



University of Colorado
Boulder

GRADUATE STUDY IN CHEMICAL ENGINEERING

An Advising Guide for Graduate Studies
in Chemical and Biological Engineering
at the University of Colorado

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1 INTRODUCTION

The Graduate School of the University of Colorado Boulder offers advanced instruction leading to the following degrees in the Department of Chemical and Biological Engineering:

- Doctor of Philosophy (Ph.D.)
- Master of Science (M.S.)

This booklet is intended for graduate students in chemical engineering, as a supplement to the information contained in the Graduate School Rules. In some areas, the Department of Chemical and Biological Engineering has more specific requirements than the Graduate School (<http://www.colorado.edu/GraduateSchool/policies/index.html>), and the regulations herein should be used. However, the Department is subject to all minimum requirements of the Graduate School. This book is to be used as a general guideline. This manual can be corrected or updated at any time.

Please note that **each graduate student holds complete responsibility for his/her own program**. Therefore, it is expected that the student will become familiar with the contents of this booklet, as well as the general rules of the Graduate School and the University of Colorado Boulder.

2 ADMISSION REQUIREMENTS

2.1 *General Admission Requirements*

General criteria for admission to the graduate program are:

- a) A Baccalaureate degree from a college or university of recognized standing, equivalent to the degree given at this university, or college work equivalent to that required for such a degree, at least 96 semester hours of which must be acceptable toward a Baccalaureate degree at this university;
- b) Have an undergraduate GPA of at least 3.25/4.00
- c) Promise of ability to pursue advanced study and research, as judged by previous scholastic record or otherwise; and
- d) Adequate preparation to enter graduate study in the chosen field.
- e) All supported graduate students in the Department are admitted directly to the Ph.D. degree. However, those without a Master's degree in Chemical and Biological Engineering have the option of receiving an M.S. degree (Plan I or Plan II, see Sections 3.1 or 3.2, respectively) on the way to the Ph.D. Those who elect to receive an M.S. degree from the University of Colorado must subsequently complete a new application form for the Ph.D, unless the M.S. degree conferred is Plan II, non-thesis, no exam.

2.2 *Classification of Students*

Depending on the degree to which the applicant satisfies the requirements, admission may be either as a Regular Degree Student or as a Provisional Degree Student.

2.2.1 Regular Degree Student

A student can be admitted as a Regular Degree Student if, in addition to fulfilling requirement (a) in Section 2.1, the overall graduate grade-point average is at least 3.25 (B). If at least nine semester hours of relevant graduate work with a 3.25 average or above have been completed, even with an undergraduate grade-point average below 3.25, the student may be admitted as a regular degree student upon recommendation of the Department of Chemical and Biological Engineering.

Privileges: The regular degree student may take courses, for which the appropriate specific prerequisites are met, on any of the four campuses of the University.

Restrictions: Regular degree students must maintain a 3.0 grade-point average for all work taken, whether it is to be applied toward the advanced degree or not. If the student fails to maintain this standard of performance, he/she may be dropped from the academic program after receiving warning from the Department or Graduate School.

2.2.2 Provisional Degree Student

If the student does not satisfy the requirements for a regular degree student, but in the opinion of the Department of Chemical and Biological Engineering, he/she merits a trial in graduate work despite a low undergraduate grade-point average or deficiencies in preparation, the student may be admitted as a Provisional Degree Student.

Ordinarily, a student admitted as a provisional student will not be eligible for a change of status to a regular degree student until at least 12 semester hours of graduate work, with an overall average of 3.25 or higher in all courses attempted, have been completed. At the time of admission to provisional degree status, the student will be informed by the Department, in writing, of the performance expected before the Department will recommend admission as a regular degree student. A student may not remain at provisional degree status for more than 18 semester hours. By that time, the Department must decide whether to recommend admission to regular degree status or not.

Privileges: The provisional degree student has all of the privileges of a regular degree student in terms of taking courses and working toward an advanced degree.

Restrictions: A provisional degree student is required to maintain a 3.0 grade-point average on all work taken, whether or not it is to be applied toward the advanced degree sought. If the student fails to maintain such a standard performance, he/she may be dropped from the academic program. A provisional degree student is not eligible for fellowship or scholarship support from the Graduate School and usually is not considered for teaching or research assistantships by the Department.

3 MASTER OF SCIENCE DEGREE

The following sections describe Plans I and II for obtaining an M.S. in Chemical Engineering. It is important to note that departmental policies permit graduate students to work directly toward a Ph.D. without completing the M.S. degree and thesis. The submission of a comprehensive bypass report on research accomplished and approval by the research advisor and department chair is necessary to fulfill this requirement.

3.1 Plan I – Thesis Option

A candidate for the Plan I (thesis option) Master of Science degree in Chemical Engineering must fulfill the following departmental requirements for coursework, exams and thesis.

3.1.1 Course Credit Requirements

A total of 30 semester credit hours is required, including at least 24 credit hours of course work, and 4-6 credits of M.S. thesis. Only courses 5000 level and above may be applied towards the M.S. degree. Moreover, only courses at the 5000 level and above in any department count toward the Ph.D. degree. An advisor must approve all courses. Only those courses for which the student receives a grade of B- or better will count toward the M.S. degree. The overall grade-point average must be 3.0 or better.

