Chemistry Courses (CHEM)

This is a list of all chemistry courses. For more information, see Chemistry.

**CHEM:1000 First-Year Seminar**  
1-2 s.h.
Small discussion class taught by a faculty member; topics chosen by instructor; may include outside activities (e.g., films, lectures, performances, readings, visits to research facilities). Requirements: first- or second-semester standing.

**CHEM:1050 Technology and Society**  
3 s.h.
Nonmathematical exploration of selected areas of technology; basic science background, current technological applications, implications for society; for non-science majors. Recommendations: closed to students who have taken college chemistry courses. GE: Natural Sciences without Lab.

**CHEM:1060 Technology and Society Laboratory**  
1 s.h.
Laboratory for CHEM:1050; demonstrations, student experiments. Corequisites: CHEM:1050 if not taken as a prerequisite. Requirements: closed to students who have earned more than 3 s.h. in chemistry courses. GE: Natural Sciences Lab only.

**CHEM:1070 General Chemistry I**  
3 s.h.
Atomic structure, chemical bonds, mole relations, stoichiometry, states of matter, acids and bases, reaction rates, electrochemistry, nuclear chemistry. Requirements: elementary algebra. GE: Natural Sciences without Lab.

**CHEM:1080 General Chemistry II**  
3 s.h.
Organic chemistry and biochemistry. Requirements: CHEM:1070 or high school chemistry. GE: Natural Sciences without Lab.

**CHEM:1090 Supplemental Chemistry Lab**  
1 s.h.
Lab techniques, elementary synthesis, measurement, analysis, case-study lectures and experiments; safety glasses, appropriate dress, compliance with laboratory safety protocols required.

**CHEM:1100 Chemistry in Industry and the Economy**  
3 s.h.
Atomic structure, chemical bonding, acid and bases, polymers, pharmaceutics, DNA, proteins, and basic economics. Requirements: non-science major. GE: Natural Sciences without Lab.

**CHEM:1110 Principles of Chemistry I**  
4 s.h.
Chemical bonding and chemical reactions; atomic and molecular structure, chemical equations, stoichiometry, gases, liquids, thermodynamics of phase changes, solutions, equilibrium, acids, bases, pH, elementary organic chemistry; the solid state, including modern materials; lecture, discussion, laboratory. Requirements: MATH:1005 with a test score of 16. GE: Natural Sciences without Lab.

**CHEM:1120 Principles of Chemistry II**  
4 s.h.
Continuation of CHEM:1110; colligative properties of solutions, chemical thermodynamics, electrochemistry, chemical kinetics, chemical bonding, aspects of industrial chemistry, nuclear chemistry; lecture, discussion, laboratory. Requirements: CHEM:1110. GE: Natural Sciences with Lab.

**CHEM:1160 Principles of Chemistry Lab**  
2 s.h.
Laboratory techniques. Requirements: grades of C or higher in CHEM:1180 and CHEM:1190. GE: Natural Sciences Lab only.

**CHEM:1180 Chemical Science I**  
3 s.h.
GE: Natural Sciences without Lab.

**CHEM:1190 Chemical Science II**  
3 s.h.
GE: Natural Sciences without Lab.

**CHEM:1200 Chemical Science Laboratory**  
2 s.h.
GE: Natural Sciences Lab only.

**CHEM:2021 Fundamentals of Chemical Measurements**  
3 s.h.
Introduction to experimental and data analysis techniques used in performing quantitative chemical measurements; topics include titrations, spectrophotometry, potentiometry, chromatography, and statistical techniques for use in data processing and interpretation; laboratory. Prerequisites: CHEM:1120. Requirements: chemistry major.

**CHEM:2210 Organic Chemistry I**  
3 s.h.
Carbon-containing compounds; structure, stereochemistry, physical properties, reactivity, reaction mechanisms, synthesis; emphasis on alkanes, alkenes, alkynes, ethers, alcohols, and alkyl halides. Prerequisites: CHEM:1120.

**CHEM:2220 Organic Chemistry II**  
3 s.h.
Continuation of CHEM:2210; use of spectroscopic techniques to determine chemical structures; chemistry of carbonyl compounds, amines, aromatics, amino acids, carbohydrates, nucleosides. Prerequisites: CHEM:2210 or CHEM:2230.

**CHEM:2230 Organic Chemistry I for Majors**  
3 s.h.
Carbon-containing compounds; structure, stereochemistry, physical properties, reactivity, reaction mechanisms, synthesis; emphasis on alkanes, alkenes, alkynes, alcohols, alkyl halides, aromatics. Prerequisites: CHEM:1120. Requirements: chemistry, biochemistry, or chemical engineering major.

**CHEM:2240 Organic Chemistry II for Majors**  
3 s.h.
Continuation of CHEM:2230; use of spectroscopic techniques to determine chemical structures; chemistry of carbonyl compounds, amines, ethers, amino acids, carbohydrates, and nucleosides. Prerequisites: CHEM:2210 or CHEM:2230. Requirements: chemistry, biochemistry, or chemical engineering major.

