Courses

CHEMISTRY

College of Natural Science

Credit cannot be earned in more than one course of each of the following groups: 141 and 151; 143, 241, and 351; 142 and 352; 245 and 355; 246 and 356; 361 and 383; 363 and 385; 384 and 461.

With department approval, students with advanced placement credit in CEM 151 and 161 may enroll in CEM 181H and 184H. Those with advanced placement credit in CEM 152 may enroll in CEM 183H, and those with advanced placement credit in CEM 153 may enroll in CEM 185H and 186H. CEM 181H-182H-183H is a more advanced treatment of material in CEM 151-152-153. CEM 184H-185H-186H is a more advanced treatment of material in CEM 161-162-163. Students with credit in an honors chemistry course may not enroll in the corresponding nonhonors course.

139. Selected Topics in Introductory Chemistry
Fall, Winter, Spring, Summer. 1 to 3 credits. May reenroll for a maximum of 7 credits. Previous college chemistry, approval of department.

Self-instructional units from CEM 140, CEM 141A, CEM 141B (or equivalent) selected and approved by the department for individual students with special needs.

140. Introductory Chemistry
Fall, Winter, Spring, Summer. 2 credits. Self-scheduled instruction only. MTH 108 or MTH 111 or concurrently. CEM 140 or satisfactory chemistry placement test score.

Chemical symbols, formulas, equations, stoichiometry, structure of atoms, bonding, states of matter, solutions.

141. Chemical Principles
(CEM 141A, CEM 141B.) Fall, Winter, Spring, Summer. 4(3-0) MTX 108 or MTH 111 or concurrently. CEM 140 or satisfactory chemistry placement test score.

Chemical principles: stoichiometry, mole concept, atomic and molecular structures, states of matter, gases, crystals, structure, solutions, kinetics, thermodynamics, acids and bases, aqueous equilibrium.

141B. Chemical Principles
Fall, Winter, Spring, Summer. Fall 4(4-0); Winter, Spring, Summer. 4 credits. Self-scheduled instruction only. MTH 108 or MTH 111 or concurrently. CEM 140 or satisfactory chemistry placement test score.

Chemical principles for students in biological, health-related, and agricultural disciplines. Approved through Fall 1990.

151. Principles of Chemistry I
Fall, Winter. 4(3-0) MTH 108 or MTH 111 or concurrently. CEM 140 or satisfactory chemistry placement test score.

First of a 3-term sequence for science majors, chemical engineering students, and others desiring a comprehensive general chemistry sequence. Atomic and molecular structures, stoichiometry, solids, liquids, and gases.

152. Principles of Chemistry II
Winter, Spring. 3(3-0) MTH 112 or concurrently. CEM 151 or CEM 141A or CEM 141B or CEM 181H.

Continuation of CEM 151. Chemical thermodynamics; kinetics, acids, bases, and aqueous equilibria; electrochemistry.

153. Introductory Inorganic Chemistry
Fall, Spring. 3(3-0) CEM 152 or CEM 182H.

Continuation of CEM 152. Descriptive inorganic chemistry with further discussion of bonding.

161. Introductory Chemistry Laboratory
Fall, Winter, Spring, Summer. 1(0-6) Concurrently. MTH 111 or concurrently; approval of department.

Self-instructional units from CEM 140, CEM 141A, CEM 141B (or equivalent) selected and approved by the department for individual students with special needs.

162. Quantitative Analysis
Fall, Winter, Spring, Summer. 3(1-6) Concurrently. CEM 141A or CEM 141B or CEM 151 or CEM 181H or CEM 161 or CEM 184H. Laboratory work in quantitative chemistry.

163. Introductory Inorganic Laboratory
Spring. 3(0-6) Concurrently. Laboratory work in quantitative chemistry.

181H. Honors Chemistry I—Principles
Fall, 4(4-0) A average in high school chemistry, physics and mathematics; CEM 112 or MTH 122 concurrently. Results of examination during orientation; approval of department.

Subatomic, atomic and molecular structure; quantum theory and bonding; experimental methods of structure determination; states of matter; nuclear chemistry.

182H. Honors Chemistry II—Principles
Winter. 4(4-0) CEM 181H with grade of 3.6 or better and/or approval of department. MTH 113 or MTH 123 concurrently.