3.1.2 Examination Requirements

A successful oral defense of the M.S. thesis is required. Notice of this examination must be filed in the Graduate School at least two weeks in advance of the examination. The examination committee must have a minimum of three faculty members, at least two of whom are members of the Department of Chemical and Biological Engineering. The Chair of the committee must be a regular faculty member. Each official member of the committee must have a graduate faculty appointment, although additional unofficial members may also participate. Students are responsible for verifying that their committee members have a graduate faculty appointment prior to the examination.

3.1.3 Thesis Requirements

An electronic copy of an acceptable M.S. thesis must be uploaded to the Graduate School by the posted due date for the semester in which the degree is to be conferred. The dissertation must be submitted and approved at <http://www.etsadmin.com/colorado>. In addition to the thesis, the student must submit an approval page stating that the content and form of the thesis meet acceptable presentation standards of scholarly work in the specified discipline, signed by the Chair of the committee and one other committee member. In addition, two copies of the thesis for binding must be submitted to the Department (one each for the faculty advisor and the department library).

3.2 Plan II – Non-thesis Option

A non-thesis Master's degree option is open to part-time students who typically are employed in local industry and do not receive financial support from the Department. In addition, students who are proceeding toward the Ph.D. degree and have elected to bypass the M.S. thesis may petition to be awarded an M.S. degree under the Plan II Option. Students must have the approval of the Department Chair to enroll under Plan II and must complete 30 credits of courses with grades of B- or better and an overall grade-point average of 3.0 or better, including the same core course requirements as for the thesis M.S.

3.3 Course Requirements

The following courses are required for any M.S. degree plan:

1. CHEN 5090: Seminar in Chemical and Biological Engineering
2. CHEN 5210: Transport Phenomena
3. CHEN 5740: Analytical Methods
4. One of the following core courses:
 - CHEN 5370: Intermediate Chemical Engineering Thermodynamics
 - CHEN 5390: Chemical Reaction Engineering

Additionally, 15 of the total required course hours must be Chemical and Biological Engineering courses, and pass/fail courses do not count toward the degree.

3.4 Course Sequencing and Registration

It is expected that students in their first two semesters will register for Chemical and Biological Engineering Seminar (CHEN 5090), which is a one-credit, pass/fail course. The student is not expected to register for the course if the one-hour change results in an increase in tuition. Additionally, it is expected that students in their first semester register for a course in Research Ethics and Methods (CHEN 5343).

For first-semester students on teaching assistantships, the required full load consists of four courses (12 credits), plus their TA duties, the department seminar, and Research Ethics and Methods. If TA duties are deferred until the second semester, the students should take an additional course (15 credits total, not including seminar) in the first semester. The Department must approve any deviations from this plan; otherwise, funding will be reduced proportionately. After the first semester, the student's research advisor must approve course work and thesis registration. If a student is not going to be registered for a semester, the Chair of the Department of Chemical and Biological Engineering must be informed in writing, and the student is required to return lab keys and building access cards. The student will need to enroll in the Leave of Absence Program (formally the Time Out Program) in order to save his/her enrollment space or withdraw from the University.

Registration for credit in the summer should be kept to a minimum to keep total tuition payments as low as possible. Students registering for extra courses not included in those basically required

for the degree program must have approval of their research advisors. In general, the Department will pay tuition only for those courses required for the degree.

3.5 Residence and Time Limit

It is expected that a qualified student can complete the M.S. degree in two years or less. All work, including the thesis defense and filing of the thesis with the Graduate School, if Plan I is followed, must be completed within four years. Work done prior to the four-year limit will not be accepted for the degree, unless validated by a special examination. A student is expected to complete his/her work with reasonable continuity. In general, the residence requirements may be met only by residence at this university (on any of its campuses) for at least two regular semesters, or by three full summer terms.

3.6 Leave of Absence (LOA) – Formally the Time off Program (TOP)

The Leave of Absence Program provides an opportunity for students to take a leave from the university for a semester or a year without losing his/her place in his/her current college or school. The following guidelines are used to determine eligibility:

- a) Graduate students must have a minimum 3.0 GPA.
- b) Doctoral candidates who have passed their comprehensive examinations and concurrent degree students (B.A./M.A./M.S.) are not eligible for TOP.

Download the application (<http://www.colorado.edu/registrar/students/withdraw-cu/leave-of-absence>). LOA requires an application fee of \$50 upon submittal. LOA students are guaranteed a place in his/her current college or school and major, provided that registration and deposit deadlines are followed.

If a student is not going to be registered for a semester, the Chair of the Department of Chemical and Biological Engineering must be informed in writing, and the student is required to return lab keys and building access.

3.7 Credit by Transfer

Resident graduate work of high quality done in a recognized graduate school elsewhere and coming within the four-year limit may be accepted up to a maximum of nine (9) semester hours for the M.S. degree and up to a maximum of twenty-one (21) semester hours for a PhD degree, provided it is recommended by the Department of Chemical and Biological Engineering and approved by the Dean of the Graduate School. Such credits will be transferred to the Graduate School only after the student has established a satisfactory record in residence here for at least one semester and has completed 6 credit hours. Work already applied toward another degree cannot be accepted, nor can extension work completed at another institution, nor can correspondence work.

