

## Chemistry

Make a Gift

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### Program Description

Each course offered by the department provides an opportunity for a concentrated study of the various principles of contemporary chemical knowledge. From the introductory to the advanced courses, application is made of basic theories and methods of chemical investigation. Courses offered by the department utilize lectures, discussions, library work, on-line computer literature searching, computer-assisted instructional programs, videotapes, and laboratory investigations in order to emphasize the concepts that underlie the topics covered. Each course, as well as the major itself, is designed for the curious and interested student.

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The chemistry major is approved by the American Chemical Society, as is an additional major in chemistry/biochemistry. Paths taken by majors after graduation are varied; many enter graduate work in chemistry or biochemistry. Graduates also enter medical and dental schools, industrial and government research laboratories, secondary school teaching, and numerous other fields.

### Program Requirements

The eight basic courses required for the Bachelor of Arts degree are Chemistry 105 or 107, 108, 203, 204, 221, 305, 306, and 317. Students who complete these eight basic courses along with Chemistry 375, Research (Chemistry 460 or 465), and one additional 300-level chemistry course may choose to receive a Bachelor of Science degree. An interdisciplinary major is offered in biochemistry and molecular biology; the complete description is listed under that title. Students who wish to receive a degree accredited by the American Chemical Society must complete the Bachelor of Science degree and in the process take either Chemistry 333 or 334. Physics 109 and 110 and Mathematics through 211 are required of all chemistry majors.

Additional courses in mathematics (212), biology, and physics may be recommended for those contemplating graduate study in certain areas. Junior and senior majors are expected to join with staff members in a seminar series that is designed to provide an opportunity for discussion of student initiated research and current developments in chemistry.

For the prospective secondary school teacher, the department cooperates in offering Education 304, Techniques of Teaching and Curriculum of Secondary Chemistry. Introductory biology is required for certification.

Individualized study and independent laboratory work are available in connection with some courses. During the junior or senior year, majors may elect Chemistry 460, a research course in which a student can utilize his or her knowledge and creativity intensively. Summer research, Chemistry 465, is encouraged strongly and is elected by many majors.

A minor in chemistry shall consist of Chemistry 105 (or 107) and 108, plus four other chemistry courses at or above the 200 level, one of which must be at the 300 level. Individualized study courses may not be counted toward the minor.

## Course Listing

Course level:

100 | 200 | 300 | 400

### ***CHEM-105 Fundamental Chemistry: Down on the Farm***

Application of the fundamental chemical principles to agricultural and environmental topics. The properties of matter, atomic and molecular structure, and chemical reactions are studied using as examples chemicals important in agricultural and environmental processes as examples. Laboratory component complements lectures, field trips and research projects involving the local community are included. Three lecture hours and one laboratory.

### ***CHEM-107 Chemical Structure and Bonding***

Study of fundamental chemical principles focusing on properties of matter and theories of chemical bonding, atomic and molecular structure and chemical reactions. Laboratory experiments are designed to offer a hands-on familiarity with the principles discussed in the lectures. Computers are used in the labs for computational modeling as well as data analysis. Three lecture hours and one laboratory

### ***CHEM-108 Chemical Reactivity***

Principles covered in Chem 107 are applied to broader topics such as kinetics, equilibrium, electrochemistry, and thermodynamics, with an emphasis on interdisciplinary topics. Laboratory work is designed to illustrate and complement materials discussed in class. Three lecture hours and one laboratory

### ***CHEM-118 The Life of Chemistry***

Taught in coordination with BIO 118, this class covers the fundamental principles of chemical reactivity and explores how those principles enlighten our understanding of modern biological processes, with an emphasis on the physiological function of the major organ systems. Both lectures and labs integrate chemistry and biology to convey a holistic view of how these subjects interrelate to resolve current questions in science. Students must take CHEM 118 and BIO 118 concurrently. Equivalent to CHEM 108.