Kinetic theory of gases, thermodynamics, chemical equilibria, electrochemistry, chemical kinetics, properties of solutions, macromolecular chemistry.

183H. Honors Chemistry III—Inorganic Chemistry
Spring. 3(0-3) CEM 182H with grade of 3.0 or better and/or approval of department. Descriptive inorganic chemistry by periodic group of elements. Nomenclature, bonding, stereochemistry, and reactions of compounds of the representative and transition elements.

184H. Honors Chemistry Laboratory I
Fall. 1(0-3) CEM 181H concurrently; approval of department. Techniques of measurement; errors and significant figures; experiments related to atomic and molecular structure.

185H. Honors Chemistry Laboratory II
Winter. 2(0-6) CEM 184H; CEM 182H concurrently. Explores techniques related to gas behavior, thermodynamics, electrochemistry, chemical kinetics and properties of solutions.

186H. Honors Chemistry Laboratory III
Spring. 2(0-6) Approval of department.

Self-instructional units from CEM 140, CEM 141A, CEM 141B (or equivalent) selected and approved by the department for individual students with special needs.

241. Organic Chemistry
Fall, Winter, Summer. 4(4-0) CEM 141A or CEM 141B or CEM 152 or CEM 181H; CEM 161 or CEM 184H.

Common classes of organic compounds with emphasis on nomenclature, structural principles, reactions and reaction mechanisms.

242. Organic Chemistry Laboratory
Fall, Winter, Spring. 4(4-0) CEM 241.

Continuation of CEM 241 with emphasis on polyfunctional compounds, particularly groups of compounds having biological significance.

243. Organic Chemistry Laboratory
Fall, Winter. 1(0-3); CEM 241 concurrently.

Introduction to standard organic laboratory techniques.

244. Organic Chemistry Laboratory
Fall, Winter, Spring, Summer. 1(0-3); CEM 241 concurrently.

Organic preparations and qualitative analysis.

245. Organic Chemistry
Fall, Winter, Spring. 4(4-0) CEM 242.

Selected topics of organic chemistry, especially compounds of biological interest, discussed with emphasis on mechanisms and stereochemistry. Topics include polymers, amino acids, proteins, sugars, terpenes, steroids, and alkaloids.

333. Instrumental Methods
Spring. 4(2-6) CEM 143 or CEM 241 or CEM 351; CEM 182.

Principles, applications of separation and instrumental analysis. Atomic emission, absorption, fluorescence spectroscopy, UV, visible, IR, NMR, X-ray crystal structure; solutions, gases and liquid phase chromatography; electro-analytical chemistry; electrophoresis, radiochemistry.

351. Organic Chemistry
Fall. 3(3-0) CEM 152 or CEM 182H.

A comprehensive introduction to the fundamentals of organic chemistry designed for chemistry majors but open to others who desire a rigorous, modern treatment of the subject.

352. Organic Chemistry
Winter. 3(3-0) CEM 351.

Continuation of CEM 351.

353. Organic Chemistry
Spring. 3(4-0) CEM 352.

Continuation of CEM 352.

354. Organic Chemistry Laboratory
Winter. 2(0-6) CEM 182 or CEM 185H; CEM 241 or CEM 351.

Introduction to modern organic laboratory techniques.
Chemistry — Descriptions of Courses

355. Organic Chemistry Laboratory
Spring. 2(0-6) CEM 352, CEM 354.
Application of modern organic laboratory techniques to organic synthesis and analysis.

356. Organic Chemistry Laboratory
Fall. 2(0-6) CEM 355.
Advanced organic syntheses, qualitative organic analysis, and practical literature searching.

361. Chemical Thermodynamics
Fall. 3(4-0) One year general chemistry, one year general physics; MTH 215.

362. Analytical-Physical Chemistry I
Winter. 3(4-0) CEM 361.
Applications of thermodynamics. Activity coefficients, ionic solutions, cell potentials, ionic equilibria including acid-base, complexation, solubility and redox equilibria, phase equilibria, distillation, extraction, chromatography.

363. Analytical-Physical Chemistry II
Spring. 3(4-0) CEM 362.
Chemical kinetics. Homogeneous kinetics, reaction mechanisms, temperature dependence of reaction rates, transport processes, heterogeneous kinetics, electrode kinetics, X-ray diffraction, crystal structure.