Transferred credit will not reduce the residence requirements at this university but may reduce the amount of work to be done in formal courses. Request for transfer of credit must be initiated

by the student by the beginning of the semester prior to that in which the M.S. or PhD degree is expected.

3.8 Master of Science Check Sheet

The Plan I M.S. Check Sheet (Appendix A) describes the sequence of events leading up to the conferring of the M.S. degree. The student is responsible for his or her program and for making certain that each step is completed within the indicated time schedule.

4 DOCTOR OF PHILOSOPHY DEGREE

4.1 Admission Requirements

The general admission requirements for the Doctoral program are outlined in Section 2. Admission does not follow automatically with the conferring of the M.S. degree, unless the M.S. degree conferred is Plan II, non-thesis, no exam. The student must reapply and must be recommended by the Department of Chemical and Biological Engineering.

4.2 Residence

The minimum requirement shall be six semesters (with two full-time summers counting as one semester) of scholarly work in residence beyond the attainment of an acceptable Bachelor's degree. Two semesters of residence credit may be allowed for a Master's degree from another institution of approved standing. However, at least four semesters of residence credit, at least two of which must be consecutive in one academic year, must be earned at the University of Colorado. The last two semesters of the residence requirement must be earned at the University of Colorado, except in unusual circumstances subject to the approval of the Dean of the Graduate School. **Each student must be enrolled for at least one semester after the semester in which the comprehensive examination (See Section 4.7) is passed.**

Students who are admitted to the Graduate School with deficiencies may expect to receive little or no residence credit until these deficiencies have been removed. The Graduate School rules require that 30 semester hours of 5000-level or above course work appear in the Application for Candidacy. For further residence information, see the Graduate School Rules.

4.3 Preliminary Examination

A preliminary examination is required of all Ph.D. candidates. This examination consists of an oral and written component to be completed in the second semester (for candidates entering with an M.S.) or third semester (for students entering with a bachelor's degree) (details follow). In addition, all students entering the program without a degree closely-related to chemical engineering must either take the FE exam or have completed four chemical engineering core undergraduate courses with a grade of B or better (Fluids/Heat, Mass Transfer, Thermodynamics, Kinetics or the equivalent courses). The Graduate Director or Department Chair will make assessments as to whether a degree is closely related to the chemical engineering degree.

4.3.1 Objective

To assess the research skills of a student (appropriate to his/her academic level) via examination on his/her thesis research topic. Special emphasis will be given to the following evaluative criteria:

- Knowledge of the scientific basis of experimental and/or theoretical approaches employed by the student;
- Depth and breadth of knowledge of the relevant literature;
- Demonstration of progress appropriate for the specific project;
- Presentation of the specific research plan and overall project significance; and
- Demonstration of written and oral communication skills for all of the above.

4.3.2 Timing

Each student in the Ph.D. program will take the examination for the first time during his/her second semester (if entering with an M.S.) or third semester (for students entering with a B.S.) in the program.

4.3.3 Outcome

Two outcomes are possible: pass or fail. If a student fails his/her first attempt, then he/she will have an opportunity to re-take the exam during the following semester. Two successive failures results in a terminal M.S. as the highest possible degree.

4.3.4 Written Component

The written component of the exam is a six-page typed report (12-point font, single-spaced, one inch margins, double-sided) including figures that describes the student's research project, as well as the following:

- Hypothesis and/or objective statement (0.5 page)
- Significance (0.5 page)
- Background and related, relevant literature (1.5 - 2.0 pages)
- Methods (1.5 - 2.0 pages)
- Progress-to-date (1.5 - 2.0 pages)
- Research plan (0.5 page)

The reference list should be placed *after* six pages of text and figures. A PDF of the written report must be electronically submitted at least one week prior to the oral exam date (by 5:00pm) to the department's Graduate Program Advisor (GPA) at chbegrad@colorado.edu. DO NOT submit the preliminary exam report directly to committee members.

Additional hints for the written component:

- Use spelling and grammar check.
- Follow directions.

- Be prepared to answer questions on any information contained within your paper.
- Make sure to provide citations appropriately. (Citations and/or quotations are required for figures as well as language not generated by the student.)
- Know your target audience.

4.3.5 Oral Component

The oral component of the exam consists of a 20-minute presentation (maximum time limit will be upheld), followed by 30 minutes of questioning by the examination committee. The structure/content of the presentation should be analogous to that of the written report. Questions will follow from material presented in the written report and oral presentation. Students should be prepared to answer questions on any technical aspect of his/her research topic. Students are also expected to have an understanding of the related literature.

The student is permitted (and encouraged) to practice his/her oral presentation prior to the exam, with input from the advisor and research group. The advisor may be present at the oral examination, but his/her participation will be limited to the answering of questions posed directly to him/her by a member of the examination committee. Further advice on the preliminary examination is available in Appendix C.

