BZ 594 Var [1-3]. Independent Study.

***BZ 642 03(3-0-0). Plant Metabolism.** F. Prerequisite: BC 351, BZ 440.

Biosyntheses and transformations of important plant metabolites.

BZ 692A-G Var [1-3]. Seminar.

A) Behavior. B) Development. C) Ecology. D) Genetics. E) Ornithology. F) Limnology. G) Evolution.

BZ 695 Var [1-3]. Independent Study.

BZ 698 Var. Research.

BZ 699 Var. Thesis.

BZ 784 Var [1-3]. Supervised College Teaching. F, S, SS. Maximum of 6 credits allowed in course.

BZ 792 01(0-0-1). Seminar.

BZ 795 Var [1-3]. Independent Study.

BZ 798 Var. Research.

BZ 799 Var. Dissertation.

CHEMISTRY COURSES

Department of Chemistry
College of Natural Sciences

C CC 103 03(3-0-0). Chemistry in Context. F, S, SS. For students who do not plan to take additional courses in chemistry.

Chemistry, chemical principles from more conceptual, less mathematical perspective; how chemical substances, chemical reactions affect our daily lives.

C CC 104 01(0-3-0). Chemistry in Context Laboratory. F, S, SS. Prerequisite: C/C CC 103 or concurrent registration.

Laboratory applications of principles covered in C CC 103.

C CC 107 04(4-0-0). Fundamentals of Chemistry. F, S, SS. Prerequisite: M/M CC 117 or M/M CC 120A-B or placement in M/M CC 121 or higher. For students in science-related programs requiring a year of chemistry. Quantitative reasoning but with less focus on mathematical calculations than C/C CC 111/C 113. Credit not allowed for both C/C CC 107 and C/C CC 111.

Atomic/molecular theory, gases, liquids, solids, solutions, acid/ base and oxidation/reduction reactions, kinetics, selected topics.

C CC 108 01(0-3-0). Fundamentals of Chemistry Laboratory. F, S, SS. Prerequisite: C/C CC 107 or concurrent registration. Credit not allowed for both C/C CC 108 and C/C CC 112.

Laboratory applications of principles presented in C CC 107.

C CC 111 04(3-0-1). General Chemistry I. F, S, SS. Prerequisite: M/M CC 118 or M/M CC 121 or placement in M/M CC 124 or higher. Intended for science majors. Students should complete the sequence: C/C CC 111, C/C CC 112, C 113 and C 114. Credit not allowed for both C/C CC 111 and C/C CC 107.

Fundamental aspects of chemistry and chemical principles; emphasis on structure, bonding, and stoichiometry.

C CC 112 01(0-3-0). General Chemistry Laboratory I. F, S, SS. Prerequisite: C/C CC 111 or concurrent registration. Credit not allowed for both C/C CC 112 and C/C CC 108.

Laboratory applications of principles covered in C CC 111.

C 113 03(3-0-0). General Chemistry II. F, S, SS. Prerequisite: C/C CC 107 or C/C CC 111; M/M CC 124 or M/M CC 141 or M/M CC 155 or M/M CC 160 or concurrent registration in M/M CC 155 or M/M CC 160.

Acid/base equilibria, kinetics, thermodynamics, solubility, oxidation-reduction reactions, electrochemistry, selected topics.

C 114 01(0-3-0). General Chemistry Laboratory II. F, S, SS. Prerequisite: C/C CC 112; C 113 or concurrent registration.

Laboratory applications of principles covered in C 113.

C CC 192 02(0-0-2). Introductory Seminar in Chemistry. F.

Small-group discussions of aspects of University life and of chemistry.

C 245 04(4-0-0). Fundamentals of Organic Chemistry. F, S, SS. Prerequisite: C/C CC 107 or C 113. Credit not allowed for both C 245 and C 341. Intended for students in science-related programs requiring a year of chemistry. For students who need only one semester of organic chemistry.

Nomenclature, structure, bonding, reactions, mechanisms, synthesis, stereochemistry of organic compounds.

C 246 01(0-3-0). Fundamentals of Organic Chemistry Laboratory. F, S. Prerequisite: C/C CC 108 or C/C CC 112 or C 114; C 245 or concurrent registration. Credit not allowed for both C 246 and C 344. Special fee, $20.

Laboratory applications of principles presented in C 245.

C 261 03(3-0-0). Fundamentals of Inorganic Chemistry. S. Prerequisite: C 113.

Preparation, structures, properties, and reactions of chemical elements and inorganic compounds; periodic trends, organizing principles; applications.

C 331 03(3-0-0). Quantitative Analysis. F, S. Prerequisite: C 113.

Volumetric, spectrophotometric, electrochemical methods of analysis; analytical applications of acid-base, solubility, redox, and complex ion equilibria.

C 332 02(0-6-0). Quantitative Analysis Laboratory. F, S. Prerequisite: C 114 and C 335 or concurrent registration. Special fee, $20.

Laboratory applications of principles presented in C 335.

C 334 01(0-3-0). Quantitative Analysis Laboratory. F, S. Prerequisite: C 114; C 331 or concurrent registration. Special fee, $20.

Laboratory applications of principles presented in C 331.

C 335 03(3-0-0). Introduction to Analytical Chemistry. F. Prerequisite: C 113 with grade of "C" or better.

Modern and classical applications and methods in analytical chemistry including statistical, kinetic, spectroscopic, and chromatographic analysis.

C 340 04(3-3-0). Honors Organic Chemistry I. F. Prerequisite: C 113, C 114. Participation in the University Honors Program. Intended for science majors. Students should plan to complete the sequence C 340, C 342.

Structure, nomenclature, dynamics, spectroscopy, reactions of organic molecules. Laboratory applications of principles presented in lecture.

C 341 03(3-0-0). Organic Chemistry I. F, S. Prerequisite: C 113. Intended for science majors. Students should plan to complete the sequence, C 341, C 343, and C 344.

Structure, nomenclature, dynamics, spectroscopy, reactions of organic molecules.

C 342 04(3-3-0). Honors Organic Chemistry II. S. Prerequisite: C 340. Participation in the University Honors Program. Intended for science majors. Students should plan to complete the sequence C 340, C 342.

Continue studies of reactions and mechanisms of organic molecules. Laboratory applications of principles presented in lecture.

C 343 03(3-0-0). Organic Chemistry II. F, S. Prerequisite: C 341.

Continue studies of reactions and mechanisms of organic molecules.

C 344 02(0-6-0). Organic Chemistry Laboratory. F, S. Prerequisite: C 114; C 343 or concurrent registration. Credit not allowed for both C 344 and C 246. Special fee, $20.

Laboratory applications of principles presented in C 341/C 343.

C 384 Var [1-3]. Supervised College Teaching. F, S, SS. Prerequisite: Twenty credits in chemistry, written consent of department head. Maximum of 10 credits allowed in course. Maximum of 12 credits for any combination of C 384, C 487, C 495, C 498.

C 431 04(3-3-0). Instrumental Analysis. F. Prerequisite: C 332 or C 334; C 471 or C 474 or concurrent registration.

Instrumental methods of chemical analysis.

EC 433 03(2-3-0). Clinical Chemistry. S. Prerequisite: C 245 or C 332 or C 334; one semester of biochemistry.

Principles and