

# Chemistry, Ph.D.

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The Department offers an M.S. and a Ph.D. in Chemistry. The Ph.D. is granted in recognition of breadth and depth of knowledge of the facts and theories of modern chemistry and an ability to carry out independent chemical research demonstrated through submission of an acceptable doctoral dissertation. The M.S. may be earned either through submission of an acceptable Master's thesis (Plan I) or through an approved program of graduate course work and a comprehensive oral examination (Plan II). A Master's degree is not a prerequisite for admission to the Ph.D. program.

Students in the Ph.D. and M.S. Plan I (Thesis) programs are required to complete a minimum of seven approved four-unit courses including six graduate-level courses. The M.S. Plan II (Non-Thesis) program requires that the student complete 10 four-unit courses including eight graduate level courses and a comprehensive oral examination. Graduate students are expected to attain grades of B or better to remain in good academic standing. The comprehensive oral examination assesses the competence of the candidate in the areas of chemistry covered by the chosen course work, with unanimous agreement among the three examination committee members required for satisfactory completion.

Progress toward the Ph.D. during the first year is assessed by a written examination administered after completion of the first year of study. This examination covers either research accomplishments during the first year or comprehensive knowledge acquired in course work. The time and content of the examination depends upon the student's specific area of interest.

Training in teaching is an integral part of each graduate program, and all graduate degree candidates are expected to participate in the teaching program for at least four quarters during their graduate career.

Participants in the Ph.D. program take an oral examination for formal Advancement to Candidacy. This examination consists of an oral defense before a faculty committee of the student's dissertation research project, and an original research proposition conceived, developed, and documented by the student. The committee may examine the student at this time on any subject it deems relevant to the independent pursuit of chemical research. For students in organic chemistry, the candidacy exam must be taken by the end of the sixth quarter in residence. For students in inorganic chemistry, the candidacy exam must be taken by the end of the seventh quarter in residence.

The most important component of the Ph.D. program is the doctoral dissertation, which must describe the results of original research performed by the student under the supervision of a faculty member of the Department. The criterion for acceptability of the dissertation is that its contents be of a quality suitable for publication in a scientific journal of high editorial standards. Each Ph.D. candidate is expected to present the work described in the completed dissertation in a seminar before the Department, following which the candidate will be examined on the contents of the dissertation by a committee of the faculty. A Master's thesis presented in partial fulfillment of the requirements for the M.S. under Plan I must also describe the results of a student's original research performed under the direction of a faculty member. However, no public oral defense of the Master's thesis is required.

Residency requirements specify a minimum of six quarters in residence at UCI for Ph.D. candidates and three quarters for M.S. candidates.

The normative time for completion of the Ph.D. is five years, and the maximum time permitted is seven years.

## Master of Science in Chemistry Plan I (Thesis Plan)

- Completion of a minimum of seven approved four-unit courses, including six graduate-level courses (as specified by the Department and excluding CHEM 280, CHEM 290, CHEM 291, and CHEM 399) with maintenance of a grade of B or better.
- Completion of the teaching requirement.
- Completion of three quarters in residence at UCI.
- Submission of an acceptable Master's thesis.

## Master of Science in Chemistry Plan II (Non-Thesis Plan)

- Completion of 10 four-unit courses including eight graduate-level courses (as specified by the department and excluding CHEM 290, CHEM 291, and CHEM 399 and counting CHEM 280 no more than once) with a grade of B or better.
- Completion of the teaching requirement.
- Completion of three quarters in residence at UCI.
- Satisfactory completion of a comprehensive oral examination.

## Doctor of Philosophy in Chemistry

- Completion of a minimum of seven approved four-unit courses, including six graduate-level courses (as specified by the Department and excluding CHEM 280, CHEM 290, CHEM 291, and CHEM 399) with maintenance of a grade of B or better. In addition, all students will be required to take a "Conduct of Research" course.
- Completion of the second-year Examination requirement.
- Completion of the Oral Examination requirement for Advancement to Candidacy.
- Completion of the teaching requirement.

- Completion of six quarters in residence at UCI.
- Submission of an acceptable doctoral dissertation.

## Concentration in Chemical, Applied, and Materials Physics

This is an interdisciplinary program between condensed matter physics and physical chemistry, which is designed to eliminate the barrier between these two disciplines. Students with a B.S. in Physics, Chemistry, Materials Science and Engineering, or Chemical and Biomolecular Engineering are encouraged to apply to the program. The goal of the concentration in Chemical, Applied, and Materials Physics (ChAMP) is to provide students with a broad interdisciplinary education in the applied physical sciences that emphasizes modern laboratory and computational skills. The program accepts students for both the M.S. and the Ph.D. Upon admission to the program, students are assigned two faculty advisors, one from the Department of Physics and Astronomy, and one from the Department of Chemistry, to provide guidance on curriculum and career planning.