Additional hints for the oral component:

- State the objectives of the overall project and specific aims of the student's project.
- Be able to explain the rationale behind the project and approach chosen.
- Use problem statements to demonstrate the significance of not only the overall objective but also the specific approaches/tools being developed and/or applied.
- Explain why specific techniques were chosen and what alternatives were considered and why eliminated.
- Describe future plans and include some examples of how the plans might be accomplished as well as the advantages and disadvantages of any proposed approaches and relevant alternatives.
- Be prepared to explain all information presented in your slides (equations, constants, tools, etc.).
- Know your target audience.

4.3.6 Question and Answer Component

The student's ability to answer relevant questions will also be a substantial part of the overall grade. The primary goal of the question and answer session is to explore the depth of the student's understanding of the issues outlined under the written and oral component guidelines listed above. Students should be able to answer questions of "Why" and "How" for the overall objectives and specific approaches employed. Students

are encouraged to make it clear to the committee when they do not know the answer to a question and to explain why this is so (e.g., that subject area is tangential to my research focus, that subject area is something I will explore in the future but is not as large of a priority for my current efforts, etc.). Students are allowed to prepare additional “back-up” slides that contain information to help answer anticipated questions.

4.3.7 Audience

Both written and oral components should be targeted at an audience with a broad engineering background (rather than to an expert in the research field being pursued), as members of the exam committee (Chemical and Biological Engineering Faculty) are likely to have various areas of expertise.

4.3.8 Authorship

The student is to be the sole author of the report; everything which is not the student’s own creative work must be appropriately referenced. Inclusion of uncited text and figures will be considered plagiarism.

The written report should be prepared without feedback from the student’s advisor or fellow graduate students, though the advisor can discuss an “outline” with the student (i.e., agree on important topics to cover) prior to the report being written. The advisor may discuss the final report with the student prior to the oral exam (i.e., after it is handed in).

4.4 Academic Plan and Course Requirements

The student must work out an informal degree plan early in the Ph.D. program with the aid of a Research Committee, when selected. This program will reflect specific areas of academic interest and should represent a coordinated approach to the attainment of the student’s ultimate goals. This degree plan may include the courses previously applied toward the Master’s degree, which should be so indicated, and should total at least 30 semester hours of 5000-level or above courses, not including pass/fail courses, and including up to five hours of “Special Topics in ChBE.” Note that all courses must be taught by faculty who are members of the Graduate School. Students should verify the appointment to the Graduate School of faculty for courses taken outside the Department.

4.4.1 Required Courses

Each of the following core courses must be taken for the Ph.D. degree:

- CHEN 5210: Transport Phenomena
- CHEN 5370: Intermediate Chemical Engineering Thermodynamics
- CHEN 5390: Chemical Reaction Engineering
- CHEN 5740: Analytical Methods for Chemical Engineers

Ph.D. students must complete all four core courses, with grades of B- or better.

4.4.2 Quality of Work

Students are expected to complete with distinction all work in the formal courses that apply toward the degree, and achieve a grade-point average of 3.0 or better. A course grade below B- will not be counted toward the minimum requirements for the Ph.D. degree, but it will be considered in the overall grade-point average.

4.4.3 Credit by Transfer

Requirements are the same as those outlined for the Master's degree, except that a maximum of 21 semester hours of course work may be transferred and that courses applied previously toward a Master's degree may be transferred for the Ph.D. degree.

4.5 Research Plan

Each student entering the graduate program without a Master's degree must demonstrate research ability prior to continuing to the Ph.D. degree by (a) completing a Plan I (thesis option) M.S. degree, or (b) submitting a 'M.S. bypass' paper in the style of a journal article and judged acceptable by the student's research advisor and Department Chair. *This requirement must be met within the first two years of the program if funding is to continue.*

If a student is not going to be registered for a semester, the Chair of Chemical and Biological Engineering must be informed in writing, and the student is required to return lab keys and building access.

4.5.1 First Year Research Project Presentations of Mutual Selection

During the Fall semester (generally at the beginning of November), research advisors will announce the availability of projects by writing a project description and making a brief oral presentation about the project. The written descriptions will be made available to all PhD students and the oral presentations will be publicized. The students are then given several weeks to meet with potential advisors, learn more about the projects, and decide on their preferences. Then, on a date which will be announced, each graduate student is responsible for providing a ranked list of his or her preferred PhD research projects. The department Chair and/or Graduate Director then performs a match in an effort to provide as many students as possible with their top-ranked projects.

It is extremely important that students with a potential interest in a particular project contact the advisor and meet with him or her to talk about the project and the selection process. Generally, an interested student will follow up with additional meetings as he or she narrows down his or her choices. If a student does not meet with an advisor, or does not express interest, the advisor may take that as an indication of lack of enthusiasm, which may sway him or her against accepting that student as an advisee.

4.5.2 Research Advisor and Committee

As soon as the student is ready to begin research work for the Ph.D. dissertation, a regular graduate faculty member of the department must be designated to serve as

Chair of the Research or Dissertation Committee. The Ph.D. dissertation committee must be approved by the Department Chair and consist of five members, at least three of whom are regular/special faculty members from the Department of Chemical and Biological Engineering. At least one member must be a regular faculty member in a different department at the University of Colorado. All members of the committee must have graduate faculty appointments. Students must meet with their committee once each year to review their research progress.