***CHEM-203 Organic Chemistry***

Study of the fundamental concepts of the chemistry of carbon compounds, with emphasis on molecular structure, reaction mechanisms, stereochemistry, and the application of spectroscopy to problems of identification. Three lecture hours, one lab discussion hour, and one laboratory.

***CHEM-204 Organic Chemistry***

Study of the various classes of organic compounds, including substitutions in the aromatic nucleus, cyclic compounds, and natural products such as amino acids, carbohydrates and peptides. Three lecture hours, one lab discussion hour, and one laboratory.

***CHEM-216 Introduction to Forensic Science***

An overview of the field of forensic science. The course touches upon the breadth of forensic investigation and focuses on the microscopic and spectroscopic analysis of crime scene material. In its broadest definition, forensic science includes consumer and environmental protection, as well as murder, robbery, arson, explosives, fraud, illicit drugs and poisoning. This course focuses on the practical application of the familiar chemical principles and experimental methods found in introductory and organic chemistry.

***CHEM-221 Chemical Applications of Spectroscopy***

Study of the theories and applications of infrared,  $^1\text{H}$  and  $^{13}\text{C}$  nuclear magnetic resonance, and mass spectroscopy in relation to the importance of these spectroscopic methods in the analysis of chemical systems. Scope and limitations of each type of spectroscopy are covered. Course work includes lectures, discussions, student oral presentations, and laboratory sessions. Lab periods involve use of spectrometers in the identification of organic compounds. Three lecture hours and one laboratory.

***CHEM-231 Challenges and Opportunities in Medical Science in the 21st Century***

Overview of major disease challenges worldwide and potential strategies to combat those diseases. Developing human health related products drives the pharmaceutical industry, research community, and responsible governments worldwide. Success depends on increasing specialization across chemistry, biology, physics and mathematics. The goal is to expose students to professional opportunities beyond college. Topics include global health priorities such as AIDS, influenza, malaria, tuberculosis, the war against cancer, and vaccine and therapeutic development.

### ***CHEM-246 The Physics of Life***

The course is designed to provide a basic familiarity with the most common techniques used in structural biology and their applications to challenging biochemical, biotechnology and medical problems. Course focuses on current state-of-the-art biophysical methods that are being applied to study structure and function of biological macromolecules and biological systems with a focus on the most informative methods, such as X-ray crystallography, NMR spectroscopy, and single molecule techniques. Theoretical underpinnings and the practical applications are covered.

### ***CHEM-290 Mentored Research Internship***

Quarter credit internship graded S/U.

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### ***CHEM-305 Physical Chemistry***

Study of the principles of statistical thermodynamics and chemical kinetics as applied to the states of matter, chemical reactions and equilibria, and electrochemistry, using lectures, readings, problems, discussions, and laboratory exercises. Computers are used as a tool for solving problems and for the reduction of experimental data. Prerequisites: Chem 108, Phys 110, mathematics through calculus (usually Math 211). Three lecture hours, one discussion hour, and one laboratory.

### ***CHEM-306 Physical Chemistry***

Introduction to theories of quantum mechanics, spectroscopy, and molecular reaction dynamics and their application to chemical systems through the use of problems, lectures, readings, discussions, and laboratory investigations. Three lecture hours, one discussion hour, and one laboratory afternoon. Prerequisite: Chemistry 305 or permission of instructor.

### ***CHEM-317 Instrumental Analysis***

Study of chemical analysis by use of modern instruments. Topics include complex equilibria, electroanalytical methods, quantitative spectroscopy, chromatography, and Fourier transform methods. Analytical techniques will be studied from both a chemical and an instrumental point of view. The laboratory stresses quantitative analytical procedures and includes an independent project. Three lecture hours and one laboratory afternoon.

### ***CHEM-320 Materials Chemistry***

Synthesis, properties, and characterization of materials. Topics include mechanical, electrical, and optical properties, synthesis and fabrication of materials including semiconductors and nanoparticles, surface chemistry, surface sensitive spectroscopies, electron and probe microscopies, and applications of these materials in advanced technology.

