

CHEMISTRY

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Department: Science

The overall quality of the Chemistry Program has been approved through its accreditation by the American Chemical Society. The program offers lecture and laboratory courses in support of a variety of professional, pre-professional, liberal arts, and technical curricula. A bachelor of science or a bachelor of arts degree in Chemistry may be earned. In addition, a bachelor of science degree in Chemistry Education is available.

Completion of the B.S. degree in chemistry prepares a student for employment as a practicing laboratory chemist in a wide variety of industrial, educational, and governmental enterprises. It provides excellent preparation for admission into graduate programs in chemistry, biochemistry, pharmacology, toxicology, food science, environmental science, and other related areas and for admission into the professional schools of medicine, dentistry, and veterinary medicine. Upon receiving the B.S. degree in chemistry, students are certified for immediate, full membership in the American Chemical Society.

Completion of the B.A. degree in chemistry prepares a student to seek a career in areas in which a knowledge of matter, energy, and their transformation is important including the chemical, food, health, environmental, and energy industries. Students frequently combine the B.A. degree with a second major such as biology, mathematics, physics or business administration and management.

Bachelor of Science: Chemistry (67-69 credits)**I. Chemistry Core: (44 credits)**

CHEM 231	General Chemistry I (Lecture/Lab:3/1)	4
CHEM 232	General Chemistry II (Lecture/Lab:3/2)	5
CHEM 243	Quantitative Analytical Chemistry (Lecture/Lab:3/1)	4
CHEM 244	Instrumental Analysis (Lecture/Lab:3/1)	4
CHEM 333	Intermediate Inorganic Chemistry (Lecture/Lab:3/1)	4
CHEM 351	Organic Chemistry I (Lecture/Lab:3/2)	5
CHEM 352	Organic Chemistry II (Lecture/Lab:3/2)	5
CHEM 364	Chemical Thermodynamics and Kinetics	3
CHEM 365	Quantum Chemistry and Spectroscopy	3
CHEM 366	Physical/Instrumentation Laboratory	4
CHEM 473	Biochemistry (Lab not required)	3

II. Advanced Chemistry Courses (6 credits)

CHEM 470	Advanced Laboratory	3
<i>One of the following:</i>		3
CHEM 437	Advanced Inorganic Chemistry	3
CHEM 447	Advanced Organic Chemistry	3
CHEM 457	Advanced Analytical Chemistry	3
CHEM 467	Computational Chemistry	3

III. Courses in Related Fields: (18-20 credits)

MATH 150/151	Calculus I/ II	10
PHYS 141/142	College Physics I/II	8
OR		8-10
PHYS 281/282	University Physics I/II (recommended)	10

IV. Additional recommendations:

At least one additional mathematics course is recommended, especially one chosen from:
 MATH 252, 345, 350 or 360.

68-70

Bachelor of Arts: Chemistry (31-33 credits)**I. Chemistry Core: (24 credits)**

CHEM 231	General Chemistry I (Lecture/Lab:3/1)	4
CHEM 232	General Chemistry II (Lecture/Lab:3/2)	5
CHEM 351	Organic Chemistry I (Lecture/Lab:3/2)	5
CHEM 352	Organic Chemistry II (Lecture/Lab:3/2)	5
CHEM 363	Basic Physical Chemistry (Lecture/Lab:3/1)	4
CHEM 420	Chemistry Seminar	1

II. Chemistry Option: (4 credits)

One additional four-credit course in Chemistry at the 200-level or above with a laboratory component other than those listed in Part II above. 4

ACADEMIC PROGRAMS

III. Required Courses in Related Fields: (3-5 credits)

MATH 140	Calculus: A Short Course	3
	OR	3-5
MATH 150	Calculus I.....	5

31-33

Bachelor of Arts: Chemistry, Environmental Emphasis (35-37 credits)**I. Chemistry Core:** (27 credits)

CHEM 231	General Chemistry I (Lecture/Lab:3/1)	4
CHEM 232	General Chemistry II (Lecture/Lab:3/2).....	5
CHEM 244	Instrumental Analysis	4
CHEM 351	Organic Chemistry I (Lecture/Lab:3/2)	5
CHEM 352	Organic Chemistry II (Lecture/Lab:3/2).....	5
CHEM 363	Basic Physical Chemistry (Lecture/Lab:3/1)	4

II. Required Courses in Related Fields: (8-10 credits)

ENVS 180	Environmental Science* (Lecture/Lab:3/1).....	4
ENVS 420	Environmental Science Seminar	1
MATH 140	Calculus: A Short Course	3
	OR	3-5
MATH 150	Calculus I.....	5

35-37

* ENVS 180 should be taken as part of LAC to satisfy major requirements without additional course work.