IMPORTANT: The ability to perform significant and independent research is a prime requisite for the Ph.D. degree. This research must be under the supervision of a graduate faculty member, and it is the student's responsibility to choose a topic and find a faculty member who will act as Research Advisor. This is an important step and should be done early in the program to ensure the probability of timely completion.

4.6 Communication Requirement

There is no international language requirement in chemical and biological engineering. However, the student's comprehensive exam and the research portions of the preliminary exam will be judged on written and oral presentation skills as well as content. Further, an Advanced Teaching Assistantship is required for ALL Ph.D. students.

4.6.1 Advanced Teaching Assistant (ATA) Requirement

The advanced TA is one means by which Ph.D. students satisfy the communication requirement. It provides senior graduate students with the opportunity to interact with undergraduate and graduate students and demonstrate communication tasks relevant to teaching and evaluating students in a course environment.

Specific aspects of the program include:

- **Direct interaction with students:** weekly office hours and/or recitation section and/or exam review session(s)
- **Lecture experience:** two (or more) classroom or laboratory presentations (one videotape consultation is desirable and faculty observation is required)
- **Evaluation experience:** preparation and grading of an exam question(s) and/or a quiz(zes) and/or a graded homework assignment(s)

4.7 Admission to Candidacy and Comprehensive Examination

At least two weeks before the comprehensive examination is attempted, the student must apply for admission to candidacy for the Ph.D. degree (students should obtain necessary forms from the Department of Chemical and Biological Engineering's Graduate Program Advisor (GPA) at chbegrad@colorado.edu). The student must be registered for the semester (including summer) in which the examination is to take place.

A written proposal, not to exceed 15 pages (1.5-spaced), must be distributed to the student's faculty committee two weeks before the exam. Either a PDF file or a paper version should be submitted, depending on which format each committee member prefers. The paper copy should

be copied on both sides of the paper (to save paper). The Comprehensive Examination Committee shall consist of five faculty members as described above in section 4.5.2.

The proposal is limited to 15 pages and should include:

- a discussion of the state of the art;
- details of the proposed study;
- progress to date;
- a budget estimate for the time remaining;
- a time estimate for completion of the research and dissertation; and
- a complete consideration of safety aspects of experiments.

The student is expected to deliver a 20-30 minute summary of the research proposal, after which the student will be questioned by the Examination Committee. The student must be able to demonstrate thorough knowledge of the fundamentals and application of the research field, define an original research problem and show the scientific and engineering basis for a creative, intelligent solution to the proposed research problem. In order to pass, the student must receive a majority passing vote of the Examination Committee. The comprehensive examination may be attempted a maximum of two separate times. A second examination should only be attempted in the event that the initial examination results in a failing grade.

A student shall have earned at least four semesters of residence, and shall have passed the comprehensive examination before being admitted to candidacy for the degree.

4.7.1 Registration Requirements

The student must be registered for a minimum of five dissertation hours for full-time status (part-time doctoral students may register for three hours) in the University for **both Spring and Fall semesters** during each calendar year after passing the comprehensive examination and extending through the semester in which the dissertation is successfully defended. The student must be registered for the semester (including summer) of the comprehensive examination.

See the Graduate School Rules regarding additional rules relative to the comprehensive examination, particularly regarding time limitations.

4.8 Dissertation and Final Examination

4.8.1 Dissertation Submission to Dissertation Committee

A dissertation based upon the research work done with consulting advice from the student's Research Committee should be finished and submitted electronically as a PDF file for inspection by the Dissertation Committee at least two weeks before the student takes his/her final examination. If a faculty member requests a typewritten form, it should be copied two-sided (to save paper). The dissertation must comply in mechanical

features with the University of Colorado Graduate School Specification, <http://www.colorado.edu/GraduateSchool/academics/index.html>.

4.8.2 Dissertation Submission to the Graduate School

The dissertation must be filed with the Graduate School by the posted due date for the semester in which the degree is conferred. At the time of filing, the student must submit electronic versions to his/her advisor, the Department of Chemical and Biological Engineering and the Graduate School (see <http://www.colorado.edu/GraduateSchool/current/academics/theses/electronicsub.html>). The student's advisor should also receive a printed, bound copy. PDF files of all university theses since 1997 are available through ProQuest (see <http://uclibraries.colorado.edu/about/dissertations.htm>). A valid University of Colorado email address is required for free thesis downloads.

4.8.3 Registration Requirements

The student must register for a total of at least 30 hours of doctoral dissertation credit, with no more than 10 of these credits in any one semester. Not more than 10 of these credit hours may be obtained before the semester in which the student passes the comprehensive exam and is approved as a candidate for the doctorate. If more than 10 pre-comp credits need to apply to the degree, the student must petition the Dean of the Graduate School. Dissertation credit does not apply toward the 30 hours of required course work. This credit will not be included in calculating the student's grade-point average. A letter grade of A, B, or C will be used after the dissertation is completed. A grade of IP is used prior to its completion.

Course work and work on the dissertation may proceed concurrently throughout the Doctoral program. However, a Doctoral student should not register for more than 15 hours of 5000 level and above courses without written approval from the Graduate School.

