

## Department of Chemistry

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Chemistry is the central science; the foundation on which a variety of applied and nonapplied disciplines build. Chemistry deals with the composition, structure, and properties of substances and the changes they undergo. It is the study of the materials of which the entire universe is composed. Chemistry graduates will find an impressive array of options and exciting opportunities in fields such as basic research, environmental protection, instrumentation, the search for and synthesis of new therapeutic drugs, new product and process development, technical marketing, market research, forensic chemistry, teaching at all levels, and information science. Moreover, an education in chemistry is valuable in health sciences such as medicine, pharmacology, clinical chemistry, and industrial hygiene. It can be useful as well in nontechnical areas such as advertising, journalism, patent law, banking, and investment counseling. The options are bounded only by the limits of one's imagination.

There are four distinct undergraduate curricula designed to meet a wide range of professional needs. The professional option is the curriculum of choice for students who are interested in practicing chemistry as a career, including graduate study for an advanced degree in chemistry or a related field. The degree is certifiable to the American Chemical Society. The general chemistry option provides a suitable foundation for those students needing a strong background in chemistry, but not necessarily aspiring to become professional chemists, such as those in Education or Chemical Engineering. The pre-medical option has been designed to serve the needs of those students interested in careers in medicine, pharmacy, dentistry, or other health related fields. The forensics option is a full-fledged chemistry degree that prepares students for a career in forensic science.

Students majoring in chemistry at UI have the very good fortune to interact with an award-winning, distinguished teaching faculty. They have a unique opportunity to participate in undergraduate research in a nurturing environment where they work side by side with graduate students, postdoctoral fellows, and faculty members. Very often the research carried out by undergraduates results in publications in leading chemical journals. As a result of the strong research programs in the department, undergraduates have the opportunity in their courses to have hands-on experience with, or to acquire data from, modern sophisticated instrumentation such as FT nuclear magnetic resonance spectrometers, gas chromatographs interfaced with mass spectrometers, and laser Raman, infrared and ultraviolet spectrometers, in addition to the more classical techniques. Considerable use of computers is made in laboratory courses and as an aid to instruction. Because our students receive a first-class education, they are in demand by prospective employers and graduate schools.

The Chemistry Department trains its B.S. graduates to attain a high level of familiarity with:

- basic chemical concepts and fundamental chemical processes;
- organic synthesis and characterization;
- analytical and environmental approaches and problem solving;
- inorganic, material, and nuclear chemical concepts and applications;
- physical chemical aspects of natural systems and theoretical modeling thereof.

In the course of their studies, students will acquire:

- strong lab techniques and synthetic skills;
- familiarity with the chemical literature and relevant search techniques;
- an awareness of safety issues;
- communication skills;
- problem solving skills;
- basic research skills;
- a sense of professionalism and competence.

M.S. and Ph.D. degrees are offered in chemistry with concentrations in analytical, inorganic, organic, and physical chemistry.

Entering graduate students (master's and doctoral candidates) are expected to demonstrate proficiency in chemistry by taking a series of four examinations in the areas of analytical (qualitative, quantitative, and instrumental), inorganic, organic (including qualitative organic analysis), and physical chemistry. These must be taken at the first offering after the student's arrival. These examinations are offered immediately before registration week of the fall and spring semesters. Questions are at an advanced undergraduate level.

Students who score at greater than the 50th percentile (established nationally) on a qualifying examination may begin with a 500-level course in that area in their first semester and are given credit for the relevant 400-level course (Chem 455, 466, 476, and/or 496). Students who score below the 50th percentile on an examination will begin course work in the respective area: analytical, Chem 454 (the lab in this course may be bypassed by petition if the student can present evidence of adequate exposure; previous course at B level); physical, Chem 495; inorganic, Chem 463; organic, Chem 473.

All candidates for the M.S. or Ph.D. degree in chemistry are required to have teaching experience, here or elsewhere, as part of their training and will complete Chem 506 (Introduction to Teaching and Research Skills) at their first opportunity on entering the program.

Chemistry graduate students will acquire advanced perspectives in analytical, inorganic, organic, and physical chemistry. They will gain a detailed understanding of the problems, challenges, and opportunities in their chosen subdiscipline, and an in-depth familiarity with the theoretical underpinnings and methodologies in their specific research area. Graduate students will also acquire skills in teaching, directing, and mentoring others.

## Courses

See Part 6 for courses in Chemistry (Chem).

## Undergraduate Curricular Requirements

### CHEMISTRY (B.S.)

Required course work includes the university requirements (see regulation J-3) and completion of one of the following options.