372. Analytical-Physical Chemistry Laboratory I
Winter. 2(1-3) CEM 162; CEM 383, or CEM 381.
Electronics and chemical instrumentation; spectroscopy, optical methods and lasers.

373. Analytical-Physical Chemistry Laboratory II
Spring. 2(1-3) CEM 372.
Instrumental measurements. Electrode potentials, chromatography, spectrophotometry, electrolytic conductance, solution kinetics.

383. Physical Chemistry Introductory
Fall, Summer. 3(4-0) CEM 143 or CEM 241 or CEM 351; MTH 115.
Classical and chemical thermodynamics. Introduction to the laws and their applications in treating chemical reactions, pure substances, ideal and non-ideal mixtures, and colligative properties.

384. Physical Chemistry: Introductory
Spring. 3(4-0) CEM 383.
Atomic and molecular structure. Atomic and molecular orbitals and chemical bonding. Rotaional, vibrational and electronic spectra, nuclear magnetic resonance and electron spin resonance.

385. Physical Chemistry: Introductory
Winter. 3(4-0) CEM 382.

400H. Honors Work
Fall, Winter, Spring. 1 to 3 credits. May reenroll for a maximum of 18 credits. Seniors, approval of department.
Assigned reading and investigation in chemistry under the supervision of the staff. The program will include some creative work.

411. Inorganic Chemistry I
Fall. 3(3-0) CEM 385 or CEM 363.
Principles of structure and bonding in inorganic chemistry, crystal symmetry, coordination chemistry, solvent systems, hydrogen bonding and selected examples from the chemistry of various elements.

412. Inorganic Chemistry II
Winter. 3(3-0) CEM 411.
Inorganic chemistry viewed in a variety of examples of reactions, structure, mechanisms, etc., from representative main group elements and transition elements.

419. Problems and Reports
Fall, Winter, Spring, Summer. 1 to 8 credits. May reenroll for a maximum of 8 credits. Students may not reenroll if they have an outstanding DF in CEM 410. Approval of department.

430. Introduction to Radioactivity and Radiosotope Techniques
(PHY 430.) Spring. 3(3-0) One year each of general college chemistry and physics.
Elementary nuclear processes and properties with emphasis on radioactivity, its measurement, and its interaction with matter. Effects of radiation on chemical and biological systems. Applications of nuclear technology; safety and environmental factors. Fundamentals of nuclear models, reactions and decay mechanisms. Basic principles of nuclear reactors and accelerators.

431. Laboratory for Radioactivity and Radiosotope Techniques
(PHY 431.) Spring. 110-3; CEM 161. PHY 430 concurrently. CEM 162 recommended.
Introduction to nuclear instrumentation. Experimental techniques for application of radioisotopes to problems in chemistry, the life sciences, and industry.

461. Theoretical Chemistry I
Fall. 3(4-0) One year general chemistry, one year general physics; MTH 215.

462. Theoretical Chemistry II
Winter. 3(4-0) CEM 361, CEM 461.
Spectroscopy and molecular structure. Electronic, infrared, Raman, and microwave spectroscopy, magnetic susceptibility and magnetic resonance, statistical mechanics, statistical thermodynamics, kinetic theory of gasses, absolute rate theory.

471. Analytical-Physical Chemistry Laboratory III
Fall. 2(0-6) CEM 363, CEM 373.
Kinetics, operational amplifiers, polarography, coulometry, electrochemical kinetics, stopped-flow kinetics, digital measurements, neutron activation.

472. Analytical-Physical Chemistry Laboratory IV
Winter. 2(0-6) CEM 461, CEM 471.
Molecular properties. Mass spectrometry, nuclear and electron spin resonance spectroscopy, infrared Raman, and microwave spectroscopy, dipole moments, magnetic susceptibility.

499. Seminar on Chemical Physics
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. One year of analytical-physical chemistry, MTH 215, PHY 428.
Literature of chemical physics through oral reports on selected journal articles in the area.

510. Advanced Inorganic Chemistry
Fall. 3(3-0) Approval of department.
Structure, bonding, and reactivity patterns of inorganic compounds, with emphasis on non-metallic elements and reactions in non-aqueous media.

511. Symmetry, Group and MO Theory
Winter. 3(3-0) Approval of department.
Applications of group and molecular orbital theory to chemical bonding, structure and reactions.

