. 564-3. Numerical Linear Algebra. (Math. 564.) Direct and iterative solution of linear systems. Eigenvalue and eigenvector calculation. Error analysis. Reduction by orthogonal transformation. Prer., C.S. 465 or 560, Math. 313.

C.S. 565-3. Numerical Methods for Optimization. (Math. 565.) Linear programming. Algorithms—simplex and modifications. Theory-duality, complementary slackness. Network flow algorithms. Introduction to integer-programming. Prer., Math. 313.

C.S. 566-3. Numerical Methods for Data Analysis. (Math. 566.) Least squares fitting. Singular value decomposition. Fourier analysis of data. Surface fitting. Applications. Prer., C.S. 565 or 560, Math. 313, 481, or 482.

C.S. 569-3. Numercial Methods for Nonlinear Optimization. Modern computational methods for the solution of unconstrained and constrained optimization problems, nonlinear least squares, and systems of nonlinear equations. Techniques for building algorithms to solve problems with special structure. Prer., linear algebra, multidimensional calculus.

C.S. 580-3. Operating Systems Practicum. An advanced workshop in operating systems design, development, programming, and debugging of various modules of an operating system for a local computer. Emphasis is placed upon good design methodologies and operating systems implementation techniques. Prer., C.S. 557 or consent of instructor.

C.S. 581-3. Data Management and File Systems. Design and evaluation of generalized data management systems. Tree, network, and relational approaches. Examples of systems, query languages, secondary storage devices. File organization: tree hash directories, list approaches, inverted list. Security, recovery simultaneity. Case studies of various systems. Prer., C.S. 401.

C.S. 582-3. Software Engineering. First-hand study of some of the problems connected with the development of large programs. Students, either individually or in small groups, will be involved in the actual design and development of modules for a large software system. Prer., C.S. 453, but languages other than assembly code will be used as required.

C.S. 583. System Programming. Input/output techniques for sequential and direct access devices on a minicomputer system. Other topics include microprogrammed control units, text editor design, subprogram linkages, coroutines, recursion, and reentrant programming. Prer., C.S. or E.C.E. 453 or equivalent.

C.S. 584-3. Software Development Workshop. In this software engineering practicum, student development teams perform specification, design, implementation and/or maintenance activities for some relatively complex software system. Prer., C.S. 582.

C.S. 611-3. Topics in Computer Graphics. Computer graphics hardware: printers, incremental plotters, microfilm, storage CRTs, and refreshed CRTs. Computer graphics software: special and general purpose subroutine packages, graphics languages, and data structures. Special problems: perspective viewing, hidden lines, windowing, and man-machine engineering. Prer., advanced programming ability.

C.S. 612-3. Topics in Operating Systems. Topics to be selected by instructor. Possible topics are: system design, measurement and evaluation, simulation, mathematical modeling, and parallelism. Prer., C.S. 557.

C.S. 613-3. Topics in Programming Languages. Topics to be selected by instructor. Possible topics are syntax, semantics, metacompilers, compiler design, and translator writing systems. Prer., C.S. 401.

C.S. 614-3. Topics in Computer Systems. Topics to be selected by instructor. Possible topics are on-line systems, multi-processing, microprogramming, architecture, data communications, and computing networks. Prer., C.S. 459.

C.S. 615-3. Topics in Formal Systems. Topics to be selected by instructor. Possible topics are formal languages, abstract machines, analysis of algorithms, and computational complexity. Prer., consent of instructor.

C.S. 617-3. Topics in Numerical Mathematics. Topics to be selected by instructor. Possible topics are numerical linear algebra, solution of differential equations, nonlinear algebra and optimization, data fitting, linear and nonlinear programming, solution of large problems.

C.S. 665-3, 666-3. Advanced Numerical Analysis. Prer., for C.S. 665, C.S. 566; (for C.S. 666, 665).

C.S. 700-4 to 6. Master's Thesis.

C.S. 701-3. Master's Reading Option. An alternative to the master's thesis. Students will read selected papers and pass an oral examination.

C.S. 710-3. Doctoral Preliminary Seminar. A seminar course required of all doctoral students. Students will demonstrate their research ability by investigating and reporting on current and open problems in computer science. Prer., admission to the Ph.D. program.

C.S. 800-1 to 10. Doctoral Research. An investigation in some specialized field of computer science. Approved and supervised by faculty members.

C.S. 920-1 to 3. Lower Division Undergraduate Level Independent Study. Selected topics at the elementary level for students who have had little or no previous computing experience.

C.S. 940-1 to 6. Upper Division Undergraduate Level Independent Study. This course provides opportunities for independent study, work on a small research problem, or tutoring of lower division computer science students. Prer., C.S. 120 or 130.

C.S. 940-1 to 6. Upper Division Undergraduate Level Independent Study. This course provides opportunities for independent study, work on a small research problem, or tutoring of lower division computer science students. Prer., C.S. 210.

C.S. 950-1 to 6. Graduate Level Independent Study in Computer Science. This course provides opportunities for independent study, work on a small research problem, or tutoring of lower division computer science students.

ELECTRICAL AND COMPUTER ENGINEERING

E.C.E. 130-3. Introduction to Logic Circuits. A first course with lab. for electrical engineering students in the study of Boolean algebra and its application to the synthesis of logical circuits from logical elements such as and-gates, or-gates, not-gates, nand-gates, nor-gates, delay elements, and memory elements.

E.C.E. 133-1. Logic Laboratory. Provides laboratory experience in the design and construction of digital logic circuits. Experiments are performed in combinational, sequential, and register transfer logic. Instrumentation introduced in the laboratory includes the logic probe, the oscilloscope, the logic analyzer, and a breadboarding system. Microcomputers are used to aid in the design and testing of circuits. Prer., E.C.E. 130 or 257, or consent of instructor; open to E.C.E. and C.S. majors only.

E.C.E. 134-2. Technical Writing. A technical and report writing course that must be taken concurrently with E.C.E. 133. Reports prepared for E.C.E. 133 will also be used as written material in E.C.E. 134.

E.C.E. 215-4. Circuits/Electronics I. Standard laws of circuit analysis. Node and mesh analysis. Introduction to op amp circuits. Transient response of elementary circuits. Sinusoidal steady-state response and phasor notation, including basic 3-phase concepts. Prer., E.C.E. 130 and 133, A.Math. 136; coreq. E.C.E. 255.

E.C.E. 216-4. Circuits/Electronics II. Nonideal op amp characteristics. Large signal, nonlinear circuits, including diodes, bipolar and MOS transistors. Fourier analysis of signals. Basic large signal design of transistor amplifiers, including saturation and cut-off, integrated biasing, differential pairs, and multistage amplifiers. Prer., E.C.E. 215, A.Math. 236; coreq., E.C.E. 256.

E.C.E. 222-3. Microcomputer Architecture and Programming. Machine structure and assembly language programming of small computers. Basic concepts of hardware and software engineering: processor architecture, interrupt handling, modular decomposition, concurrency. Prer., E.C.E. 130, C.S. 121, 123.

E.C.E. 223-1. Microprocessor Laboratory. Provides experience in programming, interfacing, and using microprocessor systems in electrical engineering applications. Students will use microprocessor development stations to program and debug the systems they design. Applications will be taken from signal processing, power, fields, as well as computer engineering. Programming will be performed in Pascal and assembler. Prer., E.C.E. 222.

E.C.E. 255-1. Circuits/Electronics Laboratory I. This laboratory concentrates on basic principles of electrical measurements. Coreq., E.C.E. 215.

E.C.E. 256-1. Circuits/Electronics Laboratory II. This laboratory concentrates on basic nonlinear circuit design and measurement. Coreq., E.C.E. 216.

E.C.E. 257-3. Logic Circuits. A study of Boolean algebra and its application to the synthesis of logical circuits from logical elements such as and-gates, or-gates, not-gates, nand-gates, delay elements, and memory elements. Not open to anyone who has taken E.C.E. 130. Primarily for nonmajors.

E.C.E. 302-3. Statistical Thermodynamics. Statistical approach to the understanding of thermodynamics. Thermal and diffusive equilibrium. Interactions of systems with external fields. Thermal radiation, thermal vibrations, noise. Statistics of weakly interacting particles. Electrons in metals. Semiconductor statistics. Heat engines and heat pumps. Chemical reactions. Phase transitions. Prer., E.Phys. 212, Chem. 210; prer. or coreq., E.C.E. 381.

E.C.E. 303-3. Electric Circuits I. For students not majoring in electrical engineering. Transient solution of circuits by classical and Laplace transform techniques, steady-state sinusoidal solutions, applications, filters, transistors. Prer., A.Math. 235.

E.C.E. 314-3. Electromagnetic Waves. Reflected and transmitted plane waves in layered media. Poynting's theorem of electromagnetic power, hollow waveguides, and two-conductor transmission line theory and practice; Smith chart and impedance matching. Elements of antenna theory. Prer., E.Phys. 212.

E.C.E. 317-3. Energy Conversion. This course is designed to cover the concepts of energy conversion through basic magnetics, transformers, relays and dc and ac rotating machines by singly and doubly excited systems. Prer., E.C.E. 215, 216; coreq., E.C.E. 357.

E.C.E. 323-3. Circuits/Electronics III. Frequency response of transistor amplifiers. Basic analysis and design of feedback circuits. Analog integrated circuits, including basic analysis and design of op amps. Filter and oscillator circuits, including switch capacitor design. Prer., E.C.E. 216, C.S. 120; coreq., E.C.E. 353.

E.C.E. 331-3. Linear Systems Theory. Characterization of linear systems by impulse response convolution, transfer function. Linear differential equations and linear difference equations as models. Applications to circuits, biological systems, etc. Transform methods including Fourier series and transforms, Laplace transforms, and Z transforms. Prer., E.C.E. 381 or A.Math. 481.

E.C.E. 332-3. Semiconductor Devices. Fundamentals of semiconductor materials and devices. Topics include the electrical and optical properties of semiconductors and other materials, the theory of pn junctions, bipolar and field-effect transistors, lasers, and other optoelectronic devices. Prer., E.C.E. 216.

E.C.E. 343-1. Electrical Laboratory I. For students not majoring in electrical engineering. Cathode-ray oscilloscope, electric circuits and measurements, electrical transients, introduction to the transformer and rotating electrical machinery. Coreq., E.C.E. 303.

E.C.E. 353-1. Circuits/Electronics Laboratory III. This laboratory concentrates on the practical aspects of the theory presented in E.C.E. 323-1. Coreq., E.C.E. 323.

E.C.E. 357-1. Energy Conversion Laboratory I. Basic concepts concerning electromagnetic energy conversion principles as related to practical devices. An overview of magnetics, transformers, and rotating machinery. Measurement techniques in power circuits are emphasized. Coreq. E.C.E. 317.

E.C.E. 381-3. Introduction to Probability Theory. Basic concepts, conditional and total probability, repeated independent trials, continuous distributions, functions and moments of random variables. Central Limit Theorem, characteristic functions. Prer., A.Math. 235.

E.C.E. 401-3. (D) Survey of Programming Languages. A variety of programming language features are studied from the point of view of the language user. Students explore these features by writing programs in PASCAL, ALGOL 60, FORTRAN, COBOL, LISP, and SNOBOL. Prer., E.C.E. 222.

E.C.E. 403-2. Elements of Electronics. For students not majoring in electrical engineering. Fundamentals of electronic devices and applications. Prer., E.C.E. 303 and 343 (or for physics and engineering physics majors only, Phys. 331 and 317); coreq., E.C.E. 443.

E.C.E. 413-3. (S) Control Systems Analysis. Linear analysis and analog simulation of electrical, chemical, hydraulic, and mechanical systems using block diagrams and signal flow graphs. Comparison of open and closed loop configurations. Stability studies using Nyquist, Bode, and root locus methods. Effects of simple networks on system response. Introduction of state variable techniques and digital computer solutions. Prer., senior standing with background of Laplace transforms.

E.C.E. 415-3. (S) Nonlinear Control Systems. The analysis and design of nonlinear feedback control systems; types and characteristics of equilibrium states; limit cycle phenomena; the behavior of nonlinearities such as hysteresis, saturation, and dead zone; phase space, describing function analysis. Lyapunov and Popov stability will be introduced. Prer., E.C.E. 413.

E.C.E. 416-3. (P) Energy Conversion II. Dynamic equations of motion of electromechanical systems; e.g., relays, transducers, linear and rotary motion machines. Equivalent circuits in abc and dqo coordinates for ac and dc machines. The constraints of torque production will be discussed. Prer., E. Phys. 212, E.C.E. 317.

E.C.E. 422-3. (E) Electronics IV. Switching state models of discrete components and integrated circuits, including logic gates, comparators, and operational amplifiers. Input, output, and transfer characteristics. Non-ideal properties. Application to signal generation, amplification, conditioning and processing. Analog-digital conversion. MOS integrated circuits for memories, shift registers, and charge coupled devices. Phase lock loops. Prer., E.C.E. 332.

E.C.E. 424-3. (C) Communication Theory. Introduction to principles of modern communication theory and signal processing. Random processes will be introduced and used to compare the noise performance of AM, FM, and various digital modulation systems. Definition of information and channel capacity. Introduction to error correcting codes and further topics in modern communication theory. Prer., E.C.E. 381 and 331.

E.C.E. 432-3. (M) Introduction to Quantum Electronics (Lasers). Introduction to lasers and other quantum electronic devices and to the general quantum principles that govern their operation. No background in the mathematical formalism of quantum theory is required. Discussion of various laser types, applications. Prer., E.C.E. 302 and 314.

E.C.E. 434-3. (M) Introduction to Solid State. (E.Phys. 446.) Introduction to crystallography, free electron theory including ac and dc conductivity, energy band theory, semi-conducting, dielectric, magnetic, optical and superconducting materials, processes and devices. Prer., E.C.E. 302 and 323.

E.C.E. 436-2 (M) Laboratory for Materials in Electrical Engineering. A laboratory course to accompany E.C.E. 434. Experiments selected from x-ray crystallography, phase diagrams of binary alloys, p-n junction technology, optical properties of semiconductors and dielectrics, liquid crystals, and others. Measurement techniques include use of cryogenic fluids, lasers, grating spectrometers, and other special instruments. Coreq., E.C.E. 434.

E.C.E. 437-3. (M) Integrated Circuit Technology. A lab. course offering experience in monolithic silicon integrated circuit fabrication techniques including IC layout, pattern compiling and generation, mask making, oxidation, photolithography, diffusion, implantation, metallization, bonding, process analysis, testing. A design project is included. Prer., E.C.E. 323; coreq., E.C.E. 302.

E.C.E. 443-1. Elements of Electronics Laboratory. For students not majoring in electrical engineering. Prer., E.C.E. 303 and 343; (or, for Physics and Engineering Physics majors only, Phys. 331 and 317); coreq., E.C.E. 403.

E.C.E. 450-3. (S) Analog Computer Simulation. Analog computing techniques, including time and amplitude scaling, programming of linear and nonlinear differential equations. Applications of these techniques to simulate dynamic systems, including an introduction to iterative analog computing. Some laboratory work on an analog computer and with digital simulation languages will be required. Prer., A.Math. 235 and background in basic Laplace transforms and matrix operations.

E.C.E. 451-2. (P) Power Laboratory II. Experimental investigations of the design and operating characteristics of synchronous machines, induction machines, transformers, power rectifiers, and single-phase machines. Prer., E.C.E. 317.

E.E. 452-2. (P) Power Systems Laboratory. Emphasis is placed upon analysis and operation of power systems and interactions of power equipment under dynamic conditions. Transient phenomena of rotating machines. Prer., E.C.E. 317.

E.C.E. 453-3. (D) Software Systems Development. (C.S. 453.) Lectures deal with techniques for design, documentation, coding, testing, debugging, performance evaluation and maintenance of medium-scale (2-3000 line) systems. Primary emphasis is on practical application of these techniques to a specified project. Students are required to code to detailed specifications initially, and receive progressively greater design responsibility during the semester. Teamwork is encouraged, and strict deadlines are maintained on all assignments. Prer., E.C.E. 222 or consent of instructor.

E.C.E. 454-3. (S) Control Systems Laboratory. Experimental analyses of elementary control systems are considered. Measurements of steady-state and transient characteristics of feedback control systems are performed. Prer., E.C.E. 413.

E.C.E. 456-3. (D) Digital/Analog Instrument Design. The interconnection of functional digital and analog electronic modules to perform complex instrumentation and control tasks which are described by an algorithm. Design of algorithmic state machines with gates, read only memories, and programmed logic arrays. Linked machines. Application to system control, automatic testing, and design of "intelligent" instruments. Prer., E.C.E. 130/257, and 323, or consent of instructor.

E.C.E. 458-1. (D) Logic Circuits Laboratory. Concerned with the actual wiring of electronic logic circuits and with investigation of the properties and characteristics of those circuits. Circuits will be built from solid state gates, memory elements, and medium scale integrated circuits. Computer, control, communication, and data processing systems are studied. Prer., E.C.E. 216 and 130/257.

E.C.E. 459-3. (D) Computer Organization. (C.S. 459.) This course is concerned with computer arithmetic units, memory systems, control systems, and input-output systems. The emphasis is completely on logic structure rather than electronic circuitry. Prer., E.C.E. 130/257 and 222.

E.C.E. 460-2. (D) Computer Laboratory. This course will provide laboratory experience both with digital computer subsystems and with complete computer systems. The student will construct small subsystems and work with actual subsystems of a full digital computer. Prer., E.C.E. 130/257, E.C.E. 458, and E.C.E. 459.

E.C.E. 461-2. (E) Electronics Laboratory III. Experimental work with oscillators, counters, switching circuits, r-f amplifiers, AM and FM modulators and demodulators, the superheterodyne receiver. Prer., E.C.E. 323.

E.C.E. 463-2. (F) Transmission Laboratory. Experiments verifying and extending concepts learned in E.C.E. 314. Applications of coaxial transmission line and waveguide to slotted-line measurement of impedance, stub impedance matching, antenna patterns, and the microwave superheterodyne receiver, making use of electronic and solid-state generators, crystal detectors and frequency converters, bolometer power bridge, cavity frequency meter, etc. Studies of the low-frequency artificial line for power and telephone transmission, time-domain reflectometer, hybrid tee, and ferrite devices. Prer., E.C.E. 314 or equivalent.

E.C.E. 465-2. (D) Communication Laboratory. Laboratory experiments demonstrating material taught in E.C.E. 424. Use is made of spectrum analysis to study baseband signals and signal processors. Topics include noise, AM, FM, PM, sampling, TDM, digital modulations, errors, equalizers, and a complete communication system. Prer. or coreq., E.C.E. 424 or consent of instructor.

E.C.E. 466-1. (D) Computer Systems Laboratory. This course will provide laboratory experience in designing and building computer systems. Emphasis will be placed on the methodological design of hardware/software systems using large-scale microprocessor-level components and complete microcomputer modules. Student projects will consist of producing system solutions to a variety of real world problems.

E.C.E. 470-3. (D) Switching and Finite Automata. Three lectures per week. Upper division course in switching and logical design, assuming a basic course in logic circuits. Emphasizes formal characterization of combinatorial functions and sequential machines. Covers fault diagnosis and finite state automata. Prer., E.C.E. 130/257.

E.C.E. 485-3. (CS) Physical Design Automation for VLSI. Topics discussed will be (1) VLSI chip design methodologies (custom, gate arrays, standard cells, PLA's); (2) theory, use and limitations of design, automation tools for synthesis, placement and routing. Prer., Competence in lower level calculus and circuit theory, introductory programming. If in doubt, contact instructor.

E.C.E. 486-3. (CS) Functional Design Automation for VLSI. Topics discussed include the basic theory and use of simulation tools at the circuit, switch, timing (relaxation based), logic and functional levels. The course also presents the basic ideas behind test generation (including the D algorithm), and fault simulation (including concurrent fault simulation). Prer., knowledge of basic calculus, circuit theory, electronics, programming and digital systems. If in doubt, contact instructor.

E.C.E. 491 to 499-1 to 3. Special Topics. Credit and subject matter to be arranged. Prer., variable.

Undergraduate students wishing to enroll in 500-level courses must have a *B* average or a petition and the consent of the instructor. Most of the courses listed below are offered once each year with the exception of those marked with an asterisk, which are offered on demand.

E.C.E. 501-3. (M) Quantum Theory. Wave-particle quality. Schroedinger equation. Operators. Quantum states. Stationary and time-dependent perturbation theory. Electron spin. Many-particle systems. Pauli principle. Prer., E.C.E. 302, 314, and 381.

E.C.E. 503-3. (M) Physical Properties of Crystals.* Utilizing the symmetry properties of crystals, a number of their physical properties will be studied. Tensor analysis will be developed and used to study paramagnetic and diamagnetic susceptibility, electric polarization, stress and strain tensor, piezoelectricity, elasticity, thermal and electrical conductivity, thermolectricity, refraction, and optical activity. Prer., E.C.E. 434 or equivalent.

E.C.E. 505-3. (M) Principles of Electronic Devices. A course relating performance and limitations of solid state devices to their structures and technology. For both advanced circuit and device engineers. Semiconductor physics and technology. PN-junction and MOS devices. Optoelectronic and bulk devices. Prer., senior standing.

E.C.E. 509-3. (M) Laboratory in Solid State Physics. (E. Phys. 509.) Experimental investigation on significant experiments in solid state physics. Short lectures in basic theories and experimental techniques. Experiments include x-raying, thermal arrest, NMR, various optical and magneto-optical effects, liquid crystals, semiconductor parameters, and others. Measurement techniques use cryogenic fluids, lasers, IR spectrometers, high pressure apparatus, and other special instruments. Prer. or coreq., E.C.E. 434 or E. Phys. 446 or consent of instructor.

E.C.E. 510-3. (F) Computer-Aided Microwave Circuit Design. This course will emphasize the design of strip-line and microstrip circuits, using a CAD package. Design of impedance transformers, filters, switches, phase shifters, etc., will be discussed. Assignments will include design of typical circuits and their analysis using a microwave circuit analysis program. Laboratory work will include measurements on various circuits, using a network analyzer facility. Prer., E.C.E. 314.

E.C.E. 511-3. (F) Waveguides and Transmission Lines. An intermediate-level fields course dealing with guided-wave systems at HF, microwave, and optical frequencies. Modern waveguiding structures, including circular metallic waveguides, microstrip transmission lines, and optical waveguides are treated. Additional material may include waveguide losses, excitation of waveguides, microwave network theory, coupled-mode theory, resonators, Gaussian beams, pulse propagation in waveguides. Prer., E.C.E. 314 or equivalent.

E.C.E. 513-3. (F) Electromagnetic Radiation. Incoherent radiation, including the black body radiation law, is studied first, concluding with derivation of some of the fundamental antenna laws. Radiation from electrical charge in motion is considered next. Then these concepts are specialized to broadly applicable formulations for radiation from coherent current sources. Concludes with a study of the radiation and impedance characteristics of several types of antennas and antenna systems. Prer., E.C.E. 314 or equivalent.