**CHEM:2410 Organic Chemistry Laboratory**  
3 s.h.
Preparation, purification, identification, analysis of chemical compounds, principally organic compounds. Prerequisites: CHEM:1120 and (CHEM:2210 or CHEM:2230). Corequisites: CHEM:2220 or CHEM:2240.

**CHEM:2420 Organic Chemistry Laboratory for Majors**  
3 s.h.
Preparation, purification, identification, analysis of chemical compounds, principally organic compounds. Prerequisites: CHEM:1120 and (CHEM:2210 or CHEM:2230). Corequisites: CHEM:2220 or CHEM:2240. Requirements: chemistry, biochemistry, or chemical engineering major.

**CHEM:3110 Analytical Chemistry I**  
3 s.h.
Modern theory and practice; emphasis on chemical equilibria (acid-base chemistry, solubility, complexation) and electroanalytical chemistry (potentiometry, voltammetry, coulometry). Requirements: CHEM:1120 and (MATH:1460 or MATH:1850) and (PHYS:1511 or PHYS:1611).

**CHEM:3120 Analytical Chemistry II**  
3 s.h.
Modern theory and practice; emphasis on atomic and molecular spectroscopy, mass spectrometry, chemical separations. Requirements: CHEM:1120 and (MATH:1460 or MATH:1850) and (PHYS:1511 or PHYS:1611).
CHEM:3250 Inorganic Chemistry 3 s.h.

CHEM:3430 Analytical Measurements 3 s.h.

CHEM:3440 Physical Measurements 3 s.h.
Laboratory experience using advanced instrumental and computational methods to generate and analyze data relevant to modern physical chemistry. Requirements: chemistry major, CHEM:2021 and (CHEM:4431 or CHEM:4432).

CHEM:3530 Inorganic Chemistry Laboratory 3 s.h.
Preparation and characterization of a variety of inorganic, organometallic, and coordination compounds of the main group and transition elements; emphasis on synthetic techniques, methods for characterization of inorganic species. Requirements: CHEM:2021 and (CHEM:2410 or CHEM:2420) and CHEM:3250.

CHEM:3560 Advanced Methods in Chemical Research: Special Topics 1-3 s.h.
Introduction to advanced research methods.

CHEM:3994 Undergraduate Research 1-4 s.h.

CHEM:4000 Get a Job: Collaborative Writing for Scientists and Writers in Industry 1 s.h.
Collaborative skills and cultural understanding that are highly sought after by employers in science, technology, and engineering fields, including pharmaceutical firms and biotech start-ups; collaboration on science communication and scientific-business communication projects, with visits from marketing managers, venture capitalists, and others; collaborative portfolio, résumé/interview points, and advice from business professionals in student's intended field. Requirements: graduate standing in a STEM biological, chemical, physical, medical science, or engineering discipline; or advanced undergraduate standing in journalism, creative writing, English, or other writing-intensive major.

CHEM:4171 Advanced Analytical Chemistry 3 s.h.

CHEM:4261 Selected Topics in Chemistry 1-3 s.h.

CHEM:4270 Advanced Inorganic Chemistry 3 s.h.
Modern principles, including crystal field/ligand field/molecular orbital theory, inorganic reaction mechanisms, coordination chemistry, bioinorganic chemistry, main group and transition metal organometallic chemistry, solid-state inorganic chemistry. Requirements: CHEM:3250 and CHEM:4432.

CHEM:4372 Advanced Organic Chemistry 3 s.h.
Basic concepts from perspectives of structure, mechanism, synthesis, stereochemistry. Requirements: CHEM:2220 or CHEM:2240.

CHEM:4430 Principles of Physical Chemistry 3 s.h.
Kinetics, transport properties, elementary thermodynamics, and selected topics in quantum mechanics and spectroscopy; emphasis on application of chemistry to areas of science including health and biosciences, environmental sciences, and related areas. Requirements: CHEM:1120 and (MATH:1460 or MATH:1850) and (PHYS:1512 or PHYS:1612).

CHEM:4431 Physical Chemistry I 3 s.h.
Chemical thermodynamics and its application to chemical equilibrium, phase changes and chemical equilibria; ideal and real gases; kinetic theory; surface absorption and electrochemistry; thermodynamics. Requirements: CHEM:1120 and (MATH:1560 or MATH:1860) and (PHYS:1512 or PHYS:1612).

CHEM:4432 Physical Chemistry II 3 s.h.
Quantum mechanics and its application to atomic and molecular structure; determination of structure and bonding by various spectroscopic methods; chemical kinetics. Requirements: CHEM:1120 and (MATH:1560 or MATH:1860) and (PHYS:1512 or PHYS:1612).