Following successful completion of the comprehensive exam and the "admission to candidacy," students must register continuously Fall and Spring semesters (but not summer). Students admitted to "candidacy for degree" will register for and be charged for a minimum of five hours of dissertation credit for each term of doctoral work, except students not making use of campus facilities may register for three credit hours. Continuous registration during the academic year will be required until completion of the dissertation 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 classification identified above.

4.8.4 Final Oral Examination

The final examination is an oral defense of the student's dissertation.

4.8.5 Dissertation Examination Committee

The Examination Committee consists of the student's Research or Dissertation Committee with at least five members, at least three of whom must be regular/special faculty members of the Department of Chemical and Biological Engineering and at least one must be a regular faculty member from another CU department. A regular graduate faculty member in the Department of Chemical and Biological Engineering must be the Chair of the Committee. All official members of the Committee must have graduate faculty appointments, although additional, unofficial members may participate. Arrangements for the final examination must be made in the Graduate School at least two weeks in advance. The exam must be scheduled no later than two weeks before the date on which the degree is to be conferred. A student must be registered full time at the time of the final exam.

A student who fails the final examination on his/her first attempt may attempt it one additional time upon recommendation of his/her committee. More than one dissenting vote constitutes failure of the final examination.

4.8.6 Time Limit

Doctoral students have six years from the commencement of course work in their Ph.D. graduate program at the University of Colorado, to complete all requirements, including the filing of the dissertation, with the Graduate School. Upon recommendation of the advisor, and for valid reasons, a student may be granted a one-year extension of time to complete all degree requirements. This six-year rule is applicable regardless of when the student passes the comprehensive examination (i.e., taking or retaking the comprehensive examination does not entitle a student automatically to an additional four years of time to complete the degree).

4.9 Leave of Absence (LOA) – Formally the Time off Program (TOP)

The Leave of Absence Program provides an opportunity for students to take a leave from the university for a semester or a year without losing his/her place in his/her current college or school. The following guidelines are used to determine eligibility:

- c) Graduate students must have a minimum 3.0 GPA.
- d) Doctoral candidates who have passed their comprehensive examinations and concurrent degree students (B.A./M.A./M.S.) are not eligible for TOP.

Download the application (<http://www.colorado.edu/registrar/students/withdraw-cu/leave-of-absence>). LOA requires an application fee of \$50 upon submittal. LOA students are guaranteed a place in his/her current college or school and major, provided that registration and deposit deadlines are followed.

If a student is not going to be registered for a semester, the Chair of the Department of Chemical and Biological Engineering must be informed in writing, and the student is required to return lab keys and building access.

4.10 Doctor of Philosophy Check Sheet

The Ph.D. Check Sheet (Appendix B) describes the sequence of events leading up to the conferment of the Ph.D. degree. The student is responsible for his/her program and for making certain that each step is completed within the indicated time schedule.

5 M.D./Ph.D. PROGRAM

Chemical and Biological Engineering offers training for the Ph.D. component of the MD/Ph.D. program administered by the University of Colorado Health Sciences Center (UCHSC). Admission is handled by UCHSC and questions concerning the program should be directed to the Coordinator. Students take their first two years of courses and a preliminary examination at the UCHSC. The students can do laboratory rotations in Chemical and Biological Engineering laboratories during the summers. Upon selection of a laboratory for their dissertation research, the students are required to take the following four core courses: CHEN 5210: *Transport Phenomena*; CHEN 5370: *Intermediate Chemical Engineering Thermodynamics*; CHEN 5390: *Chemical Reactor Engineering*; and CHEN 5740: *Analytical Methods for Chemical Engineers*. During their subsequent years of dissertation research, students are required to meet annually with their committee, defend their dissertation proposal in a comprehensive examination, and defend their final dissertation. There is no teaching assistant requirement for MD/Ph.D. students. The communication skills requirements are met by their medical school training.

6 ADDITIONAL INFORMATION

6.1 Financial Assistance

Financial assistance is available from the Department of Chemical and Biological Engineering. Various forms of support are available, and each student will be considered for support. Fellowships, teaching assistantships, and research assistantships are available for the support of graduate students for the calendar year. While working as assistants, students are permitted to carry a full graduate program.

6.1.1 Support Eligibility Time Limits

The Department tries to provide financial support to all qualified graduate research students whom we admit. Since degree and career goals of a student are best served by accomplishing work in a reasonable period of time and more students can receive support when the term is limited, time limits have been established. If a student's own funding is used for part of his/her residence, the length of continued support from the Department will be decided by the faculty.

6.1.2 Master's Degree Funding Limits

The upper limit (not guaranteed limit) on funding of M.S. degree students is two years. The faculty will carefully evaluate the progress of each M.S. student (starting at the end of the first semester of residence) to decide whether continued funding is justified. Continued funding will only be granted for satisfactory progress in research, course work and teaching assistance. It is expected that most students will complete their M.S. degrees in less time than indicated here.

6.1.3 Ph.D. Degree Funding Limits

Progress of each Ph.D. student will be reviewed after three, four, and five years (after entering the Department with a Bachelor's degree). Funding is not guaranteed for these durations, and continued funding will only be granted for satisfactory progress in research, course work, and teaching assistance. Funding beyond five years will be granted only under special circumstances such as having a non-chemical engineering undergraduate degree, or switching research advisors after receiving the M.S. degree or being accepted into the Ph.D. program.