### Doctor of Philosophy Requirements

The curriculum for the ChAMP program includes a summer session to assimilate students with different undergraduate backgrounds; formal shop, laboratory, and computational courses; a sequence on current topics to bridge the gap between fundamental principles and applied technology; and a course to develop communication skills. The required courses include 10 core courses and three electives as follows. In certain situations, courses may be substituted by other courses with written approval of the student's research advisor and the ChAMP Chemistry graduate advisor:

A. Complete Core Courses:	
CHEM 206	Advanced Data Acquisition and Analysis
CHEM 208	Math Methods
CHEM 266	Current Topics in Chemical, Applied, and Materials Physics
B. Select one of the following Computation/Machine Learning courses:	
CHEM 229A	Mathematical Methods for the Physical Sciences
CHEM 250	Computational Chemistry
PHYSICS 223	Machine Learning and Statistics
C. Select one of the following Quantum Mechanics courses:	
CHEM 231A	Fundamentals of Quantum Mechanics
PHYSICS 215A	Quantum Mechanics
D. Select one of the following ChAMP Chemistry courses:	
CHEM 231B	Applications of Quantum Mechanics
CHEM 264	Analytical Methods for Organic Nanomaterials
CHEM 231C	Molecular Spectroscopy
CHEM 263	Materials Chemistry
E. Select one of the following Statistical Mechanics/Thermodynamics courses:	
CHEM 232A	Thermodynamics and Introduction to Statistical Mechanics
CHEM 232B	Advanced Topics in Statistical Mechanics
PHYSICS 214A	Statistical Physics
F. Select one of the following Communication courses:	
CHEM 273	Technical Communication Skills
PHY SCI 220	Science Communication Skills
PHYSICS 250	Physics and Astronomy Communications Skills
G. Select one of the following Classical Mechanics/Electromagnetism courses:	
CHEM 228	Electromagnetism
CHEM 230	Classical Mechanics and Electromagnetic Theory
PHYSICS 213A	Electromagnetic Theory
H. Select one of the following ChAMP Physics courses:	
PHYSICS 133	Introduction to Condensed Matter Physics
PHYSICS 238A	Condensed Matter Physics
PHYSICS 239A	Plasma Physics
PHYSICS 214C	Many Body Theory
PHYSICS 230A	Biophysics of Molecules and Molecular Machines
<b>Electives (three of the following must be taken)</b>	
CHEM 213	Chemical Kinetics

CHEM 225	Polymer Chemistry: Synthesis and Characterization of Polymers
CHEM 232C	Non-Equilibrium Statistical Mechanics
CHEM 233	Nuclear and Radiochemistry
CHEM 237	Mathematical Methods in Chemistry
CHEM 243	Advanced Instrumental Analysis
CHEM 248	Electrochemistry
CHEM 249	Analytical Spectroscopy
CHEM 267	Photochemistry
EECS 285B	Lasers and Photonics
ENGRMSE 259	Transmission Electron Microscopy
PHYSICS 134A	Physical and Geometrical Optics
PHYSICS 211	Classical Mechanics
PHYSICS 215B	Quantum Mechanics
PHYSICS 222	Continuum Mechanics
PHYSICS 230B	Biophysics of Molecules and Molecular Machines
PHYSICS 238B- 238C	Condensed Matter Physics and Condensed Matter Physics

All approved 4-unit courses not fulfilling core requirements may be counted as electives; other courses may be accepted with written approval from the student's research advisor and the ChAMP Chemistry graduate advisor.

In addition to the core ChAMP requirements listed above, students are expected to complete the following Doctor of Philosophy in Chemistry requirements:

- Completion of the second-year Examination requirement.
- Completion of the Oral Examination requirement for Advancement to Candidacy.
- Completion of the teaching requirement.
- Completion of six quarters in residence at UCI.
- Submission of an acceptable doctoral dissertation.

#### **Master of Science in Chemistry**

- Completion of 10 core courses and three electives that make up the required coursework for the Ph.D. program with a grade of B or better.
- Completion of the teaching requirement.
- Completion of three quarters in residence at UCI.
- Satisfactory completion of a comprehensive examination.