CHEM:4450 Synthesis and Measurement 3 s.h.
Laboratory investigations integrating synthesis and measurement techniques from inorganic, analytical, and physical chemistry; emphasis on modern applications of chemistry in biology, medicine, environmental science, catalysis, and materials science. Prerequisites: (CHEM:4432 or CHEM:4430 or CHEM:4431) and (CHEM:2420 or CHEM:2410) and (CHEM:3120 or CHEM:3110) and CHEM:3250 and CHEM:2021.

CHEM:4480 Introduction to Molecular Modeling 3 s.h.
Theory and application of ab initio quantum mechanics, semiempirical molecular orbital theory, and molecular mechanics force fields to chemical research problems; underlying theory of these methods (with emphasis on ab initio theory) and their practical application to chemical problems; computational chemistry projects using modeling software. Corequisites: CHEM:4432, if not taken as a prerequisite. Requirements: CHEM:4432.

CHEM:4760 Radiochemistry: Energy, Medicine, and the Environment 3 s.h.
Fundamental theoretical concepts of radiochemistry and their application in energy, medicine, and environmental sectors. Requirements: CHEM:1120 and (CHEM:2210 or CHEM:2230).

CHEM:4850 Upstream Biotechnology Processes 2 s.h.
Introduction to fermentation, fermenter preparation, cell growth and medium requirements, inoculation, sampling, process termination, separation of cells, fermentation case study, enzyme activity, and biocatalysis. Same as PHAR:4850.

CHEM:4873 Atmospheric and Environmental Chemistry 3 s.h.
Fundamental chemical processes of importance in the atmosphere, soil, and water, with emphasis on kinetics and photochemistry of homogeneous and heterogeneous reactions, atmospheric structure and dynamics, global geochemical cycling, chemistry-climate relationships, environmental remediation strategies; experimental methods in field and laboratory studies. Corequisites: CHEM:4431 or CHEM:4432, if not taken as a prerequisite. Requirements: CHEM:4431 or CHEM:4432.

CHEM:4875 Introduction to Polymer Chemistry 2-3 s.h.
Synthesis, structures, characterization, properties, and applications of polymers. Requirements: CHEM:2220 or CHEM:2240.
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CHEM:5433 Quantum and Computational Chemistry 3 s.h.
Fundamental principles of quantum chemistry; angular momentum; approximation methods; theory of atomic and molecular electronic structure; applications of computational quantum mechanics to chemical systems. Corequisites: CHEM:4432, if not taken as a prerequisite.

CHEM:5434 Molecular Spectroscopy 3 s.h.
Quantum mechanical theory of molecular spectroscopy; time-dependent perturbation theory, selection rules, lineshapes; selected applications in microwave, vibrational (infrared and Raman), electronic, optical, and magnetic resonance spectroscopy. Recommendations: CHEM:5433.

CHEM:5435 Chemical Kinetics 3 s.h.
Potential energy surfaces, transition state theory, diffusion limited rates, linear free energy relationships, isotope effects, solvent effects, RRKM theory; connection between experiment and various theories in the gas and solution phases; emphasis on assignment of experimental error to derived quantities. Recommendations: CHEM:4432.

CHEM:5436 Electronic Structure and Informatics in Chemistry 3 s.h.
Basic principles of molecular electronic structure theory; molecular structure and reactivity; molecular orbital theory; density functional theory; introduction to informatics and data science; how calculations can be used to enhance experimental research projects. Recommendations: CHEM:4432. Same as IGPI:5436.

CHEM:5438 Surface Chemistry and Heterogeneous Processes 3 s.h.
Fundamental and applied aspects of surface chemical processes; theories of molecular adsorption/desorption and surface complexation; kinetics; surface analysis and instrumentation; applications of surface chemistry in heterogeneous catalysis, heterogeneous environmental/ atmospheric processes, and materials chemistry. Recommendations: CHEM:4431.

CHEM:5490 Seminar: Physical and Environmental Chemistry 0-1 s.h.

CHEM:5499 Physical Chemistry Topics 1-3 s.h.
Advanced topics relevant to modern physical chemistry. Recommendations: CHEM:4432 and MATH:1860.

CHEM:5599 Special Topics in Chemistry Education 3 s.h.
Special topics related to chemistry education; topics vary.

CHEM:5875 Perspectives in Biocatalysis 1-3 s.h.
Applied enzymology, protein design, structure-activity relationships, biosensor technology, microbial transformations, biodegradation of environmental pollutants. Requirements: graduate standing in a participating department supported by the Predoctoral Training Program in Biotechnology. Same as BIOC:5875, CBE:5875, CEE:5875, MICR:5875, PHAR:5875.

CHEM:5890 Research Frontiers in Chemistry 1 s.h.

CHEM:5990 Chemistry Colloquium 0-1 s.h.
Presentation and discussion of research by invited presenters.

CHEM:6990 Research Seminar 0-1 s.h.
Presentation and discussion of thesis research for advanced degrees.