Graduate Certificate Program in Applied Physics
University of Colorado at Boulder

INTRODUCTION

The physics department has established a Graduate Certificate Program in Applied Physics. By choosing this program, your Ph.D. degree will still be in physics, but the five core courses you take in your first few years of graduate school can be tailored towards a quicker entry into an emerging interdisciplinary area of research. Areas of specialization include Imaging Science, Nano and Materials Science, Biophysics, Geophysics, Plasma Science, Laser Science, Photonics as well as other potential future areas of interest. This program allows students to take core courses from departments outside of physics when appropriate, to better prepare them for cutting-edge research at the interface between disciplines.

As is the case for our regular Ph.D. degree program, ten graduate courses are required for a Ph.D. Example courses sequences for the Applied Physics certificate program are given below. The Comprehensive Examination sequence for this certificate program is similar to that of our regular physics Ph.D. degree. Comps I consists of the topics covered in the 5 core courses in each area of specialization. The Comps II examination is based on a paper and presentation together with an oral examination, as in our regular physics degree program. The formal thesis proposal (Comps III) is also the same as our regular physics degree program, consisting of a formal thesis proposal presentation to a faculty committee.

Please talk to your Advisor and/or the Associate Chair for Graduate Studies in Physics (currently Professor Tobin Munsat) if you are interested in this program. They will help you to plan your program of studies. You will need to have a Comps I curriculum form (downloadable below) approved by both your advisor and the Associate Chair for Graduate Studies.

Sample curricula for various Applied Physics subdisciplines are listed below.

Sample Ph.D. Curriculum in **Imaging Science**

Comps 1 courses; five from this list:

PHYS 5160	Fundamentals of Optics and Lasers
PHYS 5250, 5260	Quantum Mechanics 1 & 2
PHYS 7310, 7320	Electromagnetic Theory 1 & 2
ECEN 5126	Computational Optical Imaging

Other courses (to bring total to 30 credits) to be selected from this list:

PHYS 5210	Theoretical Mechanics
PHYS 5606	Optics Laboratory
PHYS 7230	Statistical Mechanics
PHYS 7440	Theory of the Solid State 1
PHYS 7650	Nonlinear and Nano Optics
PHYS 7660	Ultrafast Optics
PHYS 7810	Special Topics in Physics: EUV Science and Technology
APPM 5600, 5610	Numerical Analysis 1, 2
CSCI 5254	Convex Optimization and its Applications
CSCI 5922	Neural Networks and Deep Learning
ECEN 5156	Physical Optics
ECEN 5532	Digital Signal Processing Laboratory
ECEN 5616	Optoelectronic System Design
ECEN 5632	Introduction to Digital Filters
ECEN 5672	Digital Image Processing
ECEN 5696	Fourier Optics
ECEN 6006	Numerical Methods in Photonics
Other graduate courses at CU, including independent study	

Sample Ph.D. Curriculum in **Biophysics**

Comps 1 courses; five from this list:

PHYS 5250	Quantum Mechanics 1
PHYS 5560	Introduction to Biophysics
PHYS 7230	Statistical Mechanics
PHYS 7310	Electromagnetic Theory 1
CHEM 5771	Advanced General Biochemistry 1

Other courses (to bring total to 30 credits) to be selected from this list:

PHYS 5160	Fundamentals of Optics and Lasers
PHYS 5260	Quantum Mechanics 2
PHYS 7240	Advanced Statistical Mechanics
PHYS 7320	Electromagnetic Theory 2
CHEM 5776	Scientific Ethics (1 credit seminar course)
CHEM 5781	Advanced General Biochemistry 2 (5 credits)
CHEM 5801	Advanced Signal Transduction
MCDB 5520	Bioinformatics and Genomics
MCDB 5550	Cellular and molecular motion, a biophysical approach (proposed)

Sample Ph.D. Curriculum in **Optics and Laser Science**

Comps 1 courses; five from this list:

PHYS 5160	Fundamentals of Optics and Lasers
PHYS 5250, 5260	Quantum Mechanics 1 & 2
PHYS 7310, 7320	Electromagnetic Theory 1 & 2
ECEN 5606	Advanced Optics Laboratory

Other courses (to bring total to 30 credits) to be selected from this list:

PHYS 7550	Atomic and Molecular Spectra
PHYS 7560	Quantum Optics
ECEN 5156	Physical Optics
ECEN 5616	Optoelectronic System Design
ECEN 5645	Introduction to Optical Electronics
ECEN 5166	Guided Wave Optics
ECEN 5626	Active Optical Devices
ECEN 5696	Fourier Optics
ECEN 6006	Numerical Methods in Photonics