E.C.E. 514-3. (F) Electromagnetic Boundary Problems. Mathematical theories and physical concepts related to Maxwell's equations. Potential representations, scalar and vector Green's theorem, reciprocity, equivalence principle and image theorem, etc., will be treated. The second part of the course involves applications such as radiation from apertures in cylindrical surfaces, scattering by cylinders and wedges, dipole radiation over a half-space, general mode theory of metallic and surface-wave waveguides, excitations, discontinuities and bends in waveguides. Prer., E.C.E. 511 or 513 or equivalent.

E.C.E. 518-3. Probabilistic Methods in Electromagnetic Wave Propagation. Random phasor sums and their applications, field received from random scatterers, applications to ionospheric, tropospheric, and other scattering, elements of scattering from rough surfaces, propagation through inhomogeneous media, and polarization of scattered waves. Prer., E.C.E. 381 or Math. 481.

E.C.E. 521-3. Analytical Processes in Engineering. Develops analytical skills in areas of concern in engineering applications. Teaching will be by example rather than by course content but will include integration, differentiation, summation of series, approximations, and manipulation of trigonometrical expressions. Prer., fluency in elementary mathematical operations, A.Math. 235 or equivalent.

E.C.E. 525-3. (F) Radar and Remote Sensing. Includes material on wave propagation in the earth's atmosphere, basic radar concepts, and techniques and applications of passive and active remote sensing. Field trips to local radar sites are planned as well as guest lectures from personnel of the Boulder engineering and scientific community who are doing research in remote sensing. Intended for graduate and advanced undergraduate students. Prer., E.C.E. 314 or consent of instructor.

E.C.E. 526-3. (F) Propagation Effects on Satellite and Deep-Space Telecommunications. Role of propagation effects in the design of earth-space telecommunication systems. Trends in communication satellite operations. Effects dependent upon total electron content (TEC) along path, including Faraday rotation and range delay. Ionospheric and interplanetary scintillation. Tropospheric clear-air effects, including refraction, ducting, and range delay. Absorption, scatter, and cross polarization due to precipitation and clouds. Effects of terrain and multipath propagation on mobile satellite operations. Radio noise of atmospheric, terrestrial, and extraterrestrial origin. Telecommunications and radio science for deep-space missions. Prer., E.C.E. 314 or equivalent.

E.C.E. 527-3. (F) Radar Science and Techniques. Radar fundamentals. Scattering by precipitation and atmospheric turbulence. Long-wavelength radars and the dynamics of the middle and upper atmosphere. Design of meterological and clear-air radars. Profiling tropospheric winds, temperature, and humidity by radar and radiometry. Ionospheric sounding using ionosondes and incoherent-scatter radars. Prer., E.C.E. 525 or equivalent experience.

E.C.E. 530-3. Introduction to the Systems Approach.[1] Includes flowcharting, decision point analysis, project phasing and project planning, monitoring and control. Lectures during the first half of course; small group field projects in last half. Requires the production of a professional quality project report and a formal briefing.

E.C.E. 531-3. Telecommunications Systems.[1] The telecommunication systems currently in use and some of the basic technical concepts of their operation are treated in this course. The systems treated include telephone systems (voice, data, and facsimile); coaxial cable and waveguide systems; microwave relay systems (surface and satellite); low-frequency radio systems (communication, instrumentation, and navigational); medium-frequency radio systems (broadcast and point-to-point communications); high frequency radio systems (broadcast, including FM and TV; point-to-point, including troposcatter and meteor scatter; instrumentation; and navigation); and radar. The basic technical concepts treated include signal transmission theory (involving the propagation of guided and unguided electromagnetic waves) and interrelations between channel capacity, traffic theory, information measurement, bandwidth, signal power, and noise power.

E.C.E. 532-3. Telecommunications Systems Theory.[1] This course is concerned with three principal topics: operations management (operations research), communication traffic theory, and future trends in communication systems information handling capabilities. The mathematical fundamentals for study of these topics will be covered, but the student will be assumed to have a knowledge of elementary mathematical probability theory and statistics. Prer., E.C.E. 531 and 534 or equivalent.

E.C.E. 533-3. Introduction to Information Systems.[1] Provides an orientation to computer and communications hardware and software, and system design consideration for employing data processing in organizations. Lectures and seminar. Requires the production of a publishable quality term paper.

[1]Special permission must be obtained to apply telecommunications courses to any degree other than the M.S. in Telecommunications.

E.C.E. 534-3. Introduction to Telecommunication Systems Theory.[1] Fundamentals of electromagnetic fields and waves, probability, waveform analysis, and information theory for persons without a previous technical background. Designed especially for those participants in the telecommunication curriculum whose undergraduate major was in a nontechnical field.

E.C.E. 535-3. Trends in Satellite Communications Systems[1] Fundamental concepts and parametric design parameters of satellite communications systems. Emphasis will be on system throughput sensitivity and selection of satellite orbit, frequency bands, modulation coding, multiple-access schemes, on-board switching and processing, anti-jam techniques, and user terminal characteristics. Current and planned commercial and military satellite communications systems will be examined and compared to future needs and technologies. This course will be aimed at a fundamental understanding of the design drivers of satellite communications systems and their parametric relationships to the system performance.

E.C.E. 536-3. Cable Television.[1] *Summer.* This course, while technical in nature, will be aimed at breadth rather than depth. Thus pertinent FCC regulations, local franchising practices, and economic modeling will be mentioned in the introductory lectures of the course. The bulk of the lectures will treat the TV signal, distribution and interconnection, subscriber terminals, head-ends and central processors, local origination, and interactive systems (two-way). A written term paper will also be presented orally to the class in an applicable area suitable to the student's background.

E.C.E. 537-2. Telecommunications Laboratory.[1] Laboratory experiments demonstrating and verifying material taught in E.C.E. 531. Use is made of spectrum analysis to study signal processors. Topics include noise, AM, FM, PM, TDM, FDM, and data communications. Prer., E.C.E. 531.

E.C.E. 538-3. Data Communications. Basic introductory course to data communications. Defines large segments of terminologies, standards, design, considerations and processes, models, and systems. The course is subdivided into four basic segments which support the interconnection and transmission of digital information. These segments include analog, digital, networks, and protocols.

E.C.E. 539-3. Contemporary Issues in Telecommunications Policy.[1] Lectures, selected readings, and class discussion of major issues in telecommunication policy. A multidisciplinary approach will be stressed and basic values and goals for telecommunications policy making will be explored. The existing structure will be reviewed briefly and critiqued. Topics will be drawn from all areas of telecommunications policy—mass communications, common carrier, and spectrum management. Topics may be added, deleted, or expanded according to class interest.

E.C.E. 540-3. Telephone Systems. The advent of microprocessors and high density memories associated with the increase in competition in the telephone industry (within the U.S.) has stimulated the use of computers in new and novel ways. The ultimate objective is a high grade of service at the lowest possible cost. Computers used as an integral part of a telephone system can aid in accomplishing these goals. This course is aimed at exploring today's use of computers in communication and predicting tomorrow's applications. Prer., E.C.E. 531 and 534.

E.C.E. 541-3. (S) Automatic Control Systems I. Fundamental feedback equation and flow graph and its use in analysis. Synthesis of the one degree of freedom system and its inherent limitations. Synthesis of two degrees of freedom systems for controlled sensitivity to plant ignorance and disturbance attenuation. The critical role of internal noise. The ideal Bode characteristic for absolutely stable and conditionally stable systems. Nonminimum phase and open-loop multivariable and sampled-data systems is treated with special attention to design for disturbance attenuation and controlled sensitivity to parameter ignorance. Statistical optimization for minimum- and nonminimum-phase, and open-loop unstable plants. Prer., E.C.E. 413.

E.C.E. 542-3. (S) Automatic Control Systems II. Continuation of E.C.E. 541. Prer., E.C.E. 541.

E.C.E. 543-3. (S) Nonlinear Control Systems I. Analysis and synthesis of nonlinear feedback control systems. Linearization and stability in the small equivalent linearization and the describing function. The dual input describing function. Stability in the large and the second method of Lyapunov. Stability of time-varying systems. Popov's method and extensions. Prer., E.C.E. 413.

E.C.E. 544-3. (S) Advanced Linear Systems. State space concepts, state space representation of automatic control systems; state transition matrix and state transition function; stability of linear systems, controllability and observability; state-feedback control, realization of system transfer matrices; state estimator and design of feedback systems. Prer., E.C.E. 331 or 413.

E.C.E. 545-3. (S) Sampled-Data and Digital Control Systems I. A study of the analysis and synthesis of control systems characterized by the transmission of control signals by means of periodic pulses; z-transform theory and pulse transfer functions are introduced with applications to digital computers. Prer., E.C.E. 413.

E.C.E. 546-3. (S) Network Synthesis I. Fundamentals of one- and two-port synthesis techniques for achieving networks with specified frequency- or time-domain response. Theory of rational-function approximation to ideal response characteristics. Synthesis of the active inductorless networks essential for practical implementation of large-scale integrated circuit technology. Prer., E.C.E. undergraduate mathematics and network analysis.

E.C.E. 548-3. (S) Engineering System Analysis and Design. Procedures of mathematical engineering analysis and design. The formulation and solution of system problems of an interdisciplinary nature are stressed. Analog and digital computer methods of solution are used. Prer., E.C.E. 541 or equivalent.

E.C.E. 551-3. (D) The Hardware-Software Interface. Principles of interfacing hardware and software. Hardware and software processes and how to synchronize them. Hardware-software tradeoffs. Prer., E.C.E. 130/257 and E.C.E./C.S. 453.

E.C.E. 552-3. (D) Computer Data Structures. Basic concepts of data. Linear lists, strings, and arrays. Representation of trees and graphs. Storage systems and structures, storage allocation and collection. Multilinked structures. Searching and sorting techniques. Prer., E.C.E. 453.

E.C.E. 553-3. (D) Fundamental Concepts of Programming Languages. (C.S. 553.) Focuses on programming language models, including denotational and algebraic semantics, and their relationship to attribute grammars. The modeling theory is used to develop both a mathematical model and an attribute grammar for a significant fragment of a programming language. Prer., E.C.E. 222 and 401, or consent of instructor.

E.C.E. 554-3. (D) Seminumerical Methods for Digital Computers. (C.S. 554.) This is a survey of topics in the borderline area between numerical analysis and computer systems programming and design. A knowledge of assembly language and some familiarity with computer architecture are necessary for the course. Some topics covered are computer round-off error, floating point arithmetic, the generation of random numbers, and parallelism in numerical calculation. Prer., E.C.E. 401, 453, and numerical analysis.

E.C.E. 556-3. (D) Translation of Programming Languages. (C.S. 556.) A study of practical techniques for translating text generated by humans into programs understood by machines: lexical, syntatic and semantic analysis, code generation, assembly and optimization, error reporting and recovery. Prer., E.C.E. 222 or 453; and 553, or consent of instructor.

E.C.E. 557-3. Operating Systems. (C.S. 557.) A study of the supervisory programs within a computer system which interact most closely with the hardware, and which allow efficient and shared access to the computer. Topics covered include processes (communication implementation, synchronization), memory management (storage allocation, virtual memory), and processor management (multiprogramming, timesharing, scheduling). Prer., C.S. 401 or 553, C.S. 225 or equivalent.

E.C.E. 558-3. (D) Artificial Intelligence. (C.S. 558.) The design of machines and systems that have been created to perform tasks that are considered to require intelligence. Prer., E.C.E. 401.

[1]Special permission must be obtained to apply telecommunications courses to any degree other than the M.S. in Telecommunications.

E.C.E. 559-3. (D) Advanced Computer Architecture. A broad scope treatment of the important concepts in the structural design of computer systems. A large number of actual computers will be studied in depth. Prer., E.C.E. 459 or consent of instructor.

E.C.E. 561-3. (C) Noise and Random Processes. Brief review of probability theory, sequences of random variables, specification of stochastic processes, stationarity, correlation functions and power spectra, derivative of a random process, Markov chains, linear and nonlinear systems with random input, application to noise theory. Prer., E.C.E. 381.

E.C.E. 562-3. (C) Information Theory and Coding. Information and entropy. Markov chains, combined systems, continuous systems, coding theory, channel capacity, modulation, applications to communication engineering. Prer., E.C.E. 381 or consent of instructor.

E.C.E. 563-3. (C) Theory and Application of Digital Filtering. The use of digital and discrete time systems in engineering has been increasing due to the widespread use of digital computers and because of the ease of manufacture of digital components. This course is an introduction into the techniques that are used to analyze such systems. The primary emphasis is on study of linear discrete time systems that are used to perform operation on random sequences for the purposes of signal direction, prediction, and signal enhancement. The course will cover such topics as linear difference equations, z-transforms, characterization of discrete-time systems by state variables, random sequences, deconvolution filters, discrete-time matched filters and Wiener filters, discrete-time filters in estimation and detection, properties of discrete stochastic processes. Prer., E.C.E. 331, 381, or Math. 481.

E.C.E. 564-3. (C) Modern Methods of Spectral Estimation. The analysis of time-series data is often based on a decomposition of the data in terms of sinusoidal signals or harmonics. This allows the experimenter to ascertain periodicities in the data that would otherwise be impossible to find. This course covers classical Fourier methods of spectral estimation known as the periodogram as well as the more modern methods. These include the maximum entropy or Burg method, the maximum likelihood method, the method of Pisarenko, and the modified Kalman filtering approach. Prer., E.C.E. 331 or consent of instructor.

E.C.E. 565-3. (C) Detection and Extraction of Signals From Noise. (C.S. 565.) This course is an introduction into detection and extraction methods used in signal processing and includes such subjects as decision theory, detection of known and random signals, optimum received design and evaluation, estimation theory, estimation of parameters, Weiner filtering, Kalman-Bucy filtering, application to problems in communication theory. Prer., E.C.E. 381 or equivalent.

E.C.E. 566-3. (C) Optimization Techniques. An introduction to problems involving optimization in the presence of uncertainty and a survey of computational methods for obtaining solution. Introductory material includes necessary conditions for solutions to unconstrained and constrained minimization problems (Kuhn-Tucker conditions, convex programming). Several algorithms for single and multidimensional search are given, including direct and gradient methods. Applications may include linear programming and game theory, decision theory, pattern recognition, dynamic programming, sequential decision theory, Markov chains with decision rules, and optimization of dynamical systems. Prer., E.C.E. 381 or equivalent.

E.C.E. 557-3. Operating Systems. (C.S. 557.) A study of the supervisory programs within a computer system which interact most closely with the hardware, and which allow efficient and shared access to the computer. Topics covered include processes (communication implementation, synchronization), memory management (storage allocation, virtual memory), and processor management (multiprogramming, timesharing, scheduling). Prer., E.C.E. 401 or 553, C.S. 225 or equivalent.

E.C.E. 568-3. (C) Optical Communication Systems. Analysis and design of communication systems which use light as the information carrier. Free-space, fiber-optic, turbulent atmospheric, and scattering channels, statistical channel characterization; spatial aspects of optical channels; modal representation of random fields. Coherent and incoherent sources; modulation methods; spatial modulation. Modeling and statistical analysis of quantum photodetectors; Poisson and related processes; thermal and shot noise. Direct and heterodyne detection; analog and digital transmission; signal-to-noise ratios; error probabilities. System optimization. Prer., E.C.E. 424.

E.C.E. 569-3. (C) or (F) Optical and Spatial Information Processing. Treats the processing of two- and three-dimensional spatial information. The scalar diffraction theory necessary to describe the information-bearing wavefront is developed and wavefront recording, modulation, and reconstruction are described. Topics included are holography, Fourier transform properties of lenses, two-dimensional convolution and correlation, pattern recognition, optical information processing, and data storage. Prer., E.C.E. 314 and 331 or equivalent.

E.C.E. 570-3. (P) The Nature of Polyphase Induction Machines. Parameters of the equivalent circuit, operational behavior of induction machines, influence of design parameters on performance characteristics, space and time harmonics, effect of variable frequency supplies and application of inverter supplies to induction machines, noise production. Prer., E.C.E. 317.

E.C.E. 571-3. (P) Energy Systems Analysis I. Transmission line constants, including details of GMD methods, skin effect. Analysis of balanced and unbalanced line using distributed parameters, energy flow from circle diagram approach, traveling-wave phenomena, stability. Prer., E.Phys. 212 and E.C.E. 317 or consent of instructor. (Also available via ACE TV.)

E.C.E. 572-3. (P) Energy Systems Analysis II. Application of symmetrical components to faults on transmission systems, determination of system constants, introduction to calculating board and network analyzers, measurement of sequency quantities, relaying philosophies, power-flow studies. Prer., E.C.E. 317 or consent of instructor. (Also available via ACE TV.)

E.C.E. 573-3. (P) Tensor Analysis of Electric Energy Systems. The application of matrix and tensor methods to the analysis of energy systems and subsystems; energy transfer; load prediction and system design. Introduction to Kron's method of Diakoptics. Prer., E.C.E. 416 or equivalent.

E.C.E. 574-3. (P) Synchronous Machines. Review of equivalent circuit of synchronous machines in abc and dqo coordinates; phasor diagram; steady-state, transient and subtransient operating conditions; calculation and physical interpretation of reactances; application of theory to various short circuits, synchronizing out-of-phase, damping torques, hunting, governor action, starting, etc.; discussion of standard test procedures. Prer., E.C.E. 317.

E.C.E. 575-3. (P) Energy Systems Stability I. Transient and steady-state stability limits of energy transmission systems; electrodynamic characteristics of generators, synchronous condensers and motor loads. Prer., E.C.E. 416 or equivalent.

E.C.E. 576-3. (P) Power Distribution Systems. Use of per unit methods to find transient voltage behavior of industrial power systems due to motor starting, spot welders, etc. System and device responses due to series and shunt capacitors and problems of subharmonic and over-excitation on induction motors. Prer., E.C.E. 216 and 317 or consent of instructor. (Also available via ACE TV).

E.C.E. 577-3. (P) Power System Protection. Concepts of power system operation and the use of R-X diagrams in selection of protection needs. Comparison of electromechanical and static protection systems. Review of problem areas such as system stability, loss-of-excitation and EHV line protection. Prer., E.C.E. 216 and 317 or consent of instructor. (Also available via ACE TV).

E.C.E. 578-3. (P) Electromagnetic Fields in Electrical Devices I. Methods for linear magnetic fields in electrical devices; potential equations of electromagnetic fields; function theory; conformal mapping; method of images; numerical methods. Prer., E.E. 314 and E.C.E. 416.

E.C.E. 580-3. (B) Electrophysiological Measurements. Lectures on, and demonstration of, the measurement and control of electrical activity in the nervous system and other excitable tissue. Topics include: use of microelectrode recording and stimulating techniques, voltage clamping, single and multiple unit recording in the intact brain, in vitro techniques for studying isolated neural sub-systems, electroencephalography and evoked potential studies, electrocardiography and magnetocardiography, computer processing of neuroelectric data. Of particular interest to students involved in

biomedical engineering or neuroscience programs. Prer., consent of instructor.

E.C.E. 581-3. (B) Neuroelectric Signals. The biophysical bases of electrical signal generation and propagation in nerve cells and other excitable tissues. Topics include electrochemical equilibrium across cell membranes, resting and action transmembrane potentials, control of ionic conductance changes, pacemaker firing patterns, sensory transduction, synaptic transmission, and active transport processes. Of particular interest to students involved in biomedical engineering or neuroscience programs. Prer., consent of instructor.

E.C.E. 582-3. (B) Neuroelectric Systems. An extension of cellular neuroelectric concepts into the arena of integrative neurophysiology and neuroethology. Topics include synaptic modulation of neuronal firing patterns, interactions in dendritic trees, computer simulation of interactive neural nets, the command neuron concept, sensory information processing, and the generation of simple behaviors directly correlated with neural network organization. Of particular interest to students involved in biomedical engineering or neuroscience programs. Prer., E.C.E. 581, Aero 581, or equivalent cellular neurophysiology course.

E.C.E. 583-3. (B) Biomedical Systems Analysis. Quantitative modeling of biological processes aided by computer simulation. Typical systems studied will be mammalian cardiovascular and respiratory systems, skeletal and cardiac muscle, eye-tracking mechanisms, and ecological models. Necessary biological background will be presented. Prer., A. Math. 235 or 236.

E.C.E. 585-3. (CS) VLSI Synthesis Layout and Silicon Compilation. Topics include theory, algorithms and data structures for VLSI logic synthesis (including decomposition, minimization, and synthesis into library cells), layout (including CAD algorithms for automatic place and route), and silicon compilation (including gate array, PLA, and hierarchical standard cell methodologies). Prer., E.C.E. 485 or equivalent.

E.C.E. 586-3. (CS) Simulation Tools for VLSI Systems. Topics include the theory, algorithms and data structures for VLSI simulation. Simulation at the circuit switch, timing (relaxation based, logic and functional levels will be covered. In addition, question of input language processing (lexical analysis, parsing and graphical input techniques) and test generation and fault simulation will be covered. Prer., E.C.E. 485 or equivalent, plus a strong background in programming.

E.C.E. 590-0. Graduate Seminar. Meetings of staff members, visiting speakers, and graduate students to discuss recent advances in electrical engineering research.

E.C.E. 591 to 599-0 to 3. Special Topics. Intermediate courses of variable title and variable credit, usually offered once by guest lecturers. See current departmental notices for detail.

E.C.E. 601-3. Solid State Electronics I. Introduction to the quantum theory of solids: free electron theory of metals; crystal lattices; energy band theory of crystals (particularly semiconductors); electron dynamics in perfect crystals (including tunneling); Fermi statistics; electron-photon interactions; lattice vibrations; electron transport in real crystals; elementary theories of ferromagnetism and of superconductivity. Prer., E.C.E. 434 and 501, or consent of instructor.

E.C.E. 602-3. Solid State Electronics II. Intermediate quantum theory of solids; advanced methods in band theory (group theory, approximation methods, pseudopotentials); electron-electron interaction effects; quantum theory of electron scattering; BCS theory of superconductivity. Prer., E.C.E. 601.

E.C.E. 606-0 to 6. Advanced Topics in Physical Electronics. Semiformal lecture-discussion of topics of current interest. Most lectures are presented by the participants. Each student registered for credit will present at least one lecture per semester. Prer., consent of instructor.

E.C.E. 609-3. Quantum Electronics. Introduction to the theory of lasers, optical resonators, and nonlinear optics, with the emphasis on application to devices. Prer., E.C.E. 501, some background in quantum mechanics.

E.C.E. 621-3. Mathematical Functions for Engineering. Derivation and exposition of important functional properties as required in engineering applications. Emphasis on those properties that have been found important in engineering. Functions examined include gamma, Bessel, Legendre, elliptic, hypergeometric, and others. Prer., E.C.E. 521 or M.E. 522.

E.C.E. 627-3. Mathematical Methods of Field Theory I. Study and application of some of the mathematical methods needed in solving certain boundary-value problems in electromagnetic field theory. The material will be chosen from a wide area, including the following: Wiener-Hopf and other transform methods; singular integral equations; variational calculus; mode expansions; Green's theorem; quasistatic methods; asymptotic, steepest-descent, and WHB techniques; linear vector spaces, and matrices. The methods will be illustrated by physical examples taken from waveguide diaphragms; junctions and other discontinuities; linear antennas and antenna arrays; diffraction and scattering; wave propagation at surface and inhomogeneous media. Prer., an introduction to complex variables and E.C.E. 514 or equivalent.