Students who enter the Department with a Master's degree will have their progress reviewed after one, two, three, and four years, and continued funding will only be granted for satisfactory progress in research, course work, and teaching assistance. Funding beyond four years will be granted only under special circumstances.

6.1.4 In-State Residency

Similar to most universities, the University of Colorado has a large discrepancy between resident and non-resident tuition. It is possible for U.S. students arriving from out-of-state to acquire resident status after one calendar year. To begin the one-year waiting period, the student must establish as many connections with the State as possible in the individual circumstances. Examples include: being physically present in the state with the intent to make your permanent home in Colorado; payment of Colorado state income taxes; application to the State for a Colorado driver's license or Colorado identification card; registration of motor vehicles in the State of Colorado; registration to vote in Colorado.

These connections should be established as soon as possible, ideally within 30 days after moving to the state. Eligibility for a change to resident status is determined from a written petition with documentation. Information regarding residency, petition deadlines, and the required paperwork, please see the Tuition Classification Office's website at <http://www.colorado.edu/registrar/students/state-residency>. The Department will not pay nonresident tuition beyond one year (except for international students, who cannot qualify for resident status).

6.1.5 Supplemental Funding

In order to recognize outstanding ability and to encourage students to apply for fellowship support, the Department of Chemical and Biological Engineering will permit those students receiving individual fellowship support from sources outside the Department to receive supplemental support over and above the standard monthly graduate stipend and benefits permitted by the Department. The exact amount of the supplement permitted to any student receiving a fellowship award will be determined by the Department Chair and approved by the faculty. The awarding of any such supplemental funds by the Department is contingent on the availability of funds.

6.1.6 Student Appointments

The full calendar-year appointment is meant to be for the equivalent of a full-time position working toward the degree. Thus, the appointment continues directly through all University break periods such as Winter break, Spring break, and pre- and post-summer breaks, and the Department expects students to be at work on research or courses and making progress toward the degree at all of those times unless a leave-without-pay break is taken. **Students are entitled to the equivalent of two weeks vacation per year with pay. Any time off must be taken with full knowledge and approval of the student's advisor.**

Students may not have additional employment while receiving the standard stipend from the Department, except in special circumstances with written approval by the Department Chair and the research advisor.

6.2 Full-time Status

Students must have full-time status during the semester in which they defend their thesis (including summer). In addition, students must be registered full-time in each semester used to meet Graduate School Residence requirements.

Students pursuing an M.S. degree are considered full time when registered for five hours of course work or any number of thesis or candidacy hours. Students pursuing a Ph.D. are considered full time when registered for five hours of course work or one thesis hour pre-candidacy (if taking less than five course hours, one thesis hour is necessary for full-time status). After admission to candidacy, a student is considered full time when registered for at least five thesis hours.

6.2.1 Rules of Thumb for Taking Thesis Hours

The following are basic rules of thumb to follow with regard to registering for thesis credit hours before and after the comprehensive examination.

Prior to completing the comprehensive exam:

- Zero credits of dissertation if registered for five or more course credits (which make the students full time)

- One credit of dissertation if registered for less than 5 course hours. (that one credit makes the students full time)
- Pre-comprehensive exam: three dissertation credits if registered for no classes
- Post-comprehensive exam: at least five dissertation credits if registered for no classes. Students are required to take five credits of dissertation, but can take up to 10 credits if he/she is getting close to graduating and short of the 30 required. **Students are encouraged to register for the minimum number of Doctoral Thesis Hours needed to complete the degree.**

6.3 Termination

If a student is not making satisfactory progress, then termination from an appointment or a research project prior to the allowable time limit for completing the M.S. or Ph.D. degree will be considered. In such cases, the student's advisor or supervisor must notify the student in writing that termination is being considered; the notification should specify the reasons for potential termination, the corrective action(s) which must be taken, and the time frame (at least two weeks, unless the Department Chair determines that the course for termination is especially serious) in which a decision will be made. If, at the end of this time, the advisor or supervisor decides that cause exists for the termination of the student from the project or appointment, then the department faculty shall be consulted to determine whether the student will be provided with the opportunity for another project and appointment, or dismissed from the program. Further information on termination and grievance procedures is provided in the Graduate School policies.

6.4 Records

All graduate records are kept in the Chemical and Biological Engineering Graduate Program Advisor's office, and questions involving a student's program should be directed there. Deviations from the general rules and procedures listed in this booklet or in the graduate catalog may be made only through the use of a properly executed petition to the Chair of the Department of Chemical and Biological Engineering.