Other graduate courses at CU including independent study

Sample Ph.D. Curriculum in **Geophysics**

(NOTE: students in Geophysics can also avail of Geophysics Degree Program)

Comps 1 courses; five from this list:

PHYS 5210	Theoretical Mechanics
PHYS 5250	Quantum Mechanics 1
PHYS 6610, 20, 30	Earth and Planetary Physics 1, 2 & 3
PHYS 7310	Electromagnetic Theory 1

Other courses (to bring total to 30 credits) to be selected from this list:

PHYS 5150	Introductory Plasma Physics
PHYS 5260	Quantum Mechanics 2
PHYS 7230	Statistical Mechanics
PHYS 7320	Electromagnetic Theory 2
PHYS 7440	Theory of the Solid State 1
ASTR 5400	Introduction to Fluid Dynamics
ASEN 5331	Computational Fluid Mechanics
MCEN 5023	Solid Mechanics 1

Other graduate courses at CU including independent study

Sample Ph.D. Curriculum in **Nano and Materials Science**

Comps 1 courses; five from this list:

PHYS 5250, 5260	Quantum Mechanics 1 & 2
PHYS 7230	Statistical Mechanics
PHYS 7310	Electromagnetic Theory 1
PHYS 7440	Theory of the Solid State 1

Other courses (to bring total to 30 credits) to be selected from this list:

PHYS 5520	Introduction to Magnetic Materials and Devices
PHYS 7320	Electromagnetic Theory 2
PHYS 7430	Soft Condensed Matter
PHYS 7450	Theory of the Solid State 2
ECEN 5005	Special Topics: Organic Electronics
ECEN 5015	Special Topics: Nanophotonics
ECEN 5355	Principles of Electronic Devices
ECEN 5555	Principles of Energy Systems & Devices
ECEN 6005	Special Topics: Photovoltaic Devices

Other graduate courses at CU including independent study

Sample Ph.D. Curriculum in **Plasma Science**

Comps 1 courses; five from this list:

PHYS 5150	Introductory Plasma Physics
PHYS 7310, 7320	Electromagnetic Theory 1 & 2
PHYS 5210	Theoretical Mechanics
PHYS 5250	Quantum Mechanics 1
PHYS 7230	Statistical Mechanics

Other courses (to bring total to 30 credits) to be selected from this list:

PHYS 5030	Intermediate Mathematical Physics 2
PHYS 5220	Nonlinear Dynamics
PHYS 5260	Quantum Mechanics 2
PHYS 5430	Advanced Laboratory
PHYS 7160	Intermediate Plasma Physics
ASEN 5331	Computational Fluid Mechanics
ASTR 5400	Introduction to Fluid Dynamics

Other graduate courses at CU including independent study.

Sample Ph.D. Curriculum in **Engineering (for ECEE students)**

Comps 1 courses; five from this list:

1 semester in Quantum Mechanics	
1 semester in Electromagnetic Theory	
PHYS 5160	Fundamentals of Optics and Lasers
ECEN 5156	Physical Optics

ECEN 5606 Advanced Optics Laboratory

Other courses (to bring total to 30 credits) to be selected from this list:

PHYS 7550 Atomic and Molecular Spectra
PHYS 7560 Quantum Optics
ECEN 5696 Fourier Optics
ECEN 6006 Numerical Methods in Photonics
ECEN 5166 Guided Wave Optics
Other graduate courses at CU including independent study

Ph.D. Curriculum in **Chemical Physics, Geophysics, Optical Science and Engineering, and Molecular Biophysics**

There are existing programs in Chemical Physics, Geophysics, Optical Science and Engineering, and Molecular Biophysics that students can also apply to for admission.

Other areas of interest to faculty and students

Additional tracks may be added according to faculty and student interest. Please contact the Associate Chair for Graduate Studies if you are interested in discussing a new area of specialization.

Terminal Master's Curriculum For Certificate In Applied Physics

The master's degree requirements for this program are the same as for the regular Ph.D. program, except the core courses are those listed in each area of specialization.

Engineering Students

Students from the College of Engineering who would like to supplement their Engineering Degree with a Certificate in Applied Physics may do so by taking courses at the graduate level that are equivalent to the proposed curricula. These would include a course on Quantum Mechanics or Applied Quantum Mechanics, a course on Electricity and Magnetism/Waves, as well as a laboratory course.