E.C.E. 628-3. Mathematical Methods of Field Theory II.[1] Continuation of ECE 627. Prer., E.C.E. 627.

E.C.E. 640-3. Network Synthesis II. Active network synthesis employing negative impedance converters, gyrators, and operational amplifiers. Matrix manipulation of networks, the scattering matrix, approximation methods for generating rational functions, transfer function synthesis. Prer., E.C.E. 546.

E.C.E. 641-3. Optimal Control Theory. Formulation of optimal control problems, performance index; the variational approach to optimal control problems; Poutryagin's maximum principle; Bellman's dynamic programming; the principle of optimality, the Hamilton-Jacobi equation; computational methods; the steepest descent method, variation of extremals, quasilinearization; and gradient projection, etc. Prer., E.C.E. 544.

E.C.E. 642-3. Learning and Adaptive Systems.[1] System identification theory; adaptive systems subject to deterministic and random inputs and disturbances, sensitivity analysis; parameter variation problems, learning systems. Prer., E.C.E. 542 and 544.

E.C.E. 643-3. Theory of Nonlinear Systems.[1] The phase plane, singular points, limit cycles. Describing functions for single, multiple, and random inputs. System compensation and design by describing functions. The self-oscillating adaptive system—single- and multiple-loop designs. Liapunov functions for stability analysis and system design. Popov's method and extensions. Applications of functional analysis. Prer., E.C.E. 544.

E.C.E. 645-3. Sampled-Data and Digital Control Systems II.[1] An advanced study of the theory of discrete-time systems. Discrete-time control system stability and stochastic processes will be treated in depth. Prer., E.C.E. 545.

E.C.E. 663-3. Advanced Digital Signal Processing Methods. Presents the application of digital filtering theory to problems in communication and signal processing. Topics covered include computer implementation techniques, fast Fourier transforms, quantization effects, and recursive (adaptive) digital filtering. Prer., E.C.E. 563.

E.C.E. 673-3. Advanced Synchronous Machines.[1] Study of transient characteristics of synchronous machines such as short-circuit currents and torques, out-of-phase synchronizing, and starting torque. Prer., E.C.E. 416 or equivalent.

E.C.E. 678-3. Electromagnetic Fields in Electrical Devices II.[1] Numerical methods for nonlinear electrical devices; nonlinear partial differential equations; representation of magnetization characteristics; successive pointwise overrelaxation; successive line overrelaxation; alternating direction methods; underrelaxation of reluctivities; application to rotating machines and nuclear accelerator magnets. Prer., E.C.E. 578.

E.C.E. 691 to 699-0 to 3. Selected Topics. Courses of variable title and variable credit, usually offered once by guest lecturers. See current departmental notices for details.

E.C.E. 700-variable credit. Master's Thesis.

E.C.E. 800-0 to 8 (16 to 24 maximum). Doctor's Thesis.

E.C.E. 920-1 to 3. Independent Study. An opportunity for sophomores to do independent, creative work. Prer., consent of instructor.

E.C.E. 930-1 to 3. Independent Study. An opportunity for juniors to do independent, creative work. Prer., consent of instructor.

E.C.E. 940-1 to 3. Independent Study. An opportunity for seniors to do independent, creative work. Prer., consent of instructor.

E.C.E. 950-1 to 6. Independent Study. An opportunity for students to do independent, creative work at the 500 level. Prer., consent of advisor.

E.C.E. 959-variable credit. Telecommunications Project. Supervised study project.

E.C.E. 960-1 to 6. Independent Study. Affords an opportunity for students to do independent, creative work at the 600 level. Prer., consent of adviser.

ENGINEERING—NONDEPARTMENTAL COURSES

Engr. 101-2. Engineering Drawing. Two 3-hr. labs per wk. Beginning engineering drawing; use of instruments, orthographic projection, pictorial drawing, sections, dimensioning, and working drawings.

Engr. 109-3. Creative Uses of Technology I. An introductory-level course for students not majoring in engineering or science. The course is constructed around concepts and procedures employed by the engineer and scientist, but with major emphasis on improvement of the understanding of modern technology, its methods, and its impact on society. Modeling, decision making, and feedback as applied to biological, mechanical, electrical, thermal, and other systems. Study of problems such as population growth, traffic flow, spread of disease. Use and impact of computers.

Engr. 110-3. Creative Uses of Technology II. A continuation of Engr. 109 in which the techniques learned there are developed further and applied to problems of general interest. Prer., Engr. 109.

Engr. 131-3. Man and His Environment. A study of the interaction between technological innovations and the natural environment during the last century.

Engr. 300-2. Interaction of Engineering and Society. A seminar course of case studies in the interrelationships of engineering and society—the effects of social, political, and economic pressures on decision making and operations related to engineering and, conversely, the effects of engineering works on society. The students prepare written cases for discussion by the class. Prer., consent of instructor.

Engr. 301-3. Thermodynamics. Introduction to energy and its transformations, entropy and information theory, states of matter, and statistical mechanics, with engineering applications. Prer., E.Phys. 112 and A. Math. 236.

Engr. 316-2. Technical Report Writing and Communication. Instruction and practice in writing and analyzing reports, papers, articles, and other forms of communication. Style and editing are emphasized. Prer., junior standing.

Engr. 400-3. Occupational Safety Management. Introduction and orientation to the basic fundamentals of the interdisciplinary field of occupational safety and health including the philosophy of recent federal and local governmental enactments. Open to students in the Master of Engineering program or by consent of instructor.

Engr. 401-3. Undergraduate Research. Supervised individual research projects in the student's major department.

Engr. 403-1. Literature of the Sciences and Engineering. (Bib. 403.) A brief survey of the chief reference sources in the sciences and engineering leading to the development of a bibliography in the student's chosen field of interest under the guidance of the appropriate science librarian. Recommended for majors in sciences and engineering.

ENGINEERING PHYSICS

E.Phys. 111-4. General Physics. Three lect., one rec. per wk., plus three evening exams during the semester. First semester of three-semester sequence for science and engineering students. Covers kinematics, dynamics, momentum of particles and rigid bodies, work and energy, gravitation, simple harmonic motion, and introduction to thermodynamics. Prer., knowledge of algebra, geometry, and trigonometry; coreq., calculus through derivatives and indefinite and definite integrals of polynomials and trigonometric functions, as typically covered in Math. 130 or A.Math. 135.

E.Phys. 112-4. General Physics. Three lect., one rec. per wk., plus three evening exams during the semester. Second semester of three semester introductory sequence for science and engineering students. Covers electricity and magnetism, wave motion, and geometrical optics. Prer., E.Phys. 111; coreq., Math. 230 or A.Math. 136.

E.Phys. 114-1. Experimental Physics. One lect., one 2-hour lab. period per wk. To be taken in parallel with E.Phys. 112.

E.Phys. 116-4. General Physics—Honors. First semester of a two-semester sequence covering the material of Phys. 112, 213, and 214. Prer., Phys. 111 and consent of instructor. (If E.Phys. 116 is elected, E.Phys. 217 must be completed also.)

E.Phys. 212-4. General Physics: Electricity, Magnetism, and Optics. Covers the properties of electric and magnetic fields, Maxwell's equations, electromagnetic waves and wave equation, and the required vector analysis. Also serves as an introduction to geometrical and physical optics. A sequel to E.Phys. 111 designed especially for students enrolled in the Department of Electrical Engineering. Students may not earn credit for both E.Phys. 212 and 112. Prer., E.Phys. 111, Math. 230, or Math. 136; coreq., Math. 240 or A.Math. 235.

E.Phys. 213-3. General Physics. Three lect. per wk. Third semester of introductory sequence for science and engineering students. Covers special relativity, quantum theory, atomic physics, solid state, and nuclear physics. Prer., E.Phys. 112 and 114.

E.Phys. 214-3. Introductory Modern Physics. Three rec. per wk. Introduces mathematical techniques required for a quantitative understanding of the phenomena of modern physics, including vector algebra and vector calculus, Fourier analysis, and some of the differential equations of physics. Prer., Phys. 213.

E.Phys. 215-1. Experimental Physics. One lect., one 2-hr. lab. per wk. To accompany E. Phys. 213. Includes many experiments in modern physics, including atomic physics, solid state physics, electron diffraction, radioactivity, and quantum effects.

E.Phys. 217-4. General Physics—Honors. Second semester of a two-semester sequence covering the material of Phys. 112, 213, and 214. Prer., Phys. 116 and permission of instructor.

E.Phys. 317-2 and 318-2. Junior Laboratory. One lect., one 3-hr. lab. per wk. Contains experiments on data handling, electrical measurements, electronics, optics, vacuum techniques, heat and thermodynamics, mechanics, and modern physics. Emphasis will be on developing basic skills and on design of experiments. Each student will carry out at least one project experiment each semester. Coreq., E.Phys. 331. Phys. 317 is prer. for Phys. 318.

E.Phys. 321-3. Analytical Mechanics. Three rec. per wk. Newtonian mechanics, oscillations, Lagrange's and Hamilton's equations, central forces, and scattering. Analytical procedures employing the methods of vector analysis and calculus. Prer., E.Phys. 214 and A.Math. 236 or equivalent.

E.Phys. 322-3. Analytical Mechanics and Quantum Mechanics. Topics covered include noninertial reference frames, rigid body motion, coupled ocillators, introduction to quantum mechanics, Bohr theory, simple solutions to Schroedinger equation, and perturbation theory. Prer., E.Phys. 321.

E.Phys. 331-3 and 332-3. Principles of Electricity and Magnetism. Elements of mathematical theory of electricity and magnetism including electrostatics, magnetostatics, polarized media, direct and alternating current theory, introduction to electromagnetic fields and waves, introduction to special relativity. Prer. for E.Phys. 332 is E.Phys 331.

E.Phys. 341-3. Thermodynamics and Statistical Mechanics. Statistical mechanics applied to macroscopic physical systems; statistical thermodynamics; classical thermodynamic systems; applications to simple systems. Relationship of the statistical to the thermodynamic points of view is examined. Prer., E.Phys. 321.

E.Phys. 446-3. Solid-State Physics. (E.E. 434.) Primarily for senior physics majors. Crystal structure, lattice dynamics, band theory, semiconductors, ferromagnetics, etc. Prer., Phys. 322 and 341.

E.Phys. 451-3. Optics. Basic electromagnetic theory of light, using Maxwell's equations. Examples in geometrical optics; extensive applications in physical optics, including diffraction and polarization. Spectra, including Zeeman effect and fluorescence. Recent advances in experimental techniques; microwaves, optical lasers, image converters, etc. Prer., E.Phys. 332.

E.Phys. 455-1. Optics Laboratory. One 3-hr. lab. per wk. Lab. experiments to supplement E.Phys. 451. Emphasis on techniques as well as basic principles. Prer., E.Phys. 451.

E.Phys. 491-3, 492-3. Atomic and Nuclear Physics. Topics include quantum-mechanical treatment of the one-electron atom, atomic shell structure, atomic and molecular spectroscopy, band theory of solids, X rays, nuclear properties, radioactivity, and properties of the fundamental particles. Prer., passing grade of *C* or better in Phys. 322 and 332 or permission of instructor.

E.Phys. 495-2, 496-2. Senior Laboratory. One lect., one lab. per wk., to be taken with E.Phys. 491, 492. Experiments introduce the student to realities of experimental physics so that he will gain a better understanding of theory and an appreciation of the vast amount of experimental work done in the physical sciences today. Some experiments from the optics laboratory can be included on a replacement basis for students registered for both E.Phys. 496 and 455. Prer., consent of instructor.

E.Phys. 501-3. Health Physics. *Spring, alternate years.* Two lect., one lab. per wk. Health physics is a course designed to provide job-oriented skills. Topics covered include radiation dosimetry, radiation biophysics, radioecology, reactor health physics, and medical physics. The labs include exercises with radioactive isotopes as well as tours of off-campus facilities. Prer., consent of instructor.

Phys. 503-3, 504-3. Intermediate Mathematical Physics I, II. (Math. 553, 554.) Survey of classical mathematical physics, starting with complex variable theory and finite dimensional vector spaces. Topics in ordinary and partial differential equations, the special functions, boundary value problems, potential theory, and Fourier analysis. Prer., Math. 431 and 432 or equivalent.

E.Phys. 515-3. Introductory Plasma Physics. (A.G. 515.) *Spring.* Basic phenomena of ionized gases; static and dynamic shielding, linear waves, instabilities, particles in fields, collisional phenomena, fluid equations, collisionless Boltzmann equations, Landau damping, scattering and absorption of radiation in plasmas, elementary nonlinear processes, WKB wave theory, controlled thermonuclear fusion concepts, astrophysical applications, experimental plasma physics (laboratory). Prer., A.G. 554 or equivalent; Phys. 631.

E.Phys. 516-3. Intermediate Plasma Physics. (A.G. 516.) *Fall.* Continuation of Phys. 515. topics vary yearly but include nonlinear effects such as wave coupling, quasilinear relaxation, particle trapping, nonlinear Landau damping, collisionless shocks, solitons; nonneutral plasmas; kinetic theory of waves in a magnetized plasma; anisotropy; inhomogeneity; radiation—ponderomotive force, parametric instabilities, stimulated scattering; plasma optics; kinetic theory and fluctuation phenomena. Prer., Phys. 515 or instructor consent.

E.Phys. 517-3. Advanced Plasma Physics. *Spring.* Continuation of Phys. 516. Radiative transfer of plasma waves, advanced kinetic theory of plasmas, spontaneous emission, transport phenomena, fluctuation-dissipation theorems, modulational instability, wave trapping and collapse, turbulence, special topics. Prer., Phys. 516 or instructor consent.

E.Phys. 585-3. Gravitational Theory. *Alternate years.* Theory of general relativity. Three lect. per wk. Einstein's relativistic theory of gravitation is presented from a geometric viewpoint; applications to astrophysical problems (gravitational waves, stellar collapse, etc.) are given.

E.Phys. 940-variable credit. Independent Study. Selected topics for undergraduate independent study. Subject matter to be arranged. Prer., consent of instructor.

MECHANICAL ENGINEERING

M.E. 130-2. Introduction to Mechanical Engineering. Introduction to vector analysis, dimensional analysis, and the engineering approach to problem solving and design. Professional ethics and opportunities in engineering.

M.E. 131-3. Manufacturing Processes. An introduction to materials and processes in manufacturing; basic materials consideration for fabrication; materials forming and joining techniques; fundamental metrology and quality control concepts; automation; an introduction to the design-materials-fabrication interaction.

M.E. 195-1 to 3. Special Topics in Mechanical Engineering. Subject matter to be selected from topics of current technological interest. Credit to be arranged. Prer., consent of instructor.

M.E. 203-3. Introduction to Computer-Aided Design. Review of computer languages, programming, and special requirements. Linear and nonlinear programming; matrix methods and numerical techniques including constraints, simulation, and graphical displays, optimization methods. Applications to design of mechanical systems. Prer., C.S. 120, A.Math. 136.

M.E. 212-3. Engineering Thermodynamics I. First and second laws of thermodynamics; properties, states, thermodynamic functions, entropy, and probability. Prer., A.Math. 235.

M.E. 281-3. Mechanics I. Elements of vector algebra, abstract statics of system bound vectors, equilibrium of rigid bodies, principle of virtual work. Prer., A.Math. 135.

M.E. 282-3. Mechanics II. Dynamics of a particle. Kinematics of rigid bodies, kinematics of a system of particles, vibrations. Prer., M.E. 281.

M.E. 295-1 to 3. Special Topics in Mechanical Engineering. Subject matter to be selected from topics of current technological interest. Credit to be arranged. Prer., consent of instructor.

M.E. 301-3. Introduction to Materials Science I. A unified materials science/engineering approach to engineering solids. Metals, ceramics, polymers, and composites; their structure/property interactions. Primary emphasis is on mechanical behavior. Some consideration of thermal behavior. Modification of behavior (properties) through changes in structure. Materials engineering emphasis is reflected in the design-materials-fabrication interaction. Prer., E.Phys. 213, M.E. 282.

M.E. 313-3. Engineering Thermodynamics II. Thermodynamics of state, thermodynamic cycles, reacting and nonreacting mixtures, chemical and phase equilibrium. The majority of assignments are design oriented. Prer., M.E. 212.

M.E. 314-3. Measurements I. Principles of digital and analog measurements; systems for sensing, transporting, modifying, and outputting information; impedance matching of components; systematic and random error analysis; students; *t* and *Chi* square significance tests. Prer., M.E. 212, E.Phys. 112, A.Math. 236.

M.E. 316-2. Measurements II. Two lab periods per wk. Application of the theory of measurement to a wide variety of instruments and measurement systems. Laboratory reports are required. Prer., M.E. 314.

M.E. 362-3. Heat Transfer. Basic laws of heat transfer by conduction, convection, and radiation. Computer-aided design of heat transfer devices such as fans, heat exchangers, and solar collectors. Prer., M.E. 212, 385, or equivalent, A.Math. 236.

M.E. 371-3. Systems Analysis I. (Aero. 341.) Steady-state sinusoidal analysis, complex variables, integral transform theory. Prer., A.Math. 236, M.E. 282.

M.E. 372-3. Systems Analysis II. (Aero. 342.) Transfer function, the root-locus method, analog simulation, hydraulic, pneumatic, and electrical systems applications. Prer., M.E. 371.

M.E. 383-3. Mechanics III. Elements of tensor notation. Kinematics of deformable media. Mass, momentum, and energy conservation principles. Constitutive equation for linearly elastic solids and Newtonian viscous fluids. Prer., M.E. 282, A.Math. 236.

M.E. 384-3. Mechanics IV. Constitutive equations of a linear elastic solid. Extension torsion and flexure of rods with application to design problems. Cylinder under pressure with linearization to thin walled cylinders; pressure vessel design. Euler buckling. Thermal stresses. Design problems are included. Prer., M.E. 383.

M.E. 385-3. Mechanics V. Fundamentals of fluid flow with application to engineering problems including fluid statics, kinematics and the conservation equations for mass, momentum, and energy. Specific emphasis is given to Bernoulli's equations, Euler's equations, potential flow, laminar and turbulent viscous boundary layers, and compressible flow. Design problems are included. Prer., M.E. 383.

M.E. 386-2. Fluid Mechanics Laboratory. One-hour lect. and 3-hour lab. which exposes students to modern methods in fluid flow visualization and measurement. Experiments include low Reynolds number drag, pipe transition flow, shock waves, fluid slashing, fluid spin-up, vortex rings, capillary waves, Taylor-Couette instabilities, and double diffusion. Prer., M.E. 385.

M.E. 395-1 to 3. Special Topics in Mechanical Engineering. Subject matter to be selected from topics of current technological interest. Credit to be arranged. Prer., consent of instructor.

M.E. 400-1 to 6. Independent Study. Subjects arranged in consultation with undergraduate advisor to fit needs of the particular student. Prer., senior standing.

M.E. 401-3. Mechanical Behavior of Materials. Study of the relationship between material structure and the fundamental processes of deformation, yield, and fracture. Includes a comprehensive discussion of stress-strain concepts, failure criteria, and deformation and strengthening mechanisms with particular emphasis on dislocation mechanics. Laboratory provides hands-on experience in the determination of mechanical behavior via computerized data reduction and analysis. Formal laboratory reports are required. Prer., M.E. 301.

M.E. 414-3. Mechanical Engineering Design I. Review of mechanics of materials and stress analysis; detailed design of various machine components including shafts, bearings, gears, brakes, springs, and fasteners. Emphasis on application and open-ended design problems. Computers are extensively used. Prer., M.E. 384.

M.E. 416-3. Mechanical Engineering Design II. Individual device development and product development cycles. Introduction of topics to motivate the creative process, the quantitative process, or a blend. Incorporation of the supporting disciplines of analysis, organization, computation, and communication as needed. Identification of difficulties in creation, organization, decision, and compromise. The subject material is organized chronologically so that a project can be started immediately. Prer., M.E. 414.

M.E. 421-3. Air Conditioning. Physical and thermodynamic laws of water vapor and air mixtures; basic principles of heating and ventilating; determination of heating and cooling loads; examination of heating and cooling systems. Prer., M.E. 313 and 362.

M.E. 422-3. Air Conditioning Design. Design and layout of heating, ventilating, air conditioning systems. Prer., M.E. 421.

M.E. 424-3. Refrigeration. Principles of mechanical refrigeration; absorption cycle; liquefaction of gases; properties of refrigerants. Thermodynamics analysis of refrigeration systems. Prer., M.E. 313 and 362.

M.E. 442-3. Mechanical Engineering Laboratory. Two 3-hr. lab. periods per wk. plus 1 hr. of classroom work. Team participation on nine experience projects on conventional equipment (compressor, engines, fans, etc.). The majority of the experiments are formulated so that the students must decide what information is required to meet the objectives of the experiment and how it is to be obtained. The one hour of classroom participation is devoted exclusively to writing and public speaking. Prer., M.E. 313, 316, 384, and 385.

M.E. 450-3. Nuclear Engineering. (Aero. 430.) Elements of atomic and nuclear processes. Basic concepts of reactor theory, design, and operation. Prer., M.E. 313.

M.E. 455-3. Energy Conversion. Power cycle thermodynamics, turbocompressor and expander processes, combustion systems, applications and limitations of direct energy conversion systems. Prer., M.E. 313.

M.E. 457-3. Combustion Phenomena. Application of multicomponent fluid equations of motion and chemical thermodynamics to a variety of combustion problems. Examples include droplet and particle combustion, boundary layer combustion, detonation and deflagration wave theory, topics related to internal combustion engines, liquid and solid rockets. Prer., M.E. 313 and 385.

M.E. 458-3. Computer Aided Thermal Design. Computer programming of thermodynamic cycles; compressor, expander, and heat exchanger component design; team design project in solar power, heating, or cooling system; oral and written reporting. Prer., M.E. 313 and 362.

M.E. 461-4. Analytical Methods of Engineering I. Solutions of linear algebraic equations and applications to theory. Topics include matrix analysis, eigenvalue problems, bilinear and quadratic forms, boundary and initial value problems of physics, solution of wave equations by the method of characteristics and applications to elastic wave propagation and supersonic flows. Prer., A.Math. 236 or equivalent.

M.E. 462-4. Analytical Methods of Engineering II. Boundary and initial value problems of physics. Topics include solution of partial differential equations of physics by the methods of separation of variables; Sturm-Liouville theory, variational principles and applications; Green's functions and applications. Prer., A.Math. 236 or equivalent.

M.E. 471-4. Fluid Mechanics. Viscous incompressible and compressible fluid flows. Topics include derivation of equation governing viscous compressible fluid motion; specializations to simple flows; boundary-layer theory; nozzles and diffusers; transition. Prer., M.E. 385 or equivalent.

M.E. 483-3. Vibration Analysis. Single and multiple degree of freedom lumped parameter systems. Shock spectra. Generalized coordinates; Lagrange's equations. Vibration of continuous systems. Prer., M.E. 384 and A.Math. 236.