Bachelor of Science: Chemistry Education (39-43 credits)**I. Chemistry Requirements:** (28 credits)

CHEM 231	General Chemistry I (Lecture/Lab:3/1)	4
CHEM 232	General Chemistry II (Lecture/Lab:3/2).....	5
CHEM 243	Quantitative Analysis (Lecture/Lab:3/1)	4
CHEM 351	Organic Chemistry I (Lecture/Lab:3/2)	5
CHEM 352	Organic Chemistry II (Lecture/Lab:3/2).....	5
CHEM 363	Basic Physical Chemistry (Lecture/Lab:3/1).....	4
CHEM 420	Chemistry Seminar	1

II. Additional Requirements: (11-15 credits)

PHYS 141/142	College Physics I/College Physics II (Lecture/Lab:3/1)	8
	OR	8-10
PHYS 181/182	University Physics I/University Physics II (Lecture/Lab:3/1)	10
MATH 140	Calculus: A Short Course	3
	OR	3-5
MATH 150	Calculus I.....	5

Total Credits: 39-43

III. Education Requirements:

The student must fulfill the Professional Education Requirements for licensure; see Education Department for current requirements.

CHEMISTRY COURSES (CHEM)**CHEM 104 General Glassblowing (2 credits)**

The fundamentals of glassblowing and frameworking with applications to the design and construction of decorative glass pieces.

CHEM 105 Scientific Glassblowing (2 credits)

The fundamentals of glassblowing and frameworking with applications to the construction and repair of scientific glassware.

CHEM 110 (LAC, E) Our Chemical World (3 credits lecture/1 credit lab)

An introductory course for non-science majors emphasizing elementary concepts of chemistry as they relate to society and the environment. May not be used as a prerequisite for any other chemistry course.

CHEM 111 (LAC, R) Chemistry in our Daily Lives (3 credits lecture/1 credit lab)

Lecture focuses on the specific chemicals and chemical systems that are encountered in homes and on farms, and includes the effect they have on a person's immediate environment and health. Laboratory work uses mainly chemicals obtained from stores to reinforce the connection between chemical theory and practice. May not be used as a prerequisite for any other chemistry course.

CHEM 121 (LAC) Basic Chemistry (3 credits lecture/1 credit lab)

For students interested in agriculture, foods, health, or technology. Introduces basic concepts and fundamental principles of chemistry with an emphasis on applications to the above areas. The required preparation for this course is two years of high school mathematics or MATH 060.

CHEM 122 Introductory Organic/Biochemistry (3 credits lecture/1 credit lab)

For students interested in agriculture, foods, health, or technology. Brief study of organic and biochemistry with an emphasis on applications to the above areas. Prerequisite: CHEM 121.

CHEM 186 Special Topics (1-4 credits)**CHEM 231 (LAC, E, T) General Chemistry I (3 credits lecture/1 credit lab)**

First course in chemistry for students majoring in a science. Topics include chemical and physical properties of matter, atomic and molecular structure, bonding, chemical notation, inorganic nomenclature, stoichiometry, and periodic laws. The required preparation for this course is three years of high school mathematics or MATH 110.

CHEM 232 General Chemistry II (3 credits lecture/2 credits lab)

Continuation of CHEM 231. Topics include molecular bonding and shapes, equilibrium, kinetics, and acid/base chemistry. Descriptive inorganic chemistry is emphasized. Laboratory work includes experiments related to the lecture material including qualitative inorganic analysis. Prerequisite: CHEM 231.

CHEM 243 Quantitative Analytical Chemistry (4 credits lecture/laboratory)

Applications of chemical equilibrium calculations to procedures for quantitative analysis. Prerequisite: CHEM 232 or concurrent enrollment.

CHEM 244 Instrumental Analysis (4 credits lecture/ lab)

Basic principles of instrumentation. Spectroscopic and chromatographic methods of quantitative and qualitative analysis. Prerequisite: CHEM 232 or concurrent enrollment.

CHEM 286 Special Topics (1-4 credits)**CHEM 292 Honors Credit in Chemistry (1 credit)**

An independent study course designed primarily for Honors Program students. This course allows more in-depth or comprehensive study or research by certain students concurrently enrolled in at least one other chemistry course. Prerequisite: consent of instructor.

CHEM 333 Intermediate Inorganic Chemistry (4 credits lecture/lab)

A study of bonding theories, structure, stereochemistry, and acid-base reactivity of inorganic compounds with an emphasis on main group elements. Symmetry and group theory related to transition metal complexes, coordination chemistry, and instrumentation in inorganic chemistry are discussed. Prerequisite: CHEM 232.