APPENDIX A

ChBE – Master’s Final Checklist:

The following forms must be submitted to ChBE department for approval unless stated otherwise. **IMPORTANT: Check Graduate School deadlines prior to semester start.**

MS Coursework

- **Application for Diploma** (*See Grad School deadlines*) ☞ myCUinfo.colorado.edu. On the Student tab, select the Apply for Graduation link under Academic Resources. This notifies the Graduate School and your department that you intend to graduate and it provides necessary information to the Commencement Office for ordering and shipping diplomas. graduate online whether or not you plan to attend the ceremony. **Online graduation application** Students must apply online to graduate. To do this, logon to [If you do not complete requirements for the graduation you indicate on the online application, you must apply online to graduate for the new graduation date.](#) You must apply to
- **Candidacy Application** (*See Grad School deadlines*)
- **MS Degree Plan Approval Form** (*submitted with candidacy application – see Grad School deadlines*)
- **Complete Departmental Check-Out Sheet**

MS Thesis Option

- **Application for Diploma** (*See Grad School deadlines*) ☞ myCUinfo.colorado.edu. On the Student tab, select the Apply for Graduation link under Academic Resources. This notifies the Graduate School and your department that you intend to graduate and it provides necessary information to the Commencement Office for ordering and shipping diplomas. graduate online whether or not you plan to attend the ceremony. **Online graduation application** Students must apply online to graduate. To do this, logon to [If you do not complete requirements for the graduation you indicate on the online application, you must apply online to graduate for the new graduation date.](#) You must apply to
- **Candidacy Application** (*See Grad School deadlines*)
- **Master’s Examination Report** (*At least 2 weeks prior to exam*)
- **Submit Dissertation** (*To thesis committee at least 2 weeks prior to exam*)
- **Successfully Defend Thesis**
- **Final Grade Card** (*Submitted by ChBE – follow Grad School deadlines*)
- **Signature Page – original copy with original signatures** (*See Grad School deadlines*)
- **Final Copy of Dissertation** (*Electronic copy to Grad School – See Grad School deadlines/rules*)
 - **Final Copy of Dissertation** (*At least 2 printed copies to ChBE to be bound – Before finishing check-out sheet*) ☞
 - One copy to department
 - One copy to advisor (Submit more copies if you have multiple advisors)
- **Complete Departmental Check-Out Sheet**

**Students must be registered during the semester in which the comprehensive exam is passed.

(This includes the Summer term)**

APPENDIX B

ChBE - Final Exam Checklist:

The following forms must be submitted to ChBE department for approval unless stated otherwise.

****IMPORTANT:** Check Graduate School deadlines prior to semester start

- **Application for Diploma** (*See Grad School deadlines*)
 - Online graduation application Students must apply online to graduate. To do this, logon to myCUinfo.colorado.edu. On the Student tab, select the Apply for Graduation link under Academic Resources. This notifies the Graduate School and your department that you intend to graduate, and it provides necessary information to the Commencement Office for ordering and shipping [diplomas](#). If you do not complete requirements for the graduation you indicate on the online application, you must apply online to graduate for the new graduation date. You must apply to [graduate online](#) whether or not you plan to attend the ceremony.
- **Title of Dissertation** (*See Grad School deadlines – can be sent to ChBE (chbegrad@colorado.edu) in email form*)
- **Dissertation Defense Leaflet** (*At least 2 weeks prior to exam*)
- **Doctoral Examination Report** (*At least 2 weeks prior to exam*)
- **Submit Dissertation** (*To thesis committee at least 2 weeks prior to exam*)
- **Successfully Defend Thesis**
- **Final Grade Card** (*Submitted by ChBE – follow Grad School deadlines*)
- **Signature Page – original copy with original signatures** (*See Grad School deadlines*)
- **Final Copy of Dissertation** (*Electronic copy to Grad School – See Grad School deadlines/rules*)
- **Final Copy of Dissertation** (*At least 2 printed copies to ChBE to be bound – Before finishing check-out sheet*)
 - One copy to department
 - One copy to advisor (Submit more copies if you have multiple advisors)
 - Others – Optional
- **Complete Departmental Check-Out Sheet**

****Students must be registered during the semester in which the comprehensive exam is passed (this includes the Summer term).**

APPENDIX C

PH.D. PRELIMINARY EXAM – RESEARCH PORTION – EVALUATION FORM

(The 3 P's)

PREPARATION

Understanding of relevant Chemical and Biological Engineering concepts

Technical quality of the written report

- writing style, grammar, spelling, clarity, correctness, format, etc.

Technical quality of the oral presentation

- clarity, enthusiasm, visual aids, etc.

Presentation and understanding of the relevant scientific/engineering background

Presentation and understanding of the significance of and rationale for the project

PLAN (FOR RESEARCH)

Presentation and understanding of hypotheses and/or objectives

- Can the student clearly explain and answer questions related to how the objectives will be achieved and how the hypotheses will be tested?
- Can the student explain and answer questions related to the rationale for the hypotheses and objectives?

Presentation and understanding of a detailed research plan

- Are the methods appropriate, described well, and understood at an appropriate level?
- Are experiments described in adequate detail?
- Will the results of the experiments meet the objectives?
- Are appropriate control experiments described?

PROGRESS

Amount of progress/results

- Has the student made appropriate progress given the constraints of the particular project?

Presentation and understanding of preliminary results

- Are results presented appropriately, with realistic uncertainties?
- Are the results valid?
- Do they relate to the objectives?
- Are interpretations of the results valid?

Students MUST be proficient in ALL 3P's to pass the Ph.D. preliminary exam.