M.E. 485-4. Mechanisms. Analysis and synthesis of two- and three-dimensional kinematic systems. Plane motion: linerar and angular velocity and acceleration, relative velocity and instantaneous centers; the Kennedy-Aronhold theorem. Four-bar linkage, coupler curves, the Euler-Savary equation. Three-dimensional motion; finite rotation, Euler's and Chasles' theorem. Geometric and algebraic methods for generating specified motions. Prer., M.E. 383.

M.E. 486-4. Lagrangian Dynamics. Brief review of Newtonian dynamics, Lagrange's equations for particles, systems, and rigid bodies. Conservative and nonconservative systems, potential energy and dissipation functions. Constraints. Quasi-coordinates. Nonmechanical systems. Prer., M.E. 282 or equivalent, A.Math. 236.

M.E. 487-4. Rigid-Body Dynamics. Kinematics of a rigid body, principal axes, and moments of inertia, angular momentum of a rigid body, Euler equations. Applications include topics such as motion of a rigid body with a fixed point under no forces, the spinning top, stability of a sleeping top, the gyrocompass, motion of a billiard ball, rotating machinery, etc. Prer., M.E. 282 or equivalent, A.Math. 236.

M.E. 490-1. Senior Seminar. Presentation of broad range of professional opportunities available to graduating seniors through discussions with practicing engineers. Prer., senior standing.

M.E. 491-2. Legal Aspects of Engineering Practice. Professionalism in engineering; canons of ethics. Legal system. Law of contracts, torts, agency, property, sales, business associates, negotiable instruments, and patent protection. Prer., senior standing in mechanical engineering.

M.E. 495-1 to 3. Special Topics in Mechanical Engineering and Mechanics. Subject matter to be selected from topics of current technological interest. Credit to be arranged.

M.E. 500-1 to 6. Independent Study. Available only through approval of graduate advisor. Subjects arranged to fit needs of the particular student. Prer., graduate standing.

M.E. 501-3. Yield Limited Behavior of Materials. Analysis of material behavior within the "elastic range" with emphasis on the phenomenon of yield and factors that influence it. Introduction to the theory of elasticity; examination of the theory of dislocations; study of strengthening mechanisms in solids. Consideration of various time-dependent but reversible (inelastic) deformation phenomena. Presentation of appropriate engineering case studies to augment various topics. Prer., M.E. 401 or equivalent.

M.E. 503-3. Plasticity and Creep. Inelastic deformation of materials such as metals, alloys, glasses, composites, polymers, etc., from the phenomenological and structural point of view. Case studies of plastic and creep deformations in engineering materials. Prer., M.E. 401 or equivalent.

M.E. 505-3. Fracture. Examination of basic mechanisms controlling fracture of high-strength materials. Examples include reduction of capacity for plastic deformation in engineering materials used at high-strength levels prior to catastrophic fracture. Emphasis is placed on selection of materials in terms of toughness as well as strength. Prer., M.E. 401 or equivalent.

M.E. 506-3. Structure and Properties of Polymers. A comprehensive introduction to the fundamental aspects of polymer science. Emphasizes the relationship between molecular structure and polymetric properties. Topics include polymer bonding, crystallinity, physical states and transitions, rubber elasticity, yield and fracture behavior, and linear viscoelasticity. Prer., M.E. 301, 401, or equivalents or consent of instructor.

M.E. 513-3. Macroscopic Thermodynamics. (Ch.E. 538.) Axiomatic presentation of fundamentals of classical thermodynamics. Energy, work, and heat; first law. Equilibrium, reversible and irreversible processes; entropy production and the second law. Applications to stability, phase equilibrium, electric and magnetic work. Irreversible thermodynamics and the Onsager reciprocal relations. Prer., M.E. 313 or equivalent.

M.E. 514-3. Statistical Thermodynamics. (Aero. 617, ChE. 528.) Introduction to the molecular interpretation and calculation of thermodynamic properties of matter. Thermodynamic probability, distribution functions, Schrödinger wave equation and solutions, ensemble theory. Applications to ideal and real gases, solids, liquids, radiation, conduction electrons, and chemical equilibrium. Prer., M.E. 313 or equivalent.

M.E. 521-3. Methods of Engineering Analysis I. Selected topics from linear algebra, complex variable theory, and ordinary differential equations. The presentation is correlated with other analysis topics included in mechanical engineering courses and emphasizes application. Prer., graduate standing or consent of instructor.

M.E. 522-3. Methods of Engineering Analysis II. Selected topics from integral transform methods, partial differential equations, perturbation theory, and probability and statistics. The presentation is correlated with other analysis topics included in mechanical engineering courses and emphasizes application. Prer., graduate standing or consent of instructor.

M.E. 532-3. Introduction to Fluid Dynamics. (Aero. 517.) Physical properties of gases and liquids; kinematics of flow fields; equations describing viscous, heat conducting Newtonian fluids. Exact solutions and rational approximations for low and high speed dissipative flows, surface and internal waves, acoustics, stability, and potential flows. Coreq., M.E. 521, 575, or equivalent.

M.E. 534-3. Viscous Flow. (Aero. 512.) Low Reynolds number flows, incompressible and compressible laminar boundary layer theory. Similarity theory. Separation, transition, and turbulent boundary layers. Prer., M.E. 532 or equivalent.

M.E. 536-3. Compressible Flow. Energy, continuity, and momentum principles applied to compressible flow; one-, two-, and three-dimensional subsonic, supersonic, and hypersonic flows. Normal and oblique shocks, method of characteristics. Prer., M.E. 532 or equivalent.

M.E. 551-3. Second Law (Exergy) Analysis. Establishes a thermodynamically sound basis for fuel (exergy) conservation in energy systems. Method is based on the second law of thermodynamics and consists of identifying the dissipative features of a system and minimizing the exergy loss. Presentation consists of practical problems selected from the fields of heat exchanger design, energy storage, power plant design, solar energy utilization, furnace design, cryogenic engineering. Prer., M.E. 313, 362, 385, or consent of instructor.

M.E. 563-3. Heat Transfer I. (Ch.E. 627.) Review of equations governing transport of heat by conduction and radiation. Analytical and numerical solution of boundary value problems representative of heat conduction in solids. Radiation properties of solids, liquids, and gases; transport of heat by radiation. Prer., M.E. 362 or equivalent.

M.E. 564-3. Heat Transfer II. (Ch.E. 628.) Review of equations governing transport of heat in fluids in motion. Description of heat transfer in free and forced convection including laminar and turbulent flow. Dimensional analysis and heat transfer correlations, numerical methods, combined heat transfer mechanisms. Prer., M.E. 532 or equivalent.

M.E. 573-3. Theory of Vibration. Review of free and forced vibration or lumped parameter systems. Matrix methods. Nonlinear systems. Prer., M.E. 581 or equivalent.

M.E. 575-3. Introduction to continuum Mechanics. Cartesian tensor notation. Deformation, strain, strain rate, and compatibility. Definition of stress vector and tensor. Fundamental balance laws of mass, momentum, and energy; entropy invariance requirements. Constitutive equations for elastic, viscoelastic, and plastic materials; ideal, compressible, and viscous fluids. Beltrami-Mitchell and Navier-Stokes equations. Prer., graduate standing or consent of instructor.

M.E. 581-3. Dynamics. Elements of vector analysis, particle motion, kinematics of a rigid body, rotating axes, rigid body motion, and Euler's equations and applications. Introduction to analytical mechanics. Hamilton's principle, Lagrange's equations for holonomic and nonholonomic systems. Prer., graduate standing or consent of instructor.

M.E. 584-3. Advanced Strength of Materials. Review of basic equations governing a linear elastic material and associated boundary-value problems. Deduction of approximate theories for elementary structures with techniques of solution of resulting practical problems. St. Venant torsion. Prer., M.E. 383, 384, or equivalent.

M.E. 585-3. Theory of Elasticity I. Review of the basic equations of linear theory of elasticity. St. Venant torsion and flexure. Plane strain, plane stress, and generalized plane stress. Application of conformal mapping and Fourier transform techniques. Variational principles. Prer., M.E. 575.

M.E. 595 to 599-1 to 4. Selected Topics. Credits and subject matter to be arranged.

For Graduate Students Only

M.E. 600-1 to 6. Independent Study. Available only through approval of the graduate advisor. Subjects arranged to fit needs of the particular student. Prer., graduate standing.

M.E. 671-3. Advanced Dynamics. Tractable problems of particle and rigid body dynamics. Dissipative and nonholonomic systems. The principle of least action, Hamilton Jacobi equation. Small amplitude vibration theory. Prer., M.E. 581.

M.E. 678-3. Dynamics of Continuous Media. Derivation of the wave equation from the basic equations of dynamic elasticity. Propagation of elastic waves in infinite and partially bounded media; Rayleigh waves and Love waves. Pochhammer solution for rod; extensional and flexural vibration of beams, plates, and shells. Influence of material nonlinearity on vibrations and wave propagation. Prer., M.E. 581, 585.

M.E. 685-3. Theory of Elasticity II. Variational principles with applications. Three-dimensional solutions. Concentrated and line loads in complete and half spaces; problems of Kelvin, Boussinesq, and Mindlin. Transform techniques. Contact stresses. Anisotropic and nonlinear elasticity. Thermoelastic problems. Prer., M.E. 585.

M.E. 686-3. Theory of Plasticity. Fundamental concepts: the yield surface and associated flow laws. Isotropic and kinematic work-hardening. The theory of rigid, perfectly plastic, and of general elastic-plastic solids with applications. General theorems. Prer., M.E. 575.

M.E. 687-3. Theory of Inelastic Materials. Mathematical theory of linear viscoelasticity. Finite element models. Solutions of boundary-value problems in linear viscoelasticity. Non-Newtonian flow. Selected topics in nonlinear material behavior. Prer., M.E. 575.

M.E. 695 to 699-1 to 4. Selected Topics. Credit and subject matter to be arranged. Advanced graduate-level courses are available upon demand in the following subjects: theory of plates, theory of shells, theory of hydrodynamic stability; advanced continuum mechanics. Outlines of these courses are available in the departmental office.

M.E. 700-variable credit. Master's Thesis.

M.E. 800-0 to 8 (16 to 24 maximum). Doctor's Thesis.

Industrial Engineering

I.E. 303-3. Computers in Industrial Engineering. Design, creation, testing, and operation of computer models for manufacturing, production, and management. Renewal processes. Statistical validation, simulation. Policy comparison and manufacturing, optimization and decision making. Prer., M.E. 203.

I.E. 331-3. Industrial Cost Analysis. Cost estimating, labor and material costs, forecasting, operation, product, and project methods. Risk and uncertainty. Prer., A.Math. 236.

E.E. 351-3. Engineering Statistics. Introduction to probability and statistics with emphasis on engineering applications. Frequency distributions, statistical hypotheses and estimation; linear regression and correlation; nonlinear and multiple regression; analysis of variance. Prer., A.Math. 236.

I.E. 400-1 to 6. Independent Study. Study of special projects by student and instructor. For undergraduates. Prer., consent of instructor.

I.E. 431-3. Production Automation Systems. Development of models for production automation systems with emphasis on control of production machinery. Mini-micro computers. Numerical control. Prer., M.E. 131, C.S. 120; M.E. 203.

I.E. 441-3. Operations Research I. Formulation of algorithms for linear programming, and network problems. Sensitivity and duality. Introduction to dynamic optimization models. Applications from problems in production, manufacturing, management. Prer., I.E. 351, I.E. 397.

I.E. 442-3. Operations Research II. Unbounded dynamic optimization, combinatorial models, nonlinear programming, Markov chains, waiting models. Prer., I.E. 441.

I.E. 446-3. Robotics. Design principles of robots, control systems, sensing techniques, and robot applications. Prer., senior standing.

I.E. 451-3. Engineering Management. Relationship of the engineer to functions and decisions of management. Design of organization systems, project administration, audit and evaluation for optimum use of resources, leadership, performance, innovation, decision making. Emphasis on case studies and individual development. Prer., senior standing.

I.E. 460-4. Senior Project. A major project of the student's choice, simulating as closely as possible the industrial design engineer's professional activity. Strong emphasis is placed on economic evaluation methods, preparation of all specifications, and final report. Prer., senior standing.

I.E. 465-3. Human Factors. Limitations on engineering design of machines and man-machine systems due to physiological and psychological factors in human beings. Man-machine relationships, motor activities, work design, workplace layout and environment, occupational safety, work systems. Prer., senior standing.

I.E. 475-3. Industrial Systems. Analysis of complex interactive systems. Design of plausible systems. Managing systems. Computer simulations. Application to work systems, systems of production, and methods of manufacture. Prer., senior standing.

I.E. 497-3. Engineering Economy. Emphasis on life cycle costing as a design criterion to minimize total cost of service on long-term projects. Calculation of annual costs, present worth, and prospective returns on investment. A design project is required. Prer., junior standing.

I.E. 500-1 to 6. Independent Study. Special studies agreed upon by student and instructor.

I.E. 503-3. Computer-Aided Manufacturing.

I.E. 511-3. Modeling for Discrete Part Processing.

I.E. 520-3. Production Technology.

I.E. 541-3. Linear and Integer Programming. Formulation of LP models, the Simplex Method, fundamental concepts from linear algebra. Duality, post optimality, and parametric programming. Network and integer programming models. Prer., A.Math. 236.

I.E. 542-3. Nonlinear Programming. Formulation of NLP models. Fundamental concepts from convex analysis. Saddlepoint optimality conditions. Kuhn-Tucker theory. Unconstrained optimization methods. Constrained optimization algorithms. Dynamic programming and discrete optimization. Prer., I.E. 541.

I.E. 546-3. Robotics. Design principles of robots, control systems, sensing techniques, and robot applications.

I.E. 548-3. Stochastic Processes. A renewal theory approach to common stochastic models of operations research. Some topics treated are queueing, Markov and semi-Markov decision processes, maintenance, and replacement models. Prer., I.E. 441.

I.E. 551-3. Design and Analysis of Experiments I. Review of statistical hypothesis testing, regression, and simple analysis of variance. Pros and cons of experimental designs for physical sciences and engineering. Planning efficient experiments to answer various kinds of questions. Response-surface analysis. Desirability function. Optimization of experimental systems. Prer., I.E. 351.

I.E. 591-3. Advanced Engineering Economy. Advanced theory and concepts of economic analysis incorporating probabilistic aspects. Techniques of mortality analysis for equipment and production items. Mathematical models for equipment replacement. Measures of cost effectiveness concepts. Incremental models. Prer., Ch.E. 452, C.E. 497, or I.E. 397.

I.E. 592-3. Engineering-Economic Simulation. Design, construction, testing, and operation of engineering-economic models for simulation. Starting with the simple hand-computed simulations, progressing to complex models requiring the use of a high-speed digital computer. Prer., C.S. 210 or consent of instructor.

I.E. 593-3. Design Estimating. Directed toward the evaluation of design in economic terms. With design as the focus, methods of estimation, forecasting, and optimization are treated. Computer modeling. Cost-benefit analysis. Prer., I.E. 397.

I.E. 595-3. Selected Topics. Treatment of specialized aspects of industrial engineering by staff or visiting lecturers. Prer., consent of instructor.

School of Journalism

Jour. 100-3. Contemporary Mass Media. Examines the mass media and their interaction with society, looking at journalism and the mass media in historical, intellectual, economic, political, and social contexts.

Jour. 250-3. Reporting. Fundamentals of news gathering and writing; reportorial skills; news story forms. Assignments include reportorial work for campus publications. Prer., Jour. 100.

Jour. 310-3. Press Photography. The camera as a reporting tool; training in the use of cameras; composition; darkroom procedures. Prer., Jour. 250.

Jour. 340-3. Principles of Advertising. Basic principles of publication and radio and television advertising; analysis of consumers, markets, and media; organization of advertising departments and agencies.

Jour. 345-3. Advertising Copy and Layout. Creation of advertising copy and layout, analysis of consumer and product appeals. Preparing copy for various media: newspapers, magazines, radio, and television. Prer., Jour. 340.

Jour. 346-3. Advertising Media. Study of media, markets, and audiences and their relationships to advertising messages. Prer., Jour. 340.

Jour. 350-4. Reporting of Public Affairs. Problems and practice in reporting news of government, politics, the courts, industry, business, science, and other areas involving public issues. Prer., Jour. 250.

Jour. 355-3. News Editing. Principles and practice in copy editing and writing headlines for local and wire stories. Practice in page makeup, picture editing, and electronic editing. Prer., Jour. 250.

Jour. 360-3. Radio and Television News. Principles and techniques involved in the preparation of news for broadcasting. Prer., Jour. 250.

Jour. 364-3. Principles of Broadcast Production. Introduction to the use of radio and television equipment. Emphasis is on applying the basic principles to professional program production. Prer., Jour. 250.

Jour. 367-2. Television Production II. Production of material for biweekly segments on CU Today. Students produce material in various formats—16mm, super 8mm, remote and studio videotape, live studio, etc.—with and without editing. Prer., Jour. 364 or Comm. 362.

Jour. 377-3. History of Journalism. Major trends in the development of contemporary American journalism, its role in United States history, famous journalists, and foundations and evolution of freedom of the press.

Jour. 410/510-3. Advanced Photography. Advanced camera and darkroom techniques, the picture story, picture editing, trends in pictorial journalism, and individual projects. Prer., Jour. 310.

Jour. 420-3. International Mass Communication. Journalism in the international system, including comparative examinations of national and international press organizations, methods, and content. The role of mass media in developed and developing countries and the international flow of news and opinion.

Jour. 427/527-3. Public Relations. Survey of public relations in America. Case studies and individual projects.

Jour. 428/528-3. Public Relations Programs. Development and application of public relations programs from identification of the problem through execution of the public relations techniques. Prer., Jour. 427.

Jour. 429/529-3. Public Relations Practice. Seminar for students intending to enter the public relations field. Examines specific tools and activities of the field.

Jour. 440/540-3. Advertising Campaigns. Advanced copy and layout. Emphasis on planning integrated advertising campaigns for national and regional audiences. Prer., Jour. 345 and 346.

Jour. 443/543-3. Retail Advertising Campaigns. Preparation, selling, and servicing of advertising in the retail field; rate structures; building national and retail lineage. Prer., Jour. 345 and 346.

Jour. 450/550-3. Advanced Reporting. Covering writing news and features about actual events for publications under deadline pressure. Prer., Jour. 350.

Jour. 460/560-3. Editorial and Opinion Writing. The editorial page and its readers; analysis and writing of editorials and columns.

Jour. 461-1 to 2. Advanced Radio Practices. Application of the theory of radio programming and production. Assignments include producing radio programming for radio stations in Colorado and weekly discussion-critique sessions. Prer., Jour. 364 or 462 or Comm. 361, and consent of the instructor.

Jour. 462/562-3. Advanced Radio-TV News. Emphasis on visualization. Special advantages and limitations of broadcasting news and public affairs. Prer., Jour. 350 and 360.

Jour. 463/563-3. Broadcast News Projects. Interpretation, preparation, and reporting of public affairs for broadcast media; preparation of radio and film documentaries. Prer., Jour. 360 and consent of instructor.

Jour. 464/564-3. Radio-TV Station Organization and Operation. Analysis of station operations, public relations, personnel, financing, labor relations, and laws and regulations as well as the manager's ethical and social responsibilities. Prer., Jour. 100 or Comm. 260.

Jour. 465-3. Journalism and the Law. Legal rights and responsibilities of news media. Study of cases and case briefs.

Jour. 467-1 to 4. Television Production III. In-depth experience in one facet of a complex television production, e.g., directing, producing, writing, sports, commercials, etc. Prer., Jour. 364, 367, or instructor consent.

Jour. 470/570-3. Critical Writing for the Journalist. Analysis of the entertainment area, especially as it pertains to the print media; emphasis is on the composition of criticism and the attitudes and writing techniques of individual critics.

Jour. 471-3. Cultural Aspects of the Mass Media. Interdisciplinary class designed to explore the relationship between journalism and culture as expressed principally in literature, art, and film.

Jour. 480/580-3. Magazine Article Writing. Practice in writing freelance articles; consideration of types, sources, methods, titles, illustrations, and marketing. Prer., Jour. 250 or consent of instructor.

Jour. 485/585-3. Publication Design and Production. Editorial and production aspects of magazines, both general and specialized, including company publications, industrial journals, and other types of limited-audience publications. Prer., Jour. 355 or consent of instructor.

Jour. 490/590-3. Mass Communication and Public Opinion. Opinion-shaping role of the mass media; theories of public opinion and propaganda; polling; communications effects and communication theories.

Jour. 495-1 to 3. Special Projects.

Jour. 496/596-1 to 3. Newspaper Practicum. News work on *Campus Press*. Prer., consent of instructor.

Jour. 497/597-1 to 3. Advertising Practicum. Advertising work on *Campus Press*. Prer., consent of instructor.

Jour. 498-1 to 3. Internship.

Jour. 500-1 to 4. Research in Journalism. Participation in research projects with faculty members or pursuit by the student of his own primary research interest.

Jour. 505-3. Theories of Mass Communication. Study of theories and perspectives of mass communications and exploration of the role of mass media in society.

Jour. 505-3. Methods of Mass Communication Research. Continuation of Jour. 505 with emphasis on experimental and survey research methods.

Jour. 520-3. Readings in International Mass Communication. Mass communications within the international system, including similarities and differences in functions, facilities, and content; social theories of the press; and the international flow of mass communications.

Jour. 533-3. Scholastic Publications. The student newspaper, literary magazine, and yearbook. All grade levels. Emphasis on the responsibilities of the advisor in the areas of teaching, sponsoring, organizing, financing, etc.

Jour. 535-3. Television in Education. (Same as L.M. 507.) Utilization of television at all levels of education. Theory and practice in defining needs, identifying alternative solutions, producing materials, and evaluating results. Prer., Jour. 100 or consent of instructor.

Jour. 551-3. Investigative Reporting. Investigative techniques and problems, including opportunity, under supervision, to put the training into practice.

Jour. 565-3. Press and the Constitution. Graduate seminar in communications law. Study of changing law and applied legal research techniques.

Jour. 571-3. Mass Communications and the Arts. Inquiry into relationship of the arts and the mass media, including study of critics, their function, and their works.

Jour. 577-3. Readings in the History of Mass Communication. Intensive examination of specialized areas in the history of mass communications.

Jour. 592-3. Economic and Political Aspects of Mass Communications. Economic problems and political issues relevant to newspapers, magazines, broadcasting, and CATV. Problems of telecommunications and the impact of future technology on mass communications.

Jour. 595-1 to 3. Special Projects.

Jour. 598-1 to 3. Internship.

Jour. 599-1 to 3. Independent Study.

Jour. 700-1 to 6. Master's Thesis.

Jour. 930-1 to 3. Undergraduate Independent Study.

Jour. 950-1 to 3. Graduate Independent Study.

School of Law

FIRST YEAR

Law 510-3, 511-3. Contracts I and II. Basic principles of contract liability, offer, acceptance and consideration, statute of frauds, contract remedies, and the parole evidence rule. Performance of contracts, conditions, effect of changed circumstances, third party beneficiaries, assignment, specific performance.

Law 520-1. Legal Writing. Texts and mimeographed materials. Materials and methods of legal research and writing. After intensive consideration of the types of law books and their functions, students prepare written material of various kinds designed to develop both research technique and writing style.