#### A. General Option

This degree provides the basic elements needed for a career in chemistry. It is especially suited for students who wish to enter other professions that require a background in science, including high school teaching, patent law, and technology management.

Chem 111 Principles of Chemistry I (4 cr)  
Chem 112 Principles of Chemistry II (5 cr)  
Chem 253 Quantitative Analysis (5 cr)  
Chem 277, 278 Organic Chemistry I and Lab (4 cr)  
Chem 305, 307 Physical Chemistry I and Lab (4 cr)  
Chem 306, 308 Physical Chemistry II and Lab (4 cr)  
Chem 372, 374 Organic Chemistry II and Lab (4 cr)  
Chem 409 Proseminar (1 cr)  
CS 101 Introduction to Computer Science or higher CS course (3 cr)  
Math 170 Analytic Geometry and Calculus (4 cr)  
Math 175 Analytic Geometry and Calculus II (4 cr)  
Math 275 Analytic Geometry and Calculus III (3 cr)  
Phys 211 Engineering Physics I (4 cr)  
Phys 212 Engineering Physics II or Phys 213 Engineering Physics III (4 cr)  
Electives to total 128 credits for the degree

#### B. Professional Option

Note: Students who complete this option will be certifiable to the American Chemical Society.

This curriculum provides a suitable background for students wishing to enter the profession of chemistry or to pursue graduate study for an advanced degree in chemistry or a related field.

Chem 111 Principles of Chemistry I (4 cr)  
Chem 112 Principles of Chemistry II (5 cr)  
Chem 253 Quantitative Analysis (5 cr)  
Chem 277, 278 Organic Chemistry I and Lab (4 cr)  
Chem 305, 307 Physical Chemistry I and Lab (4 cr)  
Chem 306, 308 Physical Chemistry II and Lab (4 cr)  
Chem 372, 374 Organic Chemistry II and Lab (4 cr)  
Chem 409 Proseminar (1 cr)  
Chem 454 Instrumental Analysis (4 cr)  
Chem 463-464, 465 Inorganic Chemistry and Lab (7 cr)  
Chem 491 Research (2 cr)  
CS 101 Introduction to Computer Science or higher CS course (3 cr)  
Math 170 Analytic Geometry and Calculus (4 cr)  
Math 175 Analytic Geometry and Calculus II (4 cr)  
Math 275 Analytic Geometry and Calculus III (3 cr)  
MMBB 380 Intro Biochemistry (4 cr)  
Phys 211 Engineering Physics I (4 cr)  
Phys 212 Engineering Physics II or Phys 213 Engineering Physics III (4 cr)  
Foreign language courses (8 cr)

Two additional chemistry courses having Chem 306 as a prerequisite, or two advanced chemistry courses approved by the Chemistry Department in accordance with American Chemical Society stipulations.  
Electives to total 128 credits for the degree

### C. Pre-Medical Option

This curriculum provides a suitable foundation in chemistry for students who intend to enter careers in medicine, dentistry, pharmacy, etc.

Biol 115 Cells and the Evolution of Life (4 cr)  
Chem 111 Principles of Chemistry I (4 cr)  
Chem 112 Principles of Chemistry II (5 cr)  
Chem 253 Quantitative Analysis (5 cr)  
Chem 277, 278 Organic Chemistry I and Lab (4 cr)  
Chem 372, 374 Organic Chemistry II and Lab (4 cr)  
Chem 305, 307 Physical Chemistry I and Lab (4 cr)  
Chem 306, 308 Physical Chemistry II and Lab (4 cr)  
Chem 409 Proseminar (1 cr)  
Chem 472 Rational Design of Pharmaceuticals (3 cr)  
CS 101 Introduction to Computer Science or higher CS course (3 cr)  
Math 170 Analytic Geometry and Calculus (4 cr)  
Math 175 Analytic Geometry and Calculus II (4 cr)  
Math 275 Analytic Geometry and Calculus III (3 cr)  
MMBB 380 Introductory Biochemistry (4 cr)  
MMBB 382 Introductory Biochemistry Lab (2 cr)  
Phys 211 Engineering Physics I (4 cr)  
Phys 212 Engineering Physics II (4 cr)

In addition, two courses must be selected from the following list:

Chem 454 Instrumental Analysis (4 cr)  
Chem 473 Intermediate Organic Chemistry (3 cr)  
MMBB 476 Biophysical Chemistry (3 cr)