CHEM 351 Organic Chemistry I (3 credits lecture/2 credits lab)

An examination of the principle functional groups of carbon compounds and the relationship of their structure to physical and chemical properties. Laboratory work includes chemical and instrumental methods of structure elucidation. Prerequisite: CHEM 232.

CHEM 352 Organic Chemistry II (3 credits lecture/2 credits lab)

Continuation of CHEM 351. Prerequisite: CHEM 351.

CHEM 363 Basic Physical Chemistry (3 credits lecture/1 credit lab)

Principles of chemical thermodynamics and kinetics and their application to biological systems. Prerequisites: CHEM 232 and MATH 140 or 150.

CHEM 364 Chemical Thermodynamics and Kinetics (3 credits)

An introduction to chemical thermodynamics and its applications; chemical kinetics; and the kinetic theory of gases. Prerequisites: CHEM 232, MATH 151, and one year of physics.

CHEM 365 Quantum Chemistry and Spectroscopy (3 credits)

Quantum mechanics and its applications to molecular structure and spectroscopy; statistical mechanics of molecules; and chemical reaction dynamics. Prerequisites: CHEM 232, MATH 151, and one year of physics.

CHEM 366 Physical/Instrumental Laboratory (1-4 credits)

Experiments demonstrating principles of physical chemistry such as determination of reaction rates and spectroscopic means of determining molecular structures. Statistical methods of data analysis, computer-aided data acquisition, advanced laboratory instrumentation, and scientific writing are introduced in the context of these experiments. Students may complete a reduced number of experiments to earn fewer than four (4) credits. Prerequisite: CHEM 232, MATH 151, and one year of physics.

CHEM 420 Chemistry Seminar I (1 credit)

Use of the chemical literature, current developments in research, technical speaking and writing. Prerequisite: CHEM 363 or 364 or 365 or concurrent enrollment.

CHEM 437 Advanced Inorganic Chemistry (3 credits lecture/lab)

A study of advanced topics in inorganic chemistry, focusing on the development of and current trends in main group and transition-metal organometallic chemistry. Topics may include a survey of organometallic compounds of various elements from Groups 1, 2, 13, 14, 15, 16; the 18-electron rule, transition metal-carbon σ complexes, transition metal-carbon π complexes, metal-metal bonds and clusters, organometallics reactions, and organometallic catalysis. Prerequisites: CHEM 333; and CHEM 364 or 365 or concurrent enrollment.

CHEM 447 Advanced Analytical Chemistry (3 credits lecture/lab)

Advanced theory and application of topics introduced in Instrumental Analysis (CHEM 244). Subjects may include electrochemistry, chromatography, and Nuclear Magnetic Resonance (NMR) spectroscopy. Prerequisites: CHEM 244, and CHEM 364 or 365.

CHEM 457 Advanced Organic Chemistry (3 credits lecture/lab)

Transition states, reactive intermediates, free energy relationships, and kinetic isotope effects in the elucidation of reaction mechanisms. Prerequisites: CHEM 352, and CHEM 364 or 365.

CHEM 467 Computational Chemistry (3 credits lecture/lab)

An introduction to current quantum mechanical methods of computing molecular structure and spectra as well as chemical reaction dynamics. Common semi-empirical methods are discussed as are Hartree-Fock and densityfunctional methods. Both theory and practical experience with computer calculations are included. Prerequisite: CHEM 365.

CHEM 470 Advanced Laboratory (1-4 credits)

An introduction to the integrated practice of chemical science, including the use of primary chemical literature, laboratory research, and report research results in papers and seminars. May be repeated for additional credit. Students completing 3 credits or more of Advanced Laboratory must complete an independent laboratory research project and report its results in a major paper as well as in a public seminar. Prerequisite: CHEM 352 and one of CHEM 363, CHEM 364, or CHEM 365; or consent of instructor.

CHEM 473 Biochemistry (3 credits lecture/1 credit lab)

Structure, reactions and metabolism of biologically important compounds. Prerequisite: CHEM 352.

CHEM 486 Advanced Topics (1-4 credits)

Organometallics, nonaqueous solution reactions, solid-state chemistry, polymers, computers in chemistry, environmental chemistry, or similar topics. Prerequisite: consent of instructor. May be repeated for a maximum of 8 credits.

CHEM 494 Independent Study (1-4 credits)

Independent research in chemistry, directed by a faculty member. Prerequisite: consent of instructor.

CHEM 499 Internship in Chemistry (1-16 credits)

Supervised work in chemistry that takes place off campus. Prior approval of the project and credits to be taken, and final report are required by the Chemistry Program. Prerequisite: consent of Chemistry Program faculty.