Law 521-1. Appellate Court Advocacy. Preparation of an appellate brief and delivery of an oral argument before a three-judge court composed of a faculty member and upperclass students.

Law 530-3, 531-3. Civil Procedure I and II. Brief survey of common law and code pleading; major emphasis on trial and appellate practice under Federal and Colorado Rules of Civil Procedure, including jurisdiction, venue, parties, commencement, pretrial, pleadings, and jury trial; federal jurisdiction; federal and state court organization.

Law 540-3, 541-3. Torts I and II. Involves the study of the nonconsensual allocation of losses for civil wrongs, focusing primarily on the concepts of negligence and strict liability.

Law 550-4. Criminal Law. Statutory and common law of crimes and defenses, the procedures by which the law makes judgments as to criminality of conduct, the purposes of the criminal law, and the constitutional limits upon it.

Law 561-4. Property. Estates and interests in land; public and private land-use controls; easements, licenses, and covenants; and landlord-tenant law.

SECOND YEAR

Law 606-3. Real Property Security and Conveyancing. Brokers' duties and commissions, contracts for sale of land, remedies for breaches, deeds, escrows, mortgages, recording systems, title examination, and title insurance.

Law 610-3. Agency-Partnership. The rights and liabilities of the principal, the agent, and third parties with respect to each other, including the concepts of vicarious tort liability, apparent authority, ratification, imputation of knowledge, and the undisclosed principal are covered as well as the partnership form of doing business or investing. Class requirements include an optional paper which, if the student chooses to take the option, counts for 25 percent of the course grade.

Law 612-3. Public Lands Law. Deals with the legal status and management of federal lands. Federal law, policy, and agency practice affecting the use of mineral, timber, range, water, wildlife, and wilderness resources on public lands are explored.

Law 618-4. Commercial Transactions. Examination of the methodology of the Uniform Commercial Code and a study of legal devices and substantive principles thereunder relating to financing transactions in personal property and to negotiable instruments, bank deposits, and collections. Some attention to documentary transactions in the sale and shipment of goods.

Law 625-4. Corporations. The formation of corporations and their management, the relations between shareholders and officers and directors, the impact of federal legislation on directors' duties, and the special problems of the closed corporation.

Law 631-3. Water Resources. Analysis of regional and national water problems, including the legal methods by which water supplies are allocated, and an examination of the problems involved in water resource planning.

Law 635-3. Evidence. Basic methods and forms of proof in the adjudicative process, responsibility for proof, judicial notice, examination and competence of lay and expert witnesses, privileged communications, relevancy, opinion and scientific evidence, real proof, writings, and hearsay.

Law 640-3. International Law. Examination of the principles of public international law as developed and applied by all participants in the international legal process, including national and international tribunals, governmental bodies, international organizations, and others. Particular attention to the role of international law in recent events.

Law 650-3. Labor Law. Decisions and statutes relating to rights of workers to act in concert, including legal aspects of strikes, picketing, and boycotts; representation proceedings; establishment of collective bargaining; and administration of the collective agreement.

Law 651-3. Criminal Procedure. This course focuses primarily on the constitutional limitations applicable to such police investigative techniques as arrest, search, seizure, electronic surveillance, interrogation, and line-up identification.

Law 655-3. Legal Accounting. Study of accounting problems in the form they are placed before the lawyer, including a succinct study of basic bookkeeping, in-depth legal analysis of the major current problems of financial accounting, and consideration of the conduct of financial affairs of business.

Law 660-4. Income Taxation. Basic course in taxation with major emphasis on the fundamentals of the federal income tax system. Generally approached from the standpoint of the impact of the federal income tax system on the individual.

Law 661-4. Constitutional Law. A basic exposure to the full panorama of constitutional law problems. Survey of the legal problems posed by the federal system and protections afforded individual rights.

Law 662-3. Legal Process. The study of law as a purposive process and the functions and interrelationships of the various public and private institutions through which the process is carried on. Gives a general view of the American legal system as a framework to help in organizing knowledge about the various elements of the system. (Alternate year course.)

Law 663-2. Economic Analysis of Law. Designed to provide an introduction to the basic elements of price theory and to their application to legal problems. On the theoretical side, emphasis will be placed on the explication of those concepts that have been most frequently employed in the law and economics literature, including demand and utility, cost, and optimality. The majority of the legal applications will be drawn from first-year courses. The course should provide useful background to a great many upper division courses.

Law 666-2. Professional Responsibility. The legal profession as an institution, its history and traditions, and the ethics of the bar with particular emphasis on the professional responsibilities of the lawyer.

Law 669-3. Advanced Taxation. Considers the impact of the federal income tax system on the business enterprise. The major emphasis is in the partnership and corporate area. Based on a series of problems involving the taxation of partnerships and corporations and the participants in these forms of business entity.

Law 685-4 and 687-3. Legal Aid Civil Practice I and II. Emphasizes procedural and practical remedies and defenses available in civil litigation. In conjunction with this course, students will be assigned civil cases related to the course material. Develops working knowledge of courtroom skills. Prer., or coreq., Law 635.

Law 686-4, 688-3. Legal Aid Criminal Practice I and II. Thorough grounding in problems of criminal defense. Students will defend indigent misdemeanors in Boulder courts. Develops working knowledge of courtroom skills. Prer. or coreq., Law 635.

Law 698-3. Wills and Trusts. Interstate succession; family protection; execution of wills; revocation and revival; will contracts and will substitutes; creation of trusts; modification and termination; charitable trusts; fiduciary administration, including probate and contest of wills; constructional problems in estate distribution.

THIRD YEAR

Law 700-3. Administrative Law. Practices and procedures of administrative agencies and limitations thereon including the Federal Administrative Procedure Act; the relationship between courts and agencies.

Law 705-3. Conflict of Laws. The general approach to conflicts, problems, jurisdiction of courts in conflicts cases, foreign judgments, choice of law rules governing contracts, torts, worker's compensation, property and estates, constitutional limitations on choice of law rules, and law applied in the federal courts in conflicts cases.

Law 710-3. Domestic Relations. Nature of marriage, actions for annulment and divorce, problems of alimony and property division, separation agreements, custody of children. Consideration also of illegitimacy, abortion, contraception, the status of the married woman at common law and under modern statutes, and relations of parent and child.

Law 712-2. Mining Law. Federal law regulating mining of hard minerals, oil, gas, and coal on public lands; mining law with respect to privately owned lands, including study of typical coal and uranium lease provisions.

Law 714-2. Future Interests. Examination of dispositive provisions which divide property rights into successive interests, including the historical background and current application of the legal concepts involved.

Law 715-3. Federal Estate and Gift Tax. Analysis of federal estate and gift taxation of inter vivos and testamentary transfers; introduction to the income taxation of estates and trusts; elementary estate planning.

Law 716-3. Copyright and Unfair Competition. An examination of state and federal laws relating to the protection of literary, artistic, and musical works. We will consider the 1976 Copyright Act in detail. Consideration of state laws such as interference with contractual relations, passing off, trade secrets, misrepresentation, protection of ideas, and misappropriation of trade values, that supplement federal copyright. (Alternate year course.)

Law 717-2. Introduction to Patent and Trademark Law. An introductory course covering selected topics such as patentability, utilization of patent rights, definition of trademarks, and comparisons of marks with tradename and copyright protection. Practice and procedure of the Patent Office and Trademark Office will also be covered.

Law 718-2. Estate Planning. Discussion of problems and solutions for owners of various-sized estates and different types of assets including jointly-held property, stock in closely-held corporations and farms; analysis of federal taxation of generation-skipping transfers in trust; post-mortem estate planning; drafting of trusts and wills. It is recommended that students take Wills and Trusts and Federal Estate and Gift Tax before enrolling in this course. Enrollment will be limited to 35.

Law 728-3. Bankruptcy. Assumes that the student will have, from the Creditors' Remedies course, a basic familiarity with the federal Bankruptcy Code, Title 11 U.S.C., and principles of bankruptcy law arising in ordinary liquidating bankruptcy proceeding under Chapter 7 of the code. The course will examine briefly nonbankruptcy business rehabilitation devices, and then study business reorganizations under Chapter 11 of the code. Some attention will also be given to proceedings for the adjustment of debts of individuals with regular income under Chapter 13 or the code. (It is recommended that Commercial Transactions and Creditors' Remedies be taken before this course.)

Law 732-3. Land Use Planning. Public control of private land uses through the judicially created doctrine of nuisance and the legislatively created techniques of zoning, subdivision regulations, and "master" planning, including consideration of the typical constitutional and statutory limitations on such legislatively created techniques. (Alternate year course.)

Law 733-3. Oil and Gas. Deals with the legal problems associated with private arrangements for the ownership and development of oil and gas: deeds and leases to oil and gas rights, trespass, adverse possession, implied covenants in leases, conveyances of fractional interests, and the interaction of private rights and conservation regulation.

Law 734-2. Employment Discrimination. Examines constitutional, statutory, and regulatory proscriptions of race, gender, handicap, and age discrimination in private and public employment.

Law 735-3. Real Estate Planning. Consideration of the various contemporary legal problems involved in the ownership, use, development, and imposition of real estate. Particular emphasis on the income tax and financing aspects of commercial and residential use and development such as shopping plazas and apartment buildings.

Law 736-3. First Amendment. Examines free speech and free press clauses of the First Amendment. Includes the philosophical foundations of free expression; analytical problems in First Amendment jurisprudence, direct and indirect restraints on speech content, prior restraints, symbolic speech, freedom of thought and association, First Amendment rights of access, speech forums, academic freedom, and vagueness and overbreadth.

Law 737-3. American Indian Law. Investigation of the federal statutory, decisional, and constitutional law which bears upon American Indians and Indian reservation transactions. (Alternate year course.)

Law 745-3. Securities Regulation. Concerned with the various federal statutes regulating the issue of corporate securities and the cases and regulations which have arisen out of those statutes; stress on statutory interpretation.

Law 747-3. Environmental Law. Examination and analysis of important federal pollution control statutes, including the National Environmental Policy Act, the Clean Air Act, and Clean Water Act. Related economic theory and policy issues are considered. (Alternate year course.)

Law 748-2. Negotiation. Explores the lawyer's role as a negotiator in a variety of contexts, e.g., divorce, personal injury claims, labor relations, and commercial transactions. Will include several mock negotiations in which students bargain against one another.

Law 750-3. Antitrust. Concerned with the law developed from the Sherman, Clayton, and Federal Trade Commission acts. It is recommended that Corporations be taken before this course.

Law 752-3. Criminal Procedure: Adjudicative Process. Focuses primarily on criminal procedure at and after trial. Treats such topics as bail, prosecutorial discretion, discovery, plea bargaining, speedy trial, jury trial, the right to counsel at trial, double jeopardy, appeal, and federal habeas corpus.

Law 753-3. Education Law. Examines elementary and secondary education from two perspectives. The initial focus is the power of the state to compel a child to attend school and the constitutional and statutory framework within which the state regulates schooling. The

course then examines the educational opportunities an individual is entitled to receive from the state as embodied in federal and state constitutions and statutes. Various concepts of equal education opportunity—equal resources; equal treatment regardless of race, sex, or handicap; equal outcomes—are analyzed. The uses and misuses of social science research in shaping legal outcomes are also examined.

Law 754-3. Survey of Creditors and Bankruptcy. The first one-third of the course examines state enforcement procedures (execution of judgments, creditors' bills, execution and foreclosure sales, etc.), judgment liens, mechanics' liens, attorneys' liens, federal tax liens, exemptions, and fraudulant conveyance law. The remaining two-thirds of the course cover bankruptcy. The concentration will be on Chapter 7 (liquidation proceedings) and Chapter 13 (consumer bankruptcy), but Chapter 11 (business reorganization) will be examined briefly. During the course students will prepare the documents necessary for taking a debtor through a Chapter 7 proceeding, and through a Chapter 13 proceeding.

Law 755-3. Creditors' Remedies and Debtors' Protection. The course examines typical state rights and procedures for the enforcement of claims, and federal and state law limitations providing protection to debtors in the process. Included are a treatment of prejudgment attachment and garnishment; statutory and equitable remedies; fraudulent conveyance principles; and exemptions and other judicial protections afforded debtors. The course also provides an introduction to nonbankruptcy adjustment of claims proceedings and to the federal Bankruptcy Code. Title 11 U.S.C. principles of bankruptcy law will be treated primarily as they arise in liquidating bankruptcy proceedings (Chapter 7). Brief attention will also be given to proceedings for the adjustment of debts of individuals with regular income (Chapter 13 of the Code).

Law 757-3. International Business Transactions. A problem-oriented study of the legal and quasi-legal questions concerning international trade and investment, with particular attention to the problems of trade with, and investment in, developing nations. (Alternate year course.)

Law 760-3. Local Government. State legislative and judicial control of the activities, powers, and duties of local governmental units, including home rule cities and counties; some problems of federal, state, and local intergovernmental relations; and some typical state and federal constitutional and statutory limitations on governmental powers when exercised by local governmental units (the powers to regulate private activities, tax, spend, borrow money, and condemn private property for public uses). (Alternate year course.)

Law 762-2. Trial Advocacy. Student exercises focusing in turn on voir dire, opening statement, direct examination of witnesses, and cross examination.

Law 766-3. Business Planning. Focuses on the development and use of concepts derived from a number of legal areas in the context of business planning and counseling. Topics such as formation of business entities, sale of a business, recapitalization, division, reorganization, and dissolution are considered. (Alternate year course.)

Law 768-3. Natural Resource Taxation. Consideration of the federal income tax aspects applicable to the exploration for, the development of, and the operation of natural resources, as well as the financing thereof. The natural resources considered will include oil and gas, hard minerals, timber, and water. It is recommended that Income Tax be taken before this course. (Alternate year course.)

Law 770-2. Law Firm Practice. Writing course designed to familiarize students with legal problems they will encounter in their legal career. Approximately ten short problems will be assigned to students involving accounting, business, estate, ethics, fiduciary, and real estate matters. A great deal of class time will be devoted to writing techniques and the preparation of legal opinion letters.

Law 771-1 or 2. Independent Legal Research. (Two semester hours maximum.) Independent study and preparation of a thesis under supervision of faculty member. Specific permission of the supervising faculty member is required before registering.

Law 778-3. Remedies. A problem-solving course examining the types of relief available to vindicate various rights. Damages, specific performance, injunctions, and restitution are covered. Emphasis is on the planning aspect of enforcement, in view of the limitations and problems of proof associated with specific remedies.

Law 787-3. Federal Courts. Structure and jurisdiction of the federal courts, with particular emphasis on problems of federalism and separation of powers and their relationship to resolution of substantive disputes.

Law 788-2. Natural Resource Litigation Clinic. The clinic works on cases concerning natural resource protection in the Rocky Mountain region.

Law 791-1. Rothgerber Moot Court Competition. Intensive involvement in legal research, appellate brief writing, and oral arguments in a competitive context. Student finalist may continue involvement in regional and national competitions.

Law 792-1 or 2. Independent Legal Research-Law Review. Participation in the research, writing, and editing activities involved in publishing the *Colorado Law Review*. Standards for the awarding of credit are set and applied by the faculty.

Law 793-2. Advanced Trial Advocacy. An advanced course covering trial practice elements. Open only to students who have taken Trial Advocacy.

Law 794-1. International Moot Court Competition. Open only to students who actively participate in the seminar preparing for the competition, in the preparation of memorials for the competition, and in the practice of oral arguments or regional oral arguments.

SEMINARS

Law 701-2. Legislative and Administrative Process. This seminar will integrate the principles of the legislative process with the basic administrative law concepts of establishment, structure, control, and accountability of administrative agencies. Institutions making and administering law range from Congress, the president, and the federal agencies through state legislatures, to city councils, planning commissions, superintendents of schools, and professional licensing boards. The object will not be to study the specific laws these institutions make and administer, but rather to isolate certain characteristics common to the processes by which they perform their legal functions and to examine certain tools by which law prescribes and controls how they may do so.

Law 706-2. Alternatives to the Adversary System. Will provide students with an opportunity to study various forms and methods of dispute resolution available in our own or other legal systems, apart from the adversary process, such as peer pressure, mediation, arbitration, and nonadversarial judicial intervention. Interdisciplinary as well as comparative sources and materials will be used.

Law 707-2. Advanced Torts. This seminar will consider two types of problems. Some will be designed to acquaint students with areas of tort law that are no longer usually covered in a torts course, such as defamation, privacy, deceit, and the like. The second group of problems, more jurisprudential in nature, will seek to explore some of the more basic underpinnings of the law of torts, for example, theories of liability, damages, immunities, and judge-jury relationships.

Law 708-2. Constitutional Theory. An examination of the role of the courts and the other branches of government in defining and enforcing constitutional values. Attention is given to separation of powers and federalism and to a case study of school desegregation. Relevant readings are from philosophy and social science as well as cases. (It is recommended that Constitutional Law and Federal Courts be taken before this course.)

Law 711-2. Legal Rights of Children. This seminar will be concerned with the legal relationships between children, their natural or foster parents, and the state, in a variety of contexts, including child abuse, abortion, medical and psychiatric care, education, relinquishment, termination of parental rights, and custody.

Law 719-2. Products Liability. A review of theories of liability and introduction to recent developments in the law, followed by a thorough analysis of the evidentiary aspects of a specific products liability case.

Law 720-2. Comparative Law. Examines primary and secondary sources (all in translation) to consider how civil law systems treat certain selected legal problems. Emphasis will be on civil law counterparts of first-year law courses, especially contracts and civil

procedure. Consideration also of the civil law judicial process in general and its historical development.

Law 721-2. Legal History. The seminar focuses on understanding and interpreting developments in Anglo-American legal history; the development of English common law; the origin of equity and the equity courts; the reception of English law in America; the development of western mining and water law; the effect of competition between courts in the development of substantive law, and the use of history in decision making.

Law 738-2. Mergers and Acquisitions. This course covers state and federal law concerning acquisition by tender offer, proxy contest, and friendly acquisition by conventional mergers and purchase of assets. All aspects of these transactions will be considered.

Law 739-2. Equal Protection. A historical and jurisprudential examination of the American constitutional principle of legal equality.

Law 741-2. Legal Imagination. An advanced course in reading and writing for law students. Varied literary and other works are read. The course may be of interest to the student interested in the question: Does my choice to become a lawyer mean the sacrifice of any ambitions to be a serious writer (or person)?

Law 749-2. Public Choice and Theories of Justice. The seminar will examine several recent theories about the normative foundation of legal decision making. Among the theories examined will be those of Rawls, Posner, Nozick, and Buchanan. It is anticipated that the papers will center on the application of the theories studied to real, concrete legal problems.

Law 758-2 and 759-1. Energy Law I and II. A study of selected areas of energy law, beginning in the fall in conventional classroom format followed by an examination, and concluding with a spring semester sequel in which research papers will be prepared and presented. Subjects covered will include electric utility regulation, federal regulation of natural gas, and state oil-and-gas conservation legislation (spacing, allowables, and unitization). If the seminar is oversubscribed, students interested in the field may apply for permission to attend the fall (course work) segment.

Law 761-2. Legislative Drafting. This seminar focuses on legislative drafting techniques and includes an introduction of the legislative process, the role of the drafter in the legislative process, and the use of legislation in solving client problems, generally.

Law 769-2. Commercial Drafting. The primary purpose of this seminar is to expose the third year law student to legal drafting techniques that will be useful in the private practice of law. The course will emphasize adversarial drafting of commercial and real estate contracts and other nonlitigation legal documentation.

Law 774-2. Toxics and Hazardous Wastes. Explores the growing problem of handling and disposing of toxic substances in a way that protects public health and the environment. Will focus primarily on the several federal statutes that regulate hazardous waste disposal, clean-up of contaminated sites, uranium mill tailings and nuclear wastes, toxic chemicals, and pesticides. Examines a sampling of state laws, as well as common law liability for toxic torts.

Law 775-2. Law and Medicine. First five weeks devoted to discussion of theories of liability in medicial malpractice cases. The remainder of the seminar (which includes paper presentations) focuses on bioethical issues (such as the right to die) of concern to both the medical and the legal profession.

Law 776-2. Law and Mental Health. The seminar examines the uses of psychiatry in the law and the constraints that law imposes on institutional psychiatry. Possible topics include civil commitment, competency to stand trial, the insanity defense, the right to treatment, the privilege to refuse treatment, guardianship, liability of mental health professionals.

Law 777-2. Labor Relations in the Public Sector. Study of growing impact of public sector unionization. Examines judicial decisions and statutory law bearing on rights and obligation of employees and employers, the right to organize, the collective bargaining relationship, strikes, impasse, and dispute settlement.

Law 782-2. Labor Arbitration. A study of arbitration procedures and techniques, including standards used for interpreting labor contract language. Students are assigned problems in important areas of arbitration.

Law 785-2. Social Legislation. A study of government efforts to combat poverty and maintain income. Examines welfare programs, Social Security, unemployment and workmen's compensation, fair labor standards, occupational safety and health, employment discrimination, and Title VII.

Law 786-2. Natural Resources Law: Protection vs. Development. Focus on current environmental issues, particularly in the Rocky Mountain region, which illustrate the frequent conflict between resource protection and resource development. The subject matter falls into five major resource categories: land use and transportation planning, water resource development, timber and national forest management, mineral development, and fish and wildlife protection.

College of Music

CHORAL MUSIC

Mus. 317/318-2. Conducting I and II. *Fall, Spring.* Introduction to conducting and rehearsal techniques. Sect. 1—Choral. Prer., Mus. 200, 180.

Mus. 515-2. Seminar in the Literature and Performance of Choral Music. *Fall, Spring.* Advanced conducting, analytical study. Required of all choral graduate students each semester of residence. Byers, Collins, Whitten.

Mus. 576-3. History of Choral Literature. *Fall.* Systematic survey of literature of vocal ensembles and choral music from polyphonic works of Renaissance to present. Luhring.

GRADUATE INTERDEPARTMENTAL COURSES

Mus. 519-3. Psychology of Music Learning. *Spring.* Concerns musical behaviors and their development. Examination of aspects of creativity, performance, and musical response. Recommended in all pedagogy degrees. Beall, McCarthy.

Mus. 570-2 or 3. Introduction to Music Bibliography and Research. *Fall, Spring, Summer.* Basic informational sources about music and musicians and a study of bibliographic forms, research, and writing techniques employed in music research papers, theses, and dissertations. Required in all master's degree programs. Kroeger.

Mus. 691-3. Doctoral Seminar. *Fall, Spring.* Focuses on helping doctoral students define and prepare for the general knowledge-about-music component of their degree programs. Presentations, both oral and written, of music analyses, book reports, and investigations into various areas of music literature, history, and theory.

HISTORY AND LITERATURE

Mus. 180-3. Introduction to Music. *Fall.* Three lect.-labs per wk. Study of music literature with emphasis on development of intelligent listening habits and analytical tools. Coreq., Mus. 100 and 102.

Mus. 183-3. Appreciation of Music. *Fall, Spring.* Basic knowledge of music literature and development of discriminating listening habits. In addition, each section emphasizes a different aspect—aesthetics, history, concert attendance. For nonmusic majors only. Ellsworth, Kearns, Luhring.