### ***CHEM-333 Biochemistry I***

Detailed study of the structure and function of macromolecules and macromolecular assemblies as they pertain to living organisms. Topics include the structure and chemistry of proteins; the mechanisms and kinetics of enzyme catalyzed reactions; and the structure, chemistry, and functions of carbohydrates, lipids, nucleic acids, and biological membranes. Classic and modern bioanalytical methods are emphasized. Three lecture hours and one laboratory afternoon

### ***CHEM-334 Biochemistry II***

Detailed survey of the primary and secondary metabolic processes in living cells. Topics discussed include the overall organization of metabolic pathways, carbohydrate and fatty acid metabolism, biological oxidation and reduction and energy production. Special attention is given to regulation, hormone action, metabolic disorders and disease. Laboratory work includes an independent research project. Three lecture hours and one laboratory afternoon. Capstone course for Biology majors. Prerequisite: for Chemistry majors Chem 333; for Biology majors Bio 212 and Chem 204 or permission of the instructor.

### ***CHEM-353 Advanced Organic Chemistry***

Study of synthetic, mechanistic, and theoretical concepts in organic chemistry. Particular emphasis is on the study of methods used to determine organic reaction mechanisms, stereospecific reactions, pericyclic reactions, and the design of multistep syntheses of complex molecules. Three lecture hours.

### ***CHEM-375 Advanced Inorganic Chemistry***

Study of valence bond, crystal field, and molecular orbital theories; boron chemistry; organometallic compounds; structural, kinetic, and mechanistic studies of coordination compounds. Group theory and symmetry are applied to various systems. Three lecture hours and one laboratory.

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### ***CHEM-450 Individualized Study-Tutorial***

Individualized tutorial counting toward the minimum requirements in a major or minor, graded A-F

***CHEM-451 Individualized Study-Tutorial***

Individualized tutorial counting toward the minimum requirements in a major or minor, graded S/U

***CHEM-452 Individualized Study-Tutorial***

Individualized tutorial not counting in the minimum requirements in a major or minor, graded A-F

***CHEM-453 Individualized Study-Tutorial***

Individualized tutorial not counting in the minimum requirements in a major or minor, graded S/U

***CHEM-460 Individualized Study-Research***

Independent investigation in an area of mutual interest to the student and faculty director. Project normally includes both a literature and a laboratory study. An oral report to staff and students and a final written thesis are required. A student wishing to enroll in this course should consult with the faculty director at least two weeks before the end of the semester preceding the semester in which this course is to be taken. Open to junior and senior chemistry majors. Offered both semesters.

***CHEM-461 Individualized Study-Research***

Individualized research counting toward the minimum requirements in a major or minor, graded S/U

***CHEM-462 Individualized Study-Research***

Individualized research not counting in the minimum requirements in a major or minor, graded A-F

***CHEM-463 Individualized Study-Research***

Individualized research not counting in the minimum requirements in a major or minor graded S/U

***CHEM-464 Individualized Study-Research***

***CHEM-465 Individualized Study-Research***

Funded eight to ten week independent investigation in an area of mutual interest to the student and research director. Project normally includes both a literature and a laboratory study. Oral reports to staff and students and a final written thesis are required. Students wishing to enroll should consult with a chemistry department faculty member early in the spring semester.

***CHEM-470 Individualized Study-Internship***

Internship counting toward the minimum requirements in a major or minor, graded A-F

***CHEM-471 Individualized Study-Intern***

Internship counting toward the minimum requirements in a major or minor, graded S/U

***CHEM-472 Individualized Study-Internship***

Internship not counting in the minimum requirements in a major or minor, graded A-F

***CHEM-473 Individualized Study-Intern***

Internship not counting in the minimum requirements in a major or minor, graded S/U

***CHEM-474 Summer Internship***

Summer Internship graded A-F, counting in the minimum requirements for a major or minor only with written permission filed in the Registrar's Office.

***CHEM-475 Summer Internship***

Summer Internship graded S/U, counting in the minimum requirements for a major or minor only with written permission filed in the Registrar's Office

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