Electives to total 128 credits for the degree

### D. Forensics Option

Biol 115 Cells and the Evolution of Life (4 cr)  
Biol 210 Genetics (4 cr)  
Chem 111 Principles of Chemistry I (4 cr)  
Chem 112 Principles of Chemistry II (5 cr)  
Chem 253 Quantitative Analysis (5 cr)  
Chem 277, 278 Organic Chemistry I and Lab (4 cr)  
Chem 305, 307 Physical Chemistry and Lab (4 cr)  
Chem 306, 308 Physical Chemistry and Lab (4 cr)  
Chem 372, 374 Organic Chemistry II and Lab (4 cr)  
Chem 409 Proseminar (1 cr)  
Chem 454 Instrumental Analysis (4 cr)  
CS 101 Introduction to Computer Science (3 cr)  
Geol 299 Directed Study (3 cr)  
JS 101 Introduction to the Justice System (3 cr)  
Math 170 Analytic Geometry and Calculus I (4 cr)  
Math 175 Analytic Geometry and Calculus II (4 cr)  
Math 275 Analytic Geometry and Calculus III (3 cr)  
MMBB 250 General Microbiology (3 cr)  
MMBB 255 General Microbiology Lab (2 cr)  
MMBB 380 Introductory Biochemistry (4 cr)  
MMBB 382 Introductory Biochemistry Laboratory (2 cr)  
Phys 211 Engineering Physics I (4 cr)  
Phys 212 Engineering Physics II (4 cr)  
Stat 251 Statistical Methods (3 cr)  
Electives to total 128 credits for the degree

## Academic Minor Requirements

### CHEMISTRY MINOR

This program is designed to give a non-chemistry major a sufficient background in general chemistry and laboratory techniques to improve his or her employment prospects as a laboratory technician and to improve the technical background of the student interested in science education or communication.

Chem 111 Principles of Chemistry I (4 cr)  
Chem 112 Principles of Chemistry II (5 cr)  
Chem 253 Quantitative Analysis (5 cr)  
Chem 277, 278 Organic Chemistry I and Lab (4 cr)  
Chem 302, 303 Principles of Physical Chemistry and Lab (4 cr)  
Chem 372 Organic Chemistry II (3 cr)

## Graduate Degree Programs

Candidates must fulfill the requirements of the College of Graduate Studies and of the Department of Chemistry. See the College of Graduate Studies section of Part 4 for the general requirements applicable to each degree.

**Master of Science.** (A) Thesis option: General M.S. requirements apply. At least one credit must be earned in Chem 501. (B) Non-thesis option: A minimum of 30 credits in course work is required and must be divided among the following: (1) 20 credits in chemistry courses numbered 500 or above (including one credit in Chem 501); (2) 10 credits in chemistry courses numbered 400 or above, or related courses numbered 300 or above. A written and/or oral examination that covers graduate course work must be taken during the final semester in residence.

**Doctor of Philosophy – Major in Chemistry.** The student will enroll for at least 33 credit hours in courses. All students will take Chem 509 (Advanced Physical Chemistry) and obtain two credits in Chem 501 (Seminar). In addition, sufficient credit hours of research will be completed to meet a total minimum registration requirement of 78 credits.

The student is encouraged to take courses in related fields, e.g., mathematics, physics, chemical engineering, geochemistry, computer science, electronics, or biochemistry. This work can be designated as the minor or supporting field on the study program.

All Ph.D. candidates are required to participate in seminar (Chem 501) while in residence, even though not formally registered for credit in this course. Registration may be for zero credit.

Cumulative examinations are general examinations in the student's field of specialization to judge the breadth of knowledge gained by the student from courses, lectures, and the literature, as well as the ability to use this knowledge in the solution of a variety of problems. Once started, a student must continue to take these examinations each time they are offered whenever the student is in residence and is eligible. If a given examination is not taken, a failing grade is received. Examinations are approximately three hours in length and are given four times each semester and, in exceptional cases, during the summer session. Normally, students will take examinations only in the chosen area of concentration, but they may elect to take them in other areas of chemistry. The student must obtain an average grade of 50% in eight examinations to continue in the Ph.D. program.

Shortly after completing the final cumulative examination, Ph.D. students are required to submit a written proposal on their doctoral research project and defend it at an oral examination by their graduate committee (Chem 590). The proposal will be limited to a maximum of 5,000 words, excluding the bibliography, and will consist of a statement of the proposed doctoral research problem, an in-depth discussion of the relevant literature, a listing of the major research objectives, a summary of the proposed experimental work plan, and an appropriate bibliography.

**Doctor of Philosophy – Major in Biochemistry.** A Ph.D. with major in biochemistry is offered by the Department of Microbiology, Molecular Biology and Biochemistry. See that departmental section for information on the degree.