Mus. 275-3. History of Folk/Popular Music: USA. *Spring.* An examination of important trends throughout the history of the United States to the present time. Prer., Music 180 or 183.

Mus. 276-3. Music and Drama. *Fall.* Techniques used in combining music and dramatic arts through examples from musical and dramatic literature of the West from ca. 1000 to present. Prer., Mus. 180, 182, or 183. Ellsworth, Hayes.

Mus. 277-3. World Music. *Spring.* Musics outside western art tradition, using current ethnomusicological materials. Prer., Mus. 180, 182, or 183. Hayes.

Mus. 308-3. American Popular Music. *Spring.* Historical survey with focus on the popular song literature from 1920-present, and including the role of peripheral influences such as jazz, folk, country, etc. Scott.

Mus. 364-3. History of Jazz. *Fall.* Study of origins, development, and current trends. Open to all University students. Scott.

Mus. 379-3. Twentieth-Century Music and Media. *Spring.* Musical theatre, jazz, folk, rock, and hybrid styles, electronic music, and related art forms. Prer., Mus. 180, 182, or 183.

Mus. 380-3, 381-3. History of Music. *Fall, Spring.* Survey of Western art music with stylistic analysis of representative works from all major periods. Prer., Mus. 200 and one of the following: Mus. 181, 275, 276, 277, or 379. Ellsworth, Luhring.

Mus. 383-3. American 20th-Century Popular Music. *Spring.* Historical survey with focus on the popular song literature of 1920-present, including the role of peripheral influences such as jazz, folk, country, etc. Scott.

Mus. 424/524-3, 425/525-3. Church Music History. *Fall, Spring.* Comprehensive study of the philosophy of church music, with an evaluation of both fixed and free liturgies. Practical study of church choral literature, chanting, hymnology, and music in the church school.

Mus. 466/566-2. Chamber Music Literature: Winds and Percussion. *Spring.* Stylistic-historical survey in various genres from Baroque era to present. Prer., Mus. 381. Aaholm.

Mus. 471-2, 3/571-2, 4. Renaissance Music. Intensive study of monophonic and polyphonic music circa 1400-1600. History majors and others desiring extended study in this epoch may enroll for 3 hrs. credit. Prer., Mus. 380. Mus. 571—Two regular class meetings per wk., plus seminar meeting for variable credit. Those wishing to study white mensural notation in seminar should enroll for 4 hrs. credit. Luhring.

Mus. 474-3/574-3. Performance Practice of Early Music. *Spring.* A seminar-type examination of performance practices involving 16th-, 17th-, and 18th-century music. Luhring.

Mus. 475/575-3. Women Composers. (WmSt. 475.) *Spring.* A survey of Western music through works composed by women with emphasis on 19th and 20th centuries.

Mus. 476/576-3. History of Choral Literature. *Fall.* Systematic survey of literature of vocal ensembles and choral music. From polyphonic works of Renaissance to present. Prer., Mus. 380 and 381. Luhring.

Mus. 477/577-3. History of the Opera. *Fall.* Literature of the lyric theatre in its most salient currents and works from early Baroque to contemporary productions. Prer., Mus. 381. Ellsworth.

Mus. 479/579-3. Twentieth-Century Music. *Fall.* Western art tradition in an historical context. Major trends and developments explored while focusing on specific compositions of important composers. Prer., Mus. 381. Galm.

Mus. 481/581-3. Symphonic Literature. *Fall.* Study of literature for orchestra, band, and other symphonic ensembles: pre-classic, classic, romantic, and 20th century. Prer., Mus. 381. Galm.

Mus. 482-2,3/582-3,4. Ancient and Medieval Music. *Spring.* Survey from early times to circa 1400. History majors and others desiring extended study in this epoch should enroll for 3 hrs. credit. Prer., Mus. 380. Mus. 582—Two regular class meetings per wk., plus seminar for variable credit. Those wishing to study black mensural notation in seminar should enroll for 4 hrs. credit. Ellsworth.

Mus. 483-3/583-3. America's Vernacular Music. *Spring.* Intensified work in folk and popular music of America. Prer., Mus. 381. Kearns.

Mus. 484-3/584-3. Music Aesthetics. *Fall.* Various philosophies of music as they have developed during past 100 years in writings of philosophers, psychologists, sociologists, composers, critics, and historians. Prer., Mus. 381. Kearns.

Mus. 485/585-2, 3, 4. 17th- and Early 18th-Century Music. *Spring.* Music from 1580 to 1750 examined in terms of vocal and instrumental styles and national influence. Prer., Mus. 380. Two regular class meetings per wk., plus seminar in analysis for 4 hrs. credit. Luhring.

Mus. 486/586-3. America's Art Music. *Spring.* Intensified work in American art music. Prer., Mus. 381.

Mus. 487/587-3. Late 18th- and 19th-Century Music I. *Fall.* Music and documents of classic and romantic periods, 1750-1900. Prer., Mus. 381. Hayes.

Mus. 488/588-3. Late 18th- and 19th-Century Music. *Spring.* Selected topics in classic and romantic music, 1750-1900. Prer., Mus. 381. Hayes.

Mus. 489/589-3. Latin-American Music. *Spring.* Music of cultures south of the United States—Mexico, Peru, Brazil, Cuba, other countries having substantial musical heritage, with emphasis on relationship of folk, popular, and art styles. Galm.

Mus. 782-3, 783-3. Seminar in Musicology. *Fall, Spring.* Required of all musicology majors prior to completion of comprehensive examinations. A different research area is designated each semester. Periodic reports to Musicology Colloquium required. Staff.

MUSIC EDUCATION

Mus. 210-3. The Public School Music Curriculum. *Fall, Spring.* Music education within aesthetic education is principal focus of study. Patterns of music curricula in schools will be explored through class study, school observation, and participation. Special consideration given to methods and materials in general music. Prer., Mus. 100, 101, 102, 103, 180, 181. Beall.

Mus. 217-1. Laboratory Chorus. *Spring.* The study of special music literature available and suitable for young voices (ages 10-17). Opportunities to examine, sing, and conduct this literature are provided with little outside work. Prer., Mus. 100, 101, 102, 103, 180, 181, class or private voice. McCarthy.

Mus. 310-3. Teaching General Music. In-depth study of general music teaching at all levels through development of philosophy of music within aesthetic education; musical structure as content; child and adolescent development objectives; methods and approaches: Orff, Kodaly, Dalcroze, MMCP, electric approaches; evaluation. Prer., Mus. 210. Beall.

Mus. 311-3. Introduction to the Arts. *Spring.* Survey of the arts in Western culture, including architecture, painting, sculpture, poetry, prose, music, dance, comedy, tragedy, and film, along with a presentation of various approaches to relating the arts. Prer., basic course in one art. McCarthy.

Mus. 312-3. Teaching Choral Music. *Spring.* Music materials, pedagogical techniques, and administrative procedures used in choral music programs for junior and senior high school-age students. Prer., 200, 202, 210. McCarthy.

Mus. 313-1. Classroom Instruction Laboratory: Guitar. *Fall, Spring.* Basic strums and accompanying patterns are covered. Worster.

Mus. 314-3. Teaching Instrumental Music. *Spring.* Basic courses covering broad principles for administering, teaching, organizing instrumental music programs in the public schools. Staff.

Mus. 315-3. Teaching Woodwind Instruments. *Spring.* Instruction in playing and teaching all woodwind instruments. Playing experiences will be in heterogeneous and homogeneous groupings. Staff.

Mus. 316-2. Teaching Stringed Instruments. *Fall.* Instruction in playing and teaching all stringed instruments. Playing experiences will be in heterogeneous and homogeneous groupings. Staff.

Mus. 319-1. Laboratory Choir. *Spring.* McCarthy.

Mus. 320-3. Music for the Classroom Teacher. *Spring.* Practical study of vocal and general music in elementary school. Designed for classroom teacher. For education majors only. Beall.

Mus. 321-3. Teaching Brass Instruments. *Spring.* Instruction in playing and teaching all brass instruments. Playing experiences will be in heterogeneous and homogeneous groupings. Staff.

Mus. 322-3. Teaching Brass Instruments. *Spring.* Instruction in playing and teaching all brass instruments. Playing experiences will be in heterogeneous and homogeneous groupings. Staff.

Mus. 410-1. Introduction to Student Teaching. *Fall, Spring.* Prer., Mus. 310 or 312, Sect. 1. Coreq., Educ. 412. McCarthy.

Mus. 415-1. Percussion Class and Pedagogy. *Fall, Spring.* Galm.

Mus. 416-1. Introduction to Student Teaching. *Fall, Spring.* Reeves.

Mus. 417-3. Student Teaching Practicum—Elementary. Required of all students in student teaching programs. Staff.

Mus. 418-3. Student Teaching Practicum—Secondary. Required of all students in student teaching programs. Staff.

Mus. 419-1. Student Teaching Seminar (Choral, General, Instrumental). *Fall, Spring.* Required all students in student teaching programs. Beall, McCarthy.

Mus. 510-3. Teaching General Music. *Fall.* For music education majors whose emphasis is general music. Beall.

Mus. 512-3. Teaching Choral Music. *Fall.* For music education majors whose emphasis is choral music. McCarthy.

Mus. 514-2. Developing Children's Choirs. *Spring.* Areas include children's vocal development, music learning through performance, organization of children's choirs, and literature for young voices.

Mus. 515-2. Seminar in the Literature and Performance of Choral Music. *Fall, Spring.* See Choral Music section.

Mus. 518-2. Research in Teaching Music. *Spring.* Critical analysis of published research in music. Topics include approaches, data gathering, planning for survey and experimental studies, sampling, techniques for correlation, analysis of variance and covariance.

Mus. 520-2. Topics in Music Education. *Spring, Summer.* Preparation of individual topics in a seminar setting. The final project will be the major research document for master's degree students in music education.

Mus. 522-2, 3. Brass and Woodwind Pedagogy. *Fall.* Pedagogical problems in connection with teaching wind instruments, as well as survey of solo literature. Prer., 1 sem. of brass study and 1 sem. of woodwind study, or equivalent (1 sem. may be taken as coreq.). Staff.

Mus. 611-3. Foundations of Music Education I. *Fall.* Survey of historical, philosophical, psychological, and aesthetic bases of contemporary music education. Reeves.

Mus. 613-4. Comprehensive Musicianship for Teachers. *Spring.* Application of structural and analytical principles of music to teaching, conducting, and performing music for musician-teachers in the schools. Beall.

Mus. 614-2. Teaching Music Through Performance: The Conductor as Educator. *Spring.* McCarthy.

Mus. 615-3. Seminar in Elementary/Secondary/General Classroom Music. *Spring.* Investigation of theoretical bases for deriving objectives in general and classroom music in elementary and secondary schools; current curricula, methods, and materials focused on objectives; evaluative measures in music. Beall.

Mus. 617-2. Directions of Contemporary Aesthetic Education. *Fall.* Beall.

Mus. 619-1 to 3. Selected Studies in Music Education. *Fall, Spring.* May be repeated for additional credit. With consent of instructor and chairman of music education division.

These courses are available only to Doctor of Philosophy (music education) candidates.

Mus. 710-3. Research Literature and Techniques I (Historical and Philosophical). *Fall.* Sandford.

Mus. 711-3. Research Literature and Techniques II (Survey and Experimental). *Fall.* Study and analysis of procedures as applied to significant research in music education. Reeves.

Mus. 712-2. Research Practicum in Music Education. *Fall, Spring.* McCarthy.

Mus. 713-2. Contemporary Issues in College Teaching. *Spring.* Sandford.

ORGAN AND CHURCH MUSIC

Mus. 226-2. Service Playing Techniques. *Fall.* Methodology of playing for a church service including directing from the console, modulation, accompanying, and hymn playing. Vollstedt.

Mus. 326-2, 327-2. Improvisation. *Fall, Spring.*

Mus. 426/526-2, 427/527-2. Improvisation. *Fall, Spring.*

Mus. 428/528-3, 429/529-3. Organ Survey. *Fall, Spring.* Historical survey of organ music and organ construction, studying both forms of composition and types of organ for which the music was originally written. Trips to various churches in area will give the student an opportunity for first-hand observation.

Mus. 523-2 to 8. Church Music Research. *Fall, Spring.* Vollstedt.

PIANO

MUS. 110-2/210-2. Keyboard Musicianship. For music majors (non-piano). A sequence of four semesters for developing musicianship through improvising, playing by ear, harmonizing, score reading, transposing, and performing repertoire. Satisfies class minor requirements. Staff.

Mus. 112-1. Keyboard Skills. A two-semester course for freshman piano majors to develop keyboard facility in sight reading, improvising, playing by ear, harmonizing, and transposing. Duckworth, Graham.

Mus. 232-2. Functional Keyboard Techniques. *Fall.* Practical approach to functional keyboard techniques including harmonization, improvisation, transposition, modulation. Prer., consent of instructor.

Mus. 235-3. Piano Pedagogy I. *Spring.* Discussion of teaching philosophies, objectives, and procedures. Examination and evaluation of methods and materials. Practical aspects with which the private teacher is concerned. Lehnert.

Mus. 236-2. Introduction to Accompanying. *Fall.* Includes chamber music for pianists and music-making potentials. Performance required in variety of accompanying roles; critiqued and coached by class and instructor.

Mus. 334-2. Piano Pedagogy II. *Fall.* Pedagogical principles, student teaching, examination and evaluation of materials for beginners and elementary students. Prer., Mus. 235 or consent of instructor. Wallingford.

Mus. 335-3. Piano Pedagogy II. *Spring.* Observation in private studios and class meetings for summation and discussion. Bibliography and analysis for piano teachers. Prer., Mus. 235 or consent of instructor.

Mus. 432-3. Piano Literature. *Fall.* Survey from 18th century to present. Prer., Mus. 200. Wait.

Mus. 434-3. Piano Pedagogy III. *Fall.* Organization and guidance of piano groups (studio-performance instruction). Supervised teaching in children's laboratory. Duckworth.

Mus. 435-2. Piano Pedagogy III. *Spring.* Practice teaching and observation. Lesson plans and procedures for solving specific problems will be required. Observation in the studios of cooperating Boulder teachers. Prer., Mus. 434 or consent of instructor. Wallingford.

Mus. 436-2. Piano Accompanying. *Fall, Spring.* Discussion and performance of selected art songs and sonata literature with emphasis on

performance and preparation procedures. Special projects. May be repeated for additional credit. Prer., consent of instructor. Graham, Parmelee.

Mus. 530-3. Piano Pedagogy-Process of Group Environments. *Fall.* Organization and guidance of piano groups (studio-performance instruction), and classes (keyboard skills instruction). Supervised teaching in college class program. Duckworth.

Mus. 532-2. Seminar: Piano Literature. *Fall.* Keyboard music from earliest known examples through Debussy. Prer., graduate standing with major in piano performance or consent of instructor. Wait.

Mus. 533-2. Piano Music of the 20th Century. *Spring.* Study of specific contributions to piano literature by such composers as Schoenberg, Webern, Bartok, Stravinsky, Dallapiccola, Boulez, Stockhausen, Berio, Copland, Crumb, Martirano, and others. Prer., graduate standing or consent of instructor. Wait.

Mus. 534-2, 535-2. Research: Piano Literature and Pedagogy. *Fall, Spring.* Individual or group research related to piano pedagogy or literature for piano. Prer., consent of instructor.

Mus. 536-2. Piano Accompanying. *Fall, Spring.* Continuation of Mus. 436. May be repeated for additional credit. Graham, Parmelee.

Mus. 634-3, 635-3. Group Process. *Fall, Spring.* Student participation in *groups* with two to four individuals (studio-performance instruction); *classes* with five to twelve individuals (keyboard skills instruction); and *seminars* for understanding group theory. Duckworth.

Mus. 636/637. Practicum. In-depth experiences in organizing, teaching, and critiquing all phases of the group environments program. Registration is required until the following are completed: (1) a performance examination consisting of all keyboard skills, (2) Dissertation Project 825, and (3) Comprehensive Examination for candidacy.

Mus. 638-3. Group/Class Piano in College. *Fall.* Seminar dealing with educational and musical issues; organization and guidance of *groups* (studio-performance instruction); and *classes* (keyboard skills instruction). Supervised teaching in children's laboratory and college class program. Duckworth.

INSTRUMENTAL

Mus. 317/318-2. Conducting I, Conducting II. *Fall, Spring.* Introduction to conducting and rehearsal techniques. Sect. 2—Instrumental. Prer., Mus. 200, 180. Bernstein, McMurray.

Mus. 357-1. Viola Pedagogy. *Fall, Spring.*

Mus. 358-1. Violin Pedagogy. *Fall, Spring.* Bernstein, Lehnert.

Mus. 359-1. Cello Pedagogy. *Fall, Spring.*

Mus. 513-2. Advanced Conducting. *Spring.* Advanced work in conducting. Prer., a one-semester conducting class or equivalent. Bernstein, McMurray.

Mus. 552-553. Suzuki String Pedagogy. *Fall, Spring.* A study of the history, philosophy, methodology, and repertoire of the Suzuki method of teaching violin and its adaption to American music education.

THEORY/COMPOSITION

Mus. 100-3, 101-3. Theory I. *Fall, Spring.* An integrated course in the various elements of music theory, including composition, structural analysis, and principles of two-voice, three-voice, and four-voice writing. Coreq., Mus. 102, 103, and class piano. Students who do not pass a rudiments test given at the beginning of this course sequence must take Mus. 108 and 109 instead. Credit for these may not be used toward degree. Collins.

Mus. 102-1, 103-1. Theory and Ear Training Lab. I. *Fall, Spring.* Practice in rhythmic, melodic, harmonic, and contrapuntal sight singing and ear training. Coreq., Mus. 100, 101. Eakin, Scott.

Mus. 108-3. Rudiments of Music. *Fall, Spring.* Introduction to science and art of music to develop tools used in notating, performing, creating, and listening to music. For nonmusic majors only who have little or no previous schooling in subject. Collins.

Mus. 109-1. Rudiments of Music Laboratory. *Fall.* Elementary ear training and sight singing for music majors only. Required for music majors taking 108 and is coreq. with 108. Credit may not be used toward a degree.

Mus. 121, 221, 321, 421, 521, 621-1. Composition Seminar. *Fall, Spring.* Weekly assembly of all graduate and undergraduate composition students for presentations and discussions on various aspects of theory and composition. Theory/composition division staff.

P.Mus. 153, 253, 353, 453, 553, 653-2 to 3. Composition. *Fall, Spring.* Individual or small-group instruction. Theory/composition division staff.

Mus. 200-3. Theory II. *Fall.* Continuation of Theory I. Prer., Mus. 100, 101, 102, 103. Coreq., Mus. 202. Eakin, Scott.

Mus. 202-1. Theory and Ear Training Lab. II. *Fall.* Continuation of Ear Training and Sight Singing I. Prer., Mus. 102, 103. Coreq., Mus. 200. Eakin, Scott.

Mus. 207-2. Instrumentation. *Spring.* Introductory consideration to all instruments with respect to capabilities, technical and musical, singly and in combination. Scoring for smaller instrumental ensembles.

Mus. 305-2. Elementary Composition. *Spring.* Creative work in small forms. Prer., Mus. 200, 202. Eakin.

Mus. 307-3. Jazz Improvisation. *Spring.* Offers assistance and guidance to the student toward acquiring the necessary skills and gaining insights for achieving creative musical results. Prer., Mus. 100, 101, and basic skills on an instrument. Scott.

Mus. 400/500-3. Contemporary Theory. *Fall.* Study of established theoretical principles applied to advanced and recent idioms. Creative work included. Prer., Mus. 200. Prer. or coreq., Mus. 401, 402. Toensing.

Mus. 401-2. Sixteenth-Century Counterpoint. *Spring.* Prer., Mus. 200. Gonzalez.

Mus. 402-2. Eighteenth-Century Counterpoint. *Fall.* Prer., Mus. 200. Gonzalez.

Mus. 403/503-2. Scoring and Arranging. *Spring.* Practical problems, creative arranging, and scoring for various choral and instrumental groups. Prer., Mus. 207. Scott.

Mus. 404-2. Orchestration. *Fall.* Scoring for chamber and large ensembles. Prer., Mus. 207. Gonzalez.

Mus. 406-2. Analysis I. *Fall.* Selected works through the 18th century. Prer., Mus. 380 or equivalent.

Mus. 407-2. Analysis II. *Spring.* Selected works of the 19th and early 20th centuries. Prer., Mus. 380 or equivalent.

Mus. 408/508-2. Electronic Music. *Fall.* Practical approach to composition of electronic music, exploring methods of sound generation, alteration, and combination; emphasizing development of skill in use of synthesizers and recording equipment. Prer., consent of instructor.

Mus. 501-2. Advanced Counterpoint. *Spring.* Prer., Mus. 401.

Mus. 502-2. Seminar in Twelve-Tone and Serial Music. *Spring.* Music of such composers as Schoenberg, Webern, Babbitt, Nono, Stockhausen. Composition exercises using principles derived from analysis of representative works.

Mus. 503-2. Scoring and Arranging. *Spring.* Scott.

Mus. 504-2. Advanced Orchestration. *Spring.* Scoring for chamber and large ensembles. Prer., Mus. 207. Gonzalez.

Mus. 505-3. History of Theory. *Spring.* A study of important theoretical writings from ancient Greece to the present. Eakin.

Mus. 506-3, 507-3. Advanced Analysis I, II. *Fall, Spring.* Prer., Mus. 406 or 407.

Mus. 509-2. Music of Selected 20th-Century Composers. *Spring.* Musical style of a representative 20th-century composer, such as Stravinsky, Bartok, Messiaen, Ives, through an analysis of his works.

Mus. 550-1. Theory Teaching Practicum. *Spring.* Experience in planning, teaching, and evaluating undergraduate theory-composition courses. Eakin.

VOICE

Mus. 144-2. Italian Diction and Repertoire. *Fall.* Phonetics of Italian and coaching of classic arias. Hata.

Mus. 145-2. English Diction and Repertoire. *Spring.* English phonetics and coaching of art songs. Harrison.

Mus. 441/541-3. Opera Practicum. *Fall, Spring.* Jackson.

Mus. 442/542-2. Opera Theatre. *Fall, Spring.* Jackson.

Mus. 443/543-2. Russian Diction and Repertoire. *Spring, alternate years.* Russian phonetics and coaching of art songs. Hata.

Mus. 444/544-2. Vocal Pedagogy. *Fall.* Physiology, anatomy, and acoustics of the singing voice. Doscher.

Mus. 445/545-2. Repertoire for All Voices. *Spring.*

Mus. 446-3/546-2. French Diction and Repertoire. *Spring.* French phonetics and coaching in art songs. Open to singers and pianists. Paton.

Mus. 447-3/547-2. German Diction and Repertoire. *Fall.* German phonetics and coaching in Lieder. Open to singers and pianists. Paton.

Mus. 540-2. Words and Music. A discussion of the development of art song in Western civilization. Performance practices, texts, and musical styles are discussed. Prer., Mus. 546 and 547. Sable.

Mus. 548. Graduate Seminar in Vocal Pedagogy. *Spring.* Comparison methodology and supervised teaching. Prer., Mus. 444/544.