513. Advanced Inorganic Chemistry — Metals
Spring. 3(3-0) CEM 411.
Continuation of CEM 411 with emphasis on the structure and chemistry of the metals.

533. Analytical Spectroscopy
Spring. 3(3-0) Approval of department.

534. Advanced Analytical Chemistry
Fall. 3(3-0) Approval of department.
Consideration of principles and equilibria pertaining to aqueous and non-aqueous neutralization, redox and complex reactions and the various separation techniques employed in analyses.

535. Spectrochemical Methods of Analysis
Winter. 3(0-6) or 4(3-4) Approval of department.
Principles and applications of atomic absorption, emission, fluorescence; arc and spark emission spectroscopy; UV, visible, IR spectroscopy; spectrophotometric titrations; reaction rate methods; molecular fluorescence, phosphorescence spectrometry; other optical spectrometric methods.

536. Separations
Spring of odd-numbered years. 3(3-0) Approval of department.
Physical and chemical methods of separation.

537. Electroanalytical Chemistry
Spring of even-numbered years. 3(3-0) Approval of department.
Theory and applications of modern electroanalytical chemistry to chemical and biomedical problems. Coulometry, electrotitration, ion-selective voltammetry; electrochemical synthesis and preparation of species for spectroscopy; trace analysis.

538. Scientific Instrumentation
Fall, Spring, Summer. 3(1-6) May reenroll for a maximum of 9 credits. Approval of department.
Scientific measurements. Principles and applications of servo systems, operational amplifiers, linear and digital solid state devices, analog, digital and hybrid instrumentation systems, and minicomputers for scientific measurements.
844. Structural Elucidation by Instrumental Methods
Fall. 3(3-0) Approval of department.
A practical instrumental analysis course with the major emphasis on the interpretation of data rather than a detailed description of the instrumentation. The fundamental principles behind the various measurements will be discussed in a general way, and important instrumental limitations will be noted.

Fall. 3(3-0) CEM 353; CEM 492 or approval of department.
Organic reactions are presented in a mechanistic framework. Reactions which proceed via carbanions, carbocations, free radicals, carbenes, andenes and other reactive intermediates, and concerted reactions are included.

881. Structure of Organic Compounds
Winter. 3(3-0) CEM 860 or approval of department.
Structural and stereochemical principles will be developed and illustrated. Spectroscopic data will be used to illustrate the principles and to determine structure, with an emphasis on nuclear magnetic resonance spectroscopy.

924. Selected Topics in Analytical Chemistry
Fall, Winter, Spring. 3(3-0) or 2(2-0)
May reenroll for a maximum of 3 credits if different topic is taken. Among topics which may be discussed are: advances in electroanalytical chemistry or spectroscopy; nonaqueous solvents; complexation equilibria; surface chemistry; analytical chemistry of polymers.

935. Seminar in Analytical Chemistry
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Discussions of recent advances and reports by graduate students on research problems.

958. Seminar in Organic Chemistry
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Discussions of recent advances and reports by graduate students on research problems.

985. Statistical Thermodynamics
Winter. Spring. 3(3-0) May reenroll for a maximum of 9 credits if different topic is taken. Approval of department.

998. Seminar in Physical Chemistry
Fall, Winter, Spring. 1(1-0) May reenroll for a maximum of 3 credits. Discussions of recent advances and reports by graduate students on research problems.

CHINESE
See Linguistics and Germanic, Slavic, Asian and African Languages.

CIVIL AND ENVIRONMENTAL ENGINEERING

College of Engineering
Civil Engineering

280. Introduction to Environmental Engineering
Fall. Spring. 4(4-0) ECE 214, or ECE 121, MTH 112, ECE 112 or CPS 251.
Hydrology; ground water and surface water supply systems; wastewater treatment; methods of pollution control for solid waste, air, and noise.

305. Structural Analysis I
Fall, Winter. 3(3-0) MME 211.
Stability and determinacy; linearity. Plane trusses; shear and bending in beams and frames. Virtual work calculation of forces and displacements in statically-determinate plane structures.

306. Structural Analysis II
Winter. Spring. 3(3-0) C E 205.

308. Engineering Materials I
Fall, Winter. Spring. 4(3-3) MME 211 or concurrently.
Structure; composition; physical, mechanical and rheological properties of non-metallic construction materials. Emphasis on aggregates, asphalt, inorganic cements, concrete, and wood.