BACHELOR OF ARTS IN MUSIC

Mus. 398-1. Junior Research Seminar: Bachelor of Arts in Music. *Fall, Spring.* Concentration on conceptual aspects of research, the phsychology and "ordering" of a library search that leads to formal paper. Applies student's interests and curricular goals to specific topic; includes preparation of a prospectus for senior thesis. Arneson.

Mus. 490-3. Arts Management Techniques. *Spring.* Includes marketing, fund raising, budget, personnel management, contracts, and other facets of art management.

DOCTOR OF MUSICAL ARTS DISSERTATION PROJECTS

Mus. 801-1 Precandidacy for D.Mus.A. *Fall, Spring, Summer.*

Mus. 802-1. Candidacy for D.Mus.A. *Fall, Spring, Summer.*

Mus. 821-3. Dissertation Project I (Solo Recital, Choral Concert, Composition). *Fall, Spring.*

Mus. 822-3. Dissertation Project II (Solo Recital, Choral Concert, Composition, Vocal Pedagogy Project). *Fall, Spring.*

Mus. 823-3. Dissertation Project III (Chamber Music Recital, Vocal Pedagogy Project, Choral Project, Composition Recital). *Fall, Spring.*

Mus. 824-3. Dissertation Project IV (Chamber Music Recital, Choral Project, Composition Recital, Wind/Percussion Practicum). *Fall, Spring.*

Mus. 825-3. Dissertation Project V (Research Lecture). *Fall, Spring.*

Mus. 826-3. Dissertation Project VI (Research Lecture). *Fall, Spring.*

Mus. 827-1. Performance-Related Research Document. *Fall, Spring.* Coreq., Mus. 821.

Mus. 828-1. Performance-Related Research Document. *Fall, Spring.* Coreq., Mus. 822.

Mus. 829-1. Performance-Related Research Document. *Fall, Spring.* Coreq., Mus. 823.

Mus. 830-1. Performance-Related Research Document. *Fall, Spring.* Coreq., Mus. 824.

Mus. 831-3. Repertoire Project. *Fall, Spring.*

Mus. 832-2 to 6. Major Document. *Fall, Spring.* For pedagogy majors.

Mus. 833-6. Major Composition. *Fall, Spring.* For composition majors.

PERFORMING ORGANIZATIONS AND ENSEMBLES

Bell Ensemble. *Fall, Spring.* One hr. credit each sem. Open to qualified University students. Vollstedt.

Bell Ensemble. *Fall, Spring.* One hr. credit each sem. A performing organization using the University's set of 49 Whitechapel bells.

Chamber Music Ensemble. *Fall, Spring.* One hr. credit each sem. Prer., consent of instructor. Aaholm, Baird, Bernstein, Koromzay, Lehnert, Olson, and Roznoy.

Chamber Music (Two-Piano). *Fall, Spring.* One hr. credit each sem. Prer., consent of instructor. Wallingford.

Collegium Musicum. *Fall, Spring.* One hr. credit each sem. Open to qualified University students. Sanford.

Concert Band, Marching Band. *Fall, Spring.* One hr. credit each sem. Open to all qualified University students. Bailey.

Jazz Ensembles. *Fall, Spring.* One hr. credit each sem. Open to qualified University students. Diemond.

New Music Ensemble. *Fall, Spring.* One hr. credit each sem. Open to qualified University students. Gonzalez.

Symphonic Band, Wind Ensemble. *Fall, Spring.* One hr. credit each semester. Prer., consent of instructor. McMurray.

Symphony Orchestra, Chamber Orchestra. *Fall, Spring.* One hr. credit each sem. Prer., consent of instructor. Bernstein.

University Choir, University Singers, Collegiate Chorale, Women's Chorus. *Fall, Spring.* One hr. credit each sem. Open to qualified University Students. Whitten.

SPECIAL STUDIES

Mus. 940-1 to 3. Special Studies. *Fall, Spring.* Advanced undergraduate studies or special projects in selected areas. For undergraduate music majors only. May be repeated for additional credit.

Mus. 950-1 to 3. Special Studies. *Fall, Spring.* Graduate studies in specific areas and special projects. For Master of Music degree students only. May be repeated for additional credit.

Mus. 960-1 to 3. Special Studies. *Fall, Spring.* Advanced graduate studies in specific areas or special topics. For music doctoral degree students only. May be repeated for additional credit.

RECITALS, THESES, AND REQUIRED CLASSES

Mus. 399-1. Junior Recital.

Mus. 495-0 to 4. Senior Thesis (History and Literature). *Fall, Spring.*

Mus. 499-1. Senior Recital. *Fall, Spring.*

Mus. 701-2. Master's Performance Thesis I. *Fall, Spring.*

Mus. 702-2. Master's Performance Thesis II. *Fall, Spring.*

Mus. 703-2. Master's Pedagogy Thesis I. *Fall, Spring.*

Mus. 704-2. Master's Pedagogy Thesis II. *Fall, Spring.*

Mus. 705-2. Master's Literature Thesis I. *Fall, Spring.*

Mus. 706-2. Master's Literature Thesis II. *Fall, Spring.*

Mus. 707-2 or 4. Master's Composition Thesis I. *Fall, Spring.*

Mus. 708-2. Master's Composition Thesis II. *Fall, Spring.*

Mus. 709-2 or 4. Master's Music Education Thesis. *Fall, Spring.*

Mus. 800-0 to 8. Doctor's Thesis. *Fall, Spring.*

Mus. 999. Candidate for Master of Music Degree. *Fall, Spring.* Use only the semester of graduation if no other courses are taken.

Literature Class. *Fall, Spring.* Required for all undergraduate music majors.

Musicology Colloquium. *Fall, Spring.* Required for all graduate students in musicology.

APPLIED MUSIC: INDIVIDUAL AND CLASS INSTRUCTION

Courses in vocal or instrumental technique and interpretation may be found under the P.Mus. section of the *Schedule of Courses*. For individual applied music instruction, the equivalent of one hour of individual recitation (lesson) and one hour of literature class are required. Undergraduate performance majors carry 4 credit hours per semester; music education majors, 3 hours per semester (1 hour recitation); Bachelor of Arts in Music majors, 2 or 4 hours per semester; minors, 2 hours (½ hour recitation) per semester. Graduate performance majors normally carry 4 hours per semester; minors, 2 hours per semester. Place and hour of recitation are to be arranged.

School of Pharmacy

BIOPHARMACY

BIPH 308-4. Principles of Drug Action. *Spring.* An introduction to chemical, pharmacodynamic, pharmacokinetic, and biopharmaceutic concepts fundamental to the understanding of interactions between drugs and living organisms. Prer., PHCH 370 and EPOB 343.

BIPH 390/590-3. Pathology I. *Fall.* Covers the topics of cell and tissue injury, inflammation and repair, neoplasia, genetic diseases, immunopathology, and lung disease.

BIPH 391/591-2. Pathology II. *Spring.* This course examines the common disease processes in specific organ systems—cardiovascular, renal, gastrointestinal, reproductive tract, endocrine, musculoskeletal, and central nervous system. Prer., BIPH 390 or consent of instructor.

BIPH 450-3. Infectious Disease. *Fall.* Survey of diseases resulting from microbial and viral infections. Principles of immunological and drug therapy. Prer., fourth-year status and Chem. 471 or 481.

BIPH 949-1 to 3. Independent Study in Biopharmacy. *Fall, Spring.* Study involving library, laboratory, and a report. Prer., undergraduate standing and consent of instructor.

BIPH 959-1 to 3. Special Problems in Biopharmacy. *Fall, Spring.* Research techniques, methods, and reporting. Prer., graduate standing and consent of instructor.

CLINICAL PHARMACY

CNPH 421/521-6. Clinical Pharmacy and Therapeutics. *Fall.* Lect. A didactic course providing information on the appropriate use of pharmacotherapeutic principles in the treatment of selected disease states with particular attention to adverse drug reactions, drug-drug interactions, drug-disease interactions, and rationale pharmacotherapeutics. Prer., fifth-year status or consent of instructor.

CNPH 422-3. Therapeutic Aspects of Nonprescription Products. *Fall.* Lect. A didactic course providing information on the use of nonprescription products in selected disease states with particular attention to the areas of product selection, symptomatology, and patient consultation. Prer., fifth-year status.

CNPH 423-2. Institutional Pharmacy Practice. *Fall.* Lect. A didactic course providing an introduction to the principles of institutional pharmacy practice with consideration given to purchasing, basic management skills, and protocols to be observed in a hospital pharmacy practice. Prer., fifth-year status.

CNPH 424-2. Communicative and Psychosocial Aspects of Pharmacy Practice. *Fall.* Lect. and discussion. Designed to acquaint the student with aspects of both interpersonal communication relative to patient care and social issues in pharmacy practice. Prer., CNPH 486.

CNPH 425-1. Drug Literature Evaluation. *Fall.* A didactic course designed to introduce the student to concepts important in critically evaluating the drug literature. Sources of drug information and their proper utilization are also emphasized. Prer., fifth-year status or permission.

CNPH 426-4. Community Pharmacy Practice Externship I. *Spring.* Designed to familiarize the student with the practice of community pharmacy. Prer., fifth-year status.

CNPH 427-4. Community Pharmacy Practice Externship II. *Spring.* An experiential course to familiarize the student with clinical approaches in the area of community pharmacy practice with particular emphasis on patient consultation. Prer., fifth-year status.

CNPH 428-4. Institutional Pharmacy Practice Externship I. *Spring.* An experiential course designed to acquaint the student with basic procedures in hospital pharmacy practice. Prer., fifth-year status.

CNPH 429-4. Institutional Pharmacy Practice Externship II. *Spring.* An experiential course designed to acquaint the student with experience in clinical aspects of hospital pharmacy practice. Prer., fifth-year status.

CNPH 430-4. Outpatient Pharmacy Clerkship. *Spring.* An experiential course providing an opportunity for the student to gain clinical pharmacy experience in the area of ambulatory care. Prer., fifth-year status.

CNPH 431-4. Inpatient Pharmacy Practice Clerkship. *Spring.* An experiential course designed to give the student an opportunity for clinical pharmacy practice in the area of inpatient therapeutics. Prer., fifth-year status.

CNPH 432-4. Drug Information Clerkship. *Spring.* A discussion-experiential course in which the student gains experience in the use of both computerized and noncomputerized systems utilized in the process of drug information retrieval. Prer., fifth-year status.

CNPH 433-4. Rural Pharmacy Practice Externship I. *Spring.* An experiential course designed to provide the student with an opportunity for experience in pharmacy practice in rural areas of Colorado. Prer., fifth-year status.

CNPH 434-4. Rural Pharmacy Practice Externship II. *Spring.* An extension of CNPH 433, in which the student is allowed an opportunity to practice clinical pharmacy in a second rural pharmacy practice site in Colorado. Prer., fifth-year status.

CNPH 435-4. Geriatric Pharmacy Practice Externship. *Spring.* An experiential course designed to provide the student with information on the unique aspects of clinical pharmacy practice in the nursing home setting. Prer., fifth-year status.

CNPH 436-4. Industrial Pharmacy Practice Externship. *Spring.* An experiential course designed to acquaint the student with principles

of pharmacy practice in the area of pharmacy manufacturing. Prer., Phar. 417 or permission.

CNPH 437-4. Radiopharmacy Clerkship. *Spring.* An experiential course involving practical application of principles of nuclear pharmacy practice. Prer., fifth-year status.

CNPH 438-4. Pediatric Pharmacy Practice Clerkship. *Spring.* An experiential course involving principles of pharmacotherapeutics as applied to patient care interactions in pediatric patients. Prer., fifth-year status.

CNPH 439-4. Psychiatric Pharmacy Externship. *Spring.* An experiential course stressing the case of the mentally ill patient, utilization of drug therapy in mental illness, social aspects of mental illness, and the role which the pharmacist plays in the care of the mentally ill patient. Prer., fifth-year status.

CNPH 440-4. Administrative Pharmacy Practice Externship. *Spring.* An experiential course designed to provide the student with insight into the social-government and administrative aspects of pharmacy practice. Prer., fifth-year status.

CNPH 441-4. Special Projects Rotation. *Spring.* Advanced opportunities for students to participate in a selected area of pharmacy practice such as pharmaceutical product distribution, pharmaceutical sales representation, or clinical research. Prer., fifth-year status.

CNPH 442-4. Special Clinical Clerkships. *Spring.* Lect. An experiential course designed to give the student an opportunity for clinical pharmacy experience in a specific area of interest; e.g., oncology, dermatology, cardiology, respiratory disease, etc. Prer., fifth-year status.

CNPH 443-4. Veterinary Pharmacy Practice. *Spring.* Lect. An experiential course designed to provide the student with basic knowledge in drug preparation, distribution and use in veterinary medicine. Prer., fifth-year status.

CNPH 446-1. Principles of Antibiotic Therapy. *Fall.* Lect. This didactic course is designed to provide advanced information on the rational use of antibiotic agents. Information on general concepts of antibiotic therapy and various classes of antibiotic/antimicrobial medications will be presented. Prer., fifth-year status or consent of instructor.

CNPH 447-2. Drug Therapy in the Geriatric Patient. *Fall.* Lect. This didactic course is designed to provide health care students with a background in the aging process, appropriate drug therapy in the elderly, and pharmacy service in skilled nursing facilities and long term care facilities. Prer., fifth-year status or consent of instructor.

CNPH 449/549-3. Clinical Pharmacokinetics. *Fall.* Lect. Application of pharmacokinetic principles to therapeutic management of patients. Prer., fifth-year status or consent of instructor.

CNPH 510-6. Drug Information Center Clerkship. *Fall, Spring, Summer.* This experiential course is designed to provide the student with experience in drug information retrieval, drug literature analysis, and formulation of appropriate response to drug information inquiries. Prer., consent of instructor.

CNPH 511-6. Ambulatory Care Clerkship. *Fall, Spring, Summer.* This experiential course is designed to acquaint the student with outpatient-oriented services including medication histories, patient monitoring, and patient counseling. Prer., consent of instructor.

CNPH 512-6. Inpatient Pharmacy Practice Clerkship. *Fall, Spring, Summer.* This experiential course is designed to acquaint the student with patient assessment and monitoring in the inpatient setting, with particular emphasis on characteristic disease states that occur in this practice area. Prer., consent of instructor.

PHARMACEUTICAL CHEMISTRY

PHCH 370-1. Pharmaceutical Chemistry I. *Fall.* Lect. Chemical and physical characteristics of inorganic pharmaceuticals correlated with a study of physico-chemical principles as applied to pharmaceutical systems. Prer., third-year status.

PHCH 371-3. Pharmaceutical Chemistry II. *Spring.* Lect. Continuation of PHCH 370. Prer., PHCH 370.

PHCH 375-3. Physiological and Clinical Chemistry. *Spring.* Lect. Concerns regulation of metabolism with emphasis on hormonal mechanisms, changes in biochemistry due to intrinsic factors such as age and extrinsic factors such as diet, and current diagnostic tests for biochemical abnormalities. Prer., Chem. 471 or 481.

PHCH 472/572-3. Medicinal Chemistry I. *Fall.* Lect. Relationships between the chemical structures of drugs and their absorption, distribution, metabolism, excretion, and pharmacologic effects. Prer., PHCH 371 or consent of instructor.

PHCH 473/573-3. Medicinal Chemistry II. *Spring.* Lect. Continuation of PHCH 472. Prer., PHCH 472 or consent of instructor.

PHCH 540-2. Principles of Drug Design. *Fall.* Lect. A survey of techniques in rational drug design illustrated with examples from current literature. Topics will include quantitative structure-activity relationships; conformational analysis; pro-drug design; and directed structural modification to control drug absorption, distribution, metabolism, and elmination. Prer., two semesters of organic chemistry or consent of instructor.

PHCH 562-3. Instrumental Methods of Drug Analysis. *Spring, odd numbered years.* Lect. and lab. A survey of the major chromatographic and spectroscopic methods used in organic chemical analysis with emphasis on their applications to the qualitative and quantitative analysis of drugs. Prer., consent of instructor.

PHCH 563-3. Techniques in Pharmaceutical Synthesis. *Fall.* Lect. and lab. Application of synthetic procedures in the preparation of various medicinals and their intermediates. Prer., consent of instructor.

PHCH 565-2. Advanced Topics in Medicinal Chemistry. *Fall.* Lect. and discussion. A review of topics of current interest in medicinal chemistry. Prer., consent of instructor.

PHCH 566-2. Advanced Topics in Medicinal Chemistry II. *Spring.* Lect. and discussion. Continuation of PHCH 565. Prer., consent of instructor.

PHCH 568-1. Seminar in Pharmaceutical Sciences. *Fall, Spring.* Conference. Discussions concerned with current literature and research in the pharmaceutical sciences. Required of all graduate students. Prer., graduate standing.

PHCH 570-3. Advanced Physical and Inorganic Pharmaceuticals. *Fall.* Basic and advanced principles of physical and inorganic pharmaceutical chemistry; chemical properties and uses of inorganic compounds and products. Prer., general physical and inorganic chemistry, consent of instructor.

PHCH 664-1 to 3. Advanced Topics in Pharmaceutical Chemistry. *Fall, Spring.* Conference. A special topic of current in pharmaceutical chemistry will be considered each semester; course may be repeated for credit with instructor's consent. Prer., consent of instructor.

PHCH 949-1 to 3. Independent Study in Pharmaceutical Chemistry. *Fall, Spring.* Study involving library, laboratory, and a report. Prer., undergraduate standing and consent of instructor.

PHCH 959-1 to 3. Special Problems in Pharmaceutical Chemistry. *Fall, Spring.* Research techniques, methods and reporting. Prer., graduate standing and consent of instructor.

PHARMACOLOGY

PHCL 452/552-5. Mechanisms of Drug Action I. *Fall.* Lect. Mechanisms of action and effects of drugs that act on the autonomic, peripheral, and central nervous systems and the cardiovascular/renal system.

PHCL 453/553-5. Mechanisms of Drug Action II. *Spring.* Lect. Mechanisms of action and effects of drugs that are used in the treatment of endocrine disorders, hematopoietic disorders, infectious disease, and cancer.

PHCL 474-2. Toxicology. *Spring.* Lect. Current concepts of clinical, environmental, and forensic toxicology. Factors which influence toxicity as well as therapy. Prer., fourth-year status.

PHCL 550-3. Advanced Pharmacology. *Fall.* Lect. A study of the more advanced aspects of pharmacology. Prer., PHCL 452 or consent of instructor.

PHCL 556-2. Hormone and Neoplasia. *Spring, odd years.* The emphasis of this course is on the regulation of steroid hormones, polypeptide hormones, and growth factors on cell growth. General pharmacological, biochemical, and cellular principles on neoplastic growth will be discussed. Prer., consent of instructor.

PHCL 557-2. Behavioral Pharmacogenetics. *Spring, odd-numbered years.* Lect. Each term selected topics will be considered and may include behavioral and biochemical genetics, pharmacogenetics, and neurochemistry. Course may be repeated to include different topics. Prer., consent of instructor.

PHCL 558-1. Seminar in Pharmaceutical Sciences. *Fall, Spring.* Conference. Discussions concerned with current literature and research in the pharmaceutical sciences. Required of all graduate students. Prer., graduate standing.

PHCL 560-3. Advanced Toxicology. *Spring.* Lect. Discussion of aspects of pharmacology as they relate to the toxicity of a variety of chemicals. Areas such as metabolism, genetics, target organ/cell concepts and pharmacokinetics will be presented. Prer., consent of instructor.

PHCL 654-1 to 3. Advanced Topics in Pharmacology. *Fall, Spring.* Conference. A special topic of current interest in pharmacology will be considered each semester and the course may be repeated for credit with instructor's consent.

PHCL 949-1 to 3. Independent Study in Pharmacology. *Fall, Spring.* Study involving library, laboratory, and a report. Prer., undergraduate standing and consent of instructor.

PHCL 959-1 to 3. Special Problems in Pharmacology. *Fall, Spring.* Research techniques, methods and reporting. Prer., graduate standing and consent of instructor.

PHARMACY-PHARMACEUTICS

PHAR 305-2. Pharmacy Orientation. *Fall.* Lect. and rec. Introduction to pharmacy profession with emphasis on medical terminology, calculations, organization of the profession, and the pharmacist's role in health care delivery. Prer., third-year status.

PHAR 306-1. Survey of Prescription Procedures. *Spring.* Conference. Introduction to the elements of modern prescription procedures. Prer., third-year status.

PHAR 410/510-4. Pharmaceutics I. *Fall.* Lect. and lab. Continuation of PHAR 306 with emphasis on the official dosage forms. Prer., PHAR 308 and PHCH 371 or consent of instructor.

PHAR 411/511-4. Pharmaceutics II. *Spring.* Lect. and lab. Theoretical and practical techniques related to the formulation, preparation, and dispensing of modern pharmaceuticals. Prer., PHAR 410 or consent of instructor.

PHAR 412-0. Industrial Tours. *Spring.* All students in the School of Pharmacy are required to participate in the field trip to visit pharmaceutical industries. Transportation is the only expense to the student.

PHAR 416-2. Intercultural Drug Use. *Spring.* Conference. Cultural variations in health practices and attitudes with emphasis on pharmacist-patient communication. Prer., fourth-year status and consent of instructor.

PHAR 417-3. Manufacturing Pharmacy. *Fall, Spring.* Lect. and lab. Preparation of pharmaceuticals utilizing techniques and equipment suitable for quantity production. Prer., fourth-year status and consent of instructor.

PHAR 512-2. Advanced Pharmacokinetics. *Spring, odd-numbered years.* Derivation and application of classical mathematical models characterizing drug absorption, distribution, metabolism, and excretion. Emphasis is directed toward interpretation of pharmacokinetic information and design of dosage regimens. Prer., graduate standing and consent of instructor.

PHAR 517-3. Pharmaceutical Production. *Fall.* Conference and lab. Advanced techniques and current research on problems and developments in the industrial manufacture of pharmaceuticals. Prer., PHAR 417 or consent of instructor.

PHAR 518-1. Seminar in Pharmaceutical Sciences. *Fall, Spring.* Conference. Discussions concerned with current literature and research in the pharmaceutical sciences. Required of all graduate students. Prer., graduate standing.

PHAR 949-1 to 3. Independent Study in Pharmaceutics. *Fall, Spring.* Study involving library, laboratory, and a report. Prer., undergraduate standing and consent of instructor.

PHAR 959-1 to 3. Special Problems in Pharmaceutics. *Fall, Spring.* Research problems involving dosage form design, biopharmaceutics, and pharmacokinetics. Prer., graduate standing and consent of instructor.

PHARMACY ADMINISTRATION

PHAD 381-3. Laws of Pharmacy. *Fall.* Lect. and rec. State and federal statutes and regulatory decisions governing the practice of pharmacy with emphasis on the common law principles and ethics of the profession. Prer., third-year status.

PHAD 383-3. Pharmacy Financial Management. *Spring.* Lect., rec. The application of accounting principles and financial analysis to the management of a pharmacy. Prer., third-year status.

PHAD 486-3. Pharmacy Management. *Spring.* Lect. and rec. Management, marketing, and merchandising problems that must be considered in the successful operation of a pharmacy. Prer., PHAD 381 and 383.

PHAD 487-3. Pharmacy Management Seminar. *Fall.* Conference. Seminar case studies in the operation of pharmacies. Prer., PHAD 486.

PHAD 581-3. Pharmaceutical Management. *Fall, Spring.* Conference. Selected topics on current research and contemporary problems in the field of pharmacy management and marketing. Prer., consent of instructor.

PHAD 582-3. Drug and Cosmetic Law. *Fall, Spring.* Conference Study of the history and evolution of laws and regulations that control the distribution of drugs, cosmetics, and poisonous chemicals. Prer., consent of instructor.

PHAD 583-3. Hospital Pharmacy Administration I. *Fall, Spring.* Conference. Hospital organization and the relationship of the departmental components to the pharmacy with emphasis on the managerial operations of a hospital pharmacy. Prer., consent of instructor.

PHAD 584-3. Hospital Pharmacy Administration II. *Fall, Spring.* Conference. Continuation of PHAD 583. Prer., PHAD 583 or consent of instructor.

PHAD 949-1 to 3. Independent Study in Pharmacy Administration. *Fall, Spring.* Study involving library research, and a report. Prer., undergraduate standing and consent of instructor.

PHAD 959-1 to 3. Special Problems in Pharmacy Administration. *Fall, Spring.* Individual investigations in pharmacy marketing, retailing, and management. Prer., graduate standing and consent of instructor.

Reserve Officers Training Corps

AIR FORCE AEROSPACE STUDIES

Air 101-1. Development of Air Power I. One 1-hr. lect.-rec. and one 1-hr. lab. per wk. Introduction to the development of air power, management and use of aerospace power today, and use of future manned aircraft and spacecraft. Lab. involves a study of Air Force customs and courtesies, drill and ceremonies, career opportunities, and life and work of an Air Force junior officer.

Air 102-1. Development of Air Power II. A continuation of Air 101. One 1-hr. lect.-rec. and one 1-hr. lab. per wk.

Air 201-1. U.S. Military Forces I. One 1-hr. lect.-rec. and one 1-hr. lab. per wk. A survey course describing strategic offensive/defensive, general purpose, and aerospace support functions of U.S. military forces. Laboratory introduces the student to leadership experiences in a practical, supervised training environment.

Air 202-1. U.S. Military Forces II. A continuation of Air 201. One 1-hr. lect.-rec. and one 1-hr. lab. per wk.

Air 301-3. Air Force Management and Leadership I. Two 1½-hr. seminars plus one 1-hr. lab. per wk. Individual motivation and behavioral processes, leadership, communication, and group dynamics are studied and applied in actual case studies. Communicative skills development is stressed. Laboratory provides opportunity for application and testing of management/leadership training.

Air 302-3. Air Force Management and Leadership II. Two 1½-hr. seminars and 1-hr. lab. per wk. A continuation of Air 301. Basic managerial processes are emphasized, while group discussions, case studies, and role playing as learning devices are employed. Emphasis on communicative skills development is continued.

Air 401-3. National Security Forces in Contemporary American Society I. Two 1½-hr. seminars and one 1-hr. lab. per wk. Air 401 focuses on the armed forces as an integral part of society. Special themes include: societal attitudes, professionalism, U.S. defense strategy, and military foreign policy decision-making, with emphasis on the communicative skills.

Air 402-3. National Security Forces in Contemporary American Society II. Two 1½-hr. seminars and a 1-hr. lab. per wk. A continuation of Air 401. Special themes include defense strategy and conflict management, formulation/implementation of U.S. defense policy and organizational factors and case studies in policy making, international laws of warfare, and the Uniform Code of Military Justice.

MILITARY SCIENCE (U.S. ARMY)

M.S. 101-2. Introduction to Military Science. One 1-hr. lect. and one 1-hr. leadership lab per wk. An overview of the history and organization of the U.S. Army and its role in the defense of the U.S. Customs and traditions of the armed services, introduction to combat operations and small unit tactics. Lab. period covers land navigation, drill and ceremonies, and other basic soldier skills.

M.S. 102-2. Introduction to Military Science. One 1-hr. lect. and one 1-hr. leadership lab per week. A continuation of M.S. 101.

M.S. 201-3. Military Leadership and Management I. Two 1-hr. lect.-rec. and one 1½-hr. lab per wk. Leadership theory, including motivation, attitudes, leader styles, and behavior. The fundamentals of military leadership, including decisionmaking, communication, interaction, and counseling. Laboratory period improves leadership skills in land navigation, first aid, and drill.

M.S. 202-3. Military Leadership and Management II. Two 1-hr. lect.-rec and one 1½-hr. lab per wk. Continuation of M.S. 201. Leadership and Management theories applied through a modular management simulation program, stressing the development of decisionmaking and communication skills.

M.S. 301-3. Military Operations and Training I. Two 1-hr. lect.-rec. and one 1½-hr. lab per wk. Covers the military skills and professional knowledge required of the military officer. Includes principles of logistics, maintenance, unit administration, training management, tactical communications, weapons systems, and tactics. Laboratory provides the opportunity for practical application of leadership techniques by assuming leadership positions at the squad level.

M.S. 302-3. Military Operations and Training II. Two 1-hr. lect.-rec. and one 1½-hr. lab per wk. A continuation of M.S. 301. Concentrates on land navigation skills and small unit tactics.

M.S. 401-3. Seminar in Officer Development and Leadership. Two 1-hr. lect.-rec. and one 1½-hr. lab per wk. A detailed study of the organization and functions of the Army, command and staff relations, the role of the junior officer. Laboratory provides the opportunity for application of leadership techniques by assuming leadership positions at the platoon level/company staff level.

M.S. 402-3. Seminar in Officer Development and Leadership. Two 1-hr. lect.-rec. and one 1½-hr. lab per wk. A continuation of M.S. 401. Concentrates on professional ethics, national strategy, and military law.

NAVAL SCIENCE

N.S. 101-2. Introduction to Naval Organization and Ship Design. *Fall.* Introduction to the structure and principles of naval organization. Principles of ship design and construction are discussed, with an emphasis on quantitative treatment of stability and bouyancy.

N.S. 102-2. Seapower and Maritime Affairs. *Spring.* A study of the importance of seapower in domestic and international affairs including naval, maritime, and other commercial uses of the seas.

N.S. 201-3. Weapons and Systems Analysis. *Fall.* An introduction to the theoretical concepts upon which modern naval weapons systems are designed and constructed. Specific areas of study include the physics of underwater sound propagation, pulse radar theory, automatic tracking principles, and fundamentals of missile guidance.

N.S. 202-3. Naval Ship Systems. *Spring.* A detailed study of ship propulsion and related auxiliary systems. Emphasis placed on fossil-fueled and nuclear steam and gas turbine systems. Design constraints imposed by unique marine environment stressed.

N.S. 301-3. Navigation and Naval Operations. *Fall.* Theory and practical application in the art of navigation: charts, publications, piloting, dead reckoning, navigation aids and instruments, time, celestial coordinate systems, sextant use, complete sight reduction methods, electronic fixing, and voyage planning.

N.S. 302-3. Navigation and Naval Operations II. *Spring.* Thorough examination of the Inland and International Rules of the Nautical Road, including court interpretations; principles of relative motion and vector analysis with the maneuvering board; shiphandling procedures, weather, communications, and tactical operations.

N.S. 310-3. Evolution of Warfare. This course traces the development of warfare, focusing on the impact of military theorists and technical developments. The student acquires a sense of strategy, develops an understanding of military alternatives, and sees the impact of historical precedent on military actions.

N.S. 401-3. Leadership and Management I. *Fall.* A comprehensive study of organizational behavior and management in the context of the naval organization. Topics include planning, organizing and controlling; individual and group behavior; motivation and leadership; decisionmaking, communication, responsibility, authority, and accountability.

N.S. 402-3. Leadership and Management II. *Spring.* Study of junior naval officer responsibilities in naval administration. The course includes counseling methods, military justice, human resources management, directives and correspondence, personnel administration, material management and maintenance and supply systems.

N.S. 410-3. Amphibious Warfare. A survey of the development of amphibious doctrine. Emphasis is placed on the evolution of amphibious warfare in the 20th century. Present day potential and limitations on amphibious operations, including the rapid deployment force concept, are explored.

Administrative Officers and Faculty

BOARD OF REGENTS

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ROY H. SHORE, Greeley, term expires 1986
DAVID K. SUNDERLAND, Colorado Springs, term expires 1986
CHARLES M. ABERNATHY, JR., Montrose, term expires 1988
HUGH C. FOWLER, Englewood, term expires 1988
SANDY F. KRAEMER, Colorado Springs, term expires 1988

Staff

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EDWARD W. MURROW, University Treasurer and Assistant Vice President for Budget and Finance. B.S. (Acctg.), University of Colorado.

ADMINISTRATIVE OFFICERS

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Health Sciences Center

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MARIO PASQUALE, Vice Chancellor for Administration. B.S., M.P.A., University of Colorado.
ERIC W. SCHMIDT, Vice Chancellor for External Health Affairs. B.S., University of Colorado.
JONATHAN W. CASTLE, Acting Assistant Vice Chancellor for Finance. B.A. Western Washington State College, Billingham, Washington; B.S., Arizona State University; M.S., University of Colorado; C.P.A., Colorado State Board of Accountancy.

College of Arts and Sciences

ANTHROPOLOGY

BOULOS AYAD, Professor.* B.A., M.A., Ph.D., Cairo University (Egypt); M.A., University of Einshams (Egypt).

DAVID A. BRETERNITZ, Professor.* B.A., University of Denver; M.A., Ph.D., University of Arizona.

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ALICE M. BRUES, Professor Emerita.*

HELEN CANNON, Professor Emerita.

DENNIS J. DE SART, Assistant Professor (Denver).* B.A., University of Nevada; M.A., Ph.D., Cornell University.

DARNA L. DUFOUR, Assistant Professor.* B.S., Northeastern University; M.A., Ph.D., State University of New York-Binghamton.

FRANK W. EDDY, Associate Professor.* B.A., University of New Mexico; M.A., University of Arizona; Ph.D., University of Colorado.

DAVID LEE GREENE, Professor.* B.A., M.A., Ph.D., University of Colorado.

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JAMES J. HESTER, Professor.* B.A., University of New Mexico; Ph.D., University of Arizona.

GORDON W. HEWES, Professor.* A.B., Ph.D., University of California, Berkeley.

DOROTHEA V. KASCHUBE, Professor.* A.B., M.A., Ph.D., Indiana University.

ALEC J. KELSO, Professor.* B.S., Northern Illinois University; M.A., Ph.D., University of Michigan.

GOTTFRIED O. LANG, Professor.* A.B., Brown University; M.A., University of Chicago; Ph.D., Cornell University.

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JANET R. MOONE, Associate Professor (Denver). M.A., University of Colorado; B.A., Ph.D., University of Arizona.

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DUANE QUIATT, Professor (Denver).* A.B., A.M., University of Michigan; Ph.D., University of Colorado.

PAUL SHANKMAN, Department Chairman;* Associate Professor. B.A., University of California, Santa Barbara; Ph.D., Harvard University.

PAYSON D. SHEETS, Associate Professor.* B.A., M.A., University of Colorado; Ph.D., University of Pennsylvania.

OMER C. STEWART, Professor Emeritus.*

FORREST D. TIERSON, Assistant Professor (Colorado Springs).* B.A., M.A., Ph.D., State University of New York at Albany.

DENNIS P. VAN GERVEN, Professor.* B.A., University of Utah; M.A., Ph.D., University of Massachusetts.

DEWARD E. WALKER, JR., Professor.* B.A., Ph.D., University of Oregon.

RICHARD WARNER, Associate Professor Adjoint.* M.B., B.S., London University; M.A., University of Colorado; D.P.M., Royal College of Physicians, London.

JOE BEN WHEAT, Professor.* B.A., University of California; M.A., Ph.D., University of Arizona.

JANE C. WHEELER, Assistant Professor.* B.A., American University; Ph.D., University of Michigan.

THOMAS G. WYNN, Associate Professor (Colorado Springs).* A.B., Occidental College; A.M., Ph.D., University of Illinois.

ASTROPHYSICAL, PLANETARY, AND ATMOSPHERIC SCIENCES

DAVID C. ABBOTT, Lecturer.* B.S., Iowa State University; Ph.D., University of Colorado.

MORRIS L. AIZENMAN, Lecturer.* B.S., University of Alberta; Ph.D., University of Chicago.

R. GRANT ATHAY, Professor Adjoint.* B.S., Utah State University; Ph.D., University of Utah.

THOMAS R. AYRES, Lecturer.* A.B., Harvard College; Ph.D., University of Colorado.

CHARLES A. BARTH, Professor.* B.S., Lehigh University; M.A., Ph.D., University of California, Los Angeles.

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EDWARD R. BENTON, Professor.* A.B., Harvard College; A.M., Ph.D., Harvard University.

DONALD E. BILLINGS, Professor Emeritus.*

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BRUCE E. BOHANNAN. Director, Astronomical Laboratories; Associate Professor (Attendant Rank).* B.S., University of Alberta (Canada); M.A., Ph.D., University of California, Los Angeles.

TIMOTHY M. BROWN, Lecturer.* B.A., Wesleyan University; Ph.D., University of Colorado.

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KATHARINE B. GEBBIE, Professor Adjoint.* B.A., Bryn Mawr College; B.Sc., Ph.D., University College, London.

JOHN C. GILLE, Lecturer.* B.S., Yale College; B.A., M.A., Cambridge University; Ph.D., Massachusetts Institute of Technology.

PETER A. GILMAN, Professor Adjoint.* B.A., Harvard College; M.S., Ph.D., Massachusetts Institute of Technology.

MARTIN GOLDMAN, Professor.* A.B., Princeton University; M.S., Ph.D., Harvard University.

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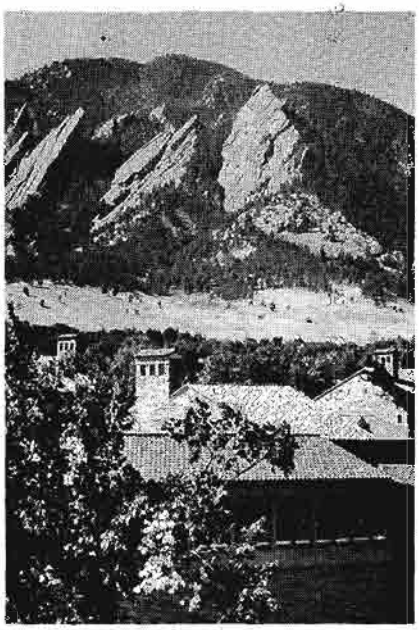

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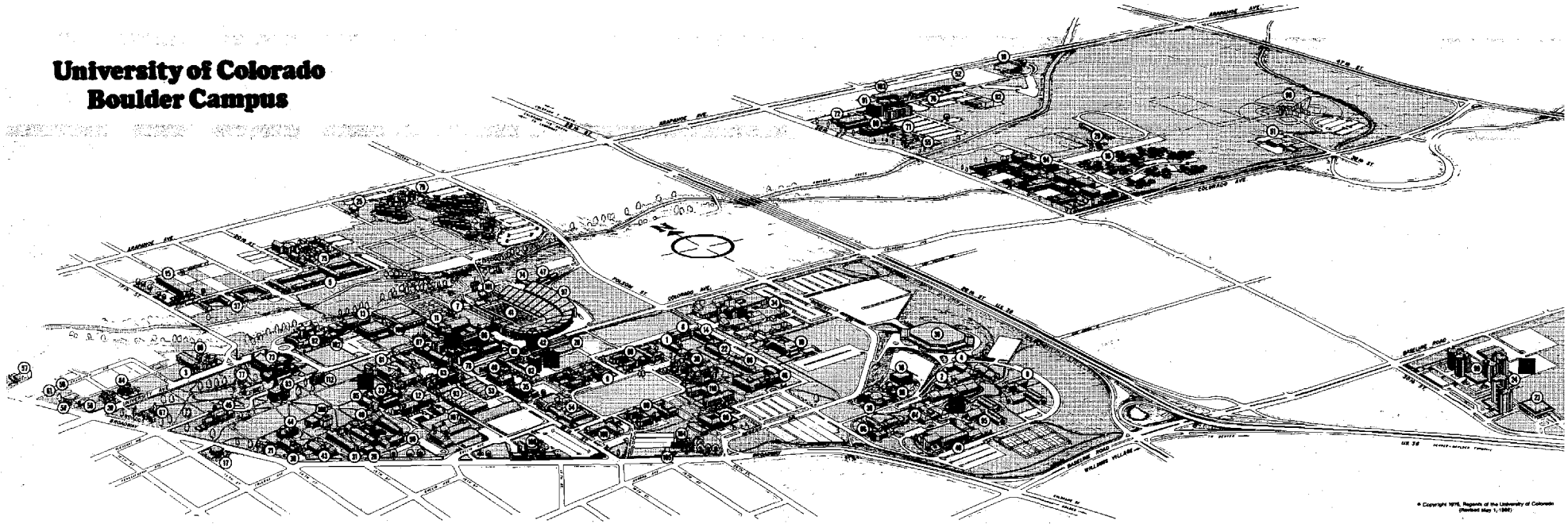

A B C D E F G H I J

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34

Academy Center and Conservatory (970 Aurora) ..... not shown
1. Aden Hall G-15
2. Andrews Hall (Kittredge Complex) H-21
3. Armory (1511 University) H-5
4. Arnett Hall (Kittredge Complex) H-22
5. Athens Court (1951 Grandview) F-8
6. Baker Hall H-14
7. Balch Fieldhouse F-11
8. Bracket Hall G-16
8. Buckingham Hall (Kittredge Complex) H-23
10. Business G-19
11. Carlson Gymnasium G-11
12. Chemistry H-10
13. Clare Small Gymnasium G-9
14. Cockerell Hall G-16
15. College Inn Conference Center (1729 Athens) F-6
16. Colorado Court (5333 Colorado Avenue) .. C-25
17. Communication (1186 Broadway) J-6
18. Communication Disorders and Speech Science G-20
19. Computing Center A-23
20. Continuing Education (1221 University) H-3
21. Cottage No. 1 ..... I-7
22. Crosman Hall G-17
23. Darley Commons (Williams Village Complex) H-34
24. Darley Towers (Williams Village Complex) H-33
25. Day Care Center (2292 Arapahoe) D-9
26. Dawson Laboratory I-8
Distribution Center (2000 Central Ave.) ..... not shown
27. Duane Physics Laboratories Complex (Includes Duane Physics and Astrophysics, Gamow Tower, Laboratory for Atmospheric and Space Physics, and Joint Institute for Laboratory Astrophysics Laboratory and Tower) G-13
28. Duane Physics and Astrophysics G-13
29. Eps Campus Std Building D-25
30. Economics I-7
31. Education I-8
32. Ekeley Chemical Laboratories Complex (Includes Ekeley Chemistry and Pharmacy) H-8
33. Ekeley Chemistry H-8
34. Engineering Center F-17
35. Environmental Design H-12
36. Events/Conference Center G-21
37. Faculty-Staff Court (18th and Athens) F-6
38. Fensand Hall H-16
39. Fiske Planetarium I-20
40. Fleming Law I-21
41. Folsom Stadium F-12
42. Gamow Tower (Duane Physical Laboratories Complex) G-13
43. Geology I-8
44. Guggenheim Geography I-7
45. Hale Science I-8
46. Hallett Hall H-17
47. Health Physics Laboratory F-13
48. Heating Plant H-12
49. Hellems Arts and Sciences I-9
50. Henderson Museum I-10
51. Housing System Maintenance Center (1256 38th) C-26
52. Housing System Support Center (3361 Mapleton) B-22
53. Hunter Science H-11
54. Imig Music I-13
55. Institute for Behavioral Genetics C-21
56. Institute of Behavioral Science No. 1 (1416 Broadway) H-3
57. Institute of Behavioral Science No. 2 (1540 Broadway) H-1
58. Institute of Behavioral Science No. 3 (1424 Broadway – H-3
59. Institute of Behavioral Science No. 4 (1229 Grandview) H-2
60. Institute of Behavioral Science No. 5 (1201 17th) G-8
61. Institute of Behavioral Science No. 6 (1243 Grandview) H-2
Internationel English Center (889 17th) ..... not shown
62. Joint Institute for Laboratory Astrophysics (JILA) (Duane Physical Laboratories Complex) H-12
63. Ketchum Arts and Sciences H-11
64. Kittredge Commons (Kittredge Complex) . H-21
65. Kittredge Complex (Includes Andrews, Arnett, Buckingham, Kittredge West, and Smith halls) I-21
66. Kittredge West Hall (Kittredge Complex) ... I-20
67. Koenig Alumni Center I-4
68. Laboratory for Atmospheric and Space Physics (LASP) (Duane Physical Laboratories Complex) G-12
LASP Engineering Center (1426 Central Ave.) ..... not shown
69. Libby Hall G-18
70. Life Sciences Laboratories Complex (Includes Muenzinger Psychology, Porter Biosciences, and Ramaley Biology) G-11
71. Life Sciences Research Laboratory C-20
72. Litman Research Laboratory B-19
73. Macky Auditorium H-7
74. Maintenance and Operations Center F-12
75. Marine Court (1350 20th) E-6
76. Marine Street Science Center (3215 Marine) B-21
77. McKenna Languages H-8
78. Muenzinger Psychology (Life Sciences Laboratories Complex) G-11
79. Newton Court (1475 Folsom, 2300 Arapahoe) D-10
80. Nichols Hall I-18
81. Norlin Library H-9
82. Nuclear Physics Laboratory B-22
83. Old Main H-7
84. Pega Foundation Center (1305 University) . H-4
85. Pharmacy (Ekeley Chemical Laboratories Complex) H-8
86. Porter Biosciences (Life Sciences Laboratories Complex) G-11
87. Ramaley Biology (Life Sciences Laboratories Complex) G-10
88. Reed Hall G-17
89. Regent Administrative Center I-17
94. Research Laboratory No. 2 (WICHE) C-20
91. Research Laboratory No. 5 (NOAA, NCAR) B-20
92. Sewall Hall G-8
93. Sibell-Wells Fine Arts H-11
94. Smiley Court (1300 30th) D-23
94. Smith Hall (Kittredge Complex) I-22
95. Sommers-Bausch Observatory H-20
97. Stadium Building F-13
98. Stadio Recreation Complex B-26
98. Stearns Towers (Williams Village Complex) G-32
100. Student Recreation Center G-10
101. Team House F-12
102. Temporary Building No. 1 ..... G-8
105. Transportation Center (3295 Marine) B-20
106. University Administrative Center (914 Broadway) I-16
106. University Administrative Center Annex (924 Broadway) I-16
108. University Club (972 Broadway) I-12
107. University Memorial Center (UMC) I-11
108. University Theatre I-8
109. Wardenburg Student Health Center I-14
110. Willard Administrative Center (North Wing) and Willard Hall (South Wing) H-16
111. Williams Village Complex (Includes Darley Commons, Darley Towers, Stearns Towers, and Heating Plant) H-33
112. Woodbury Arts and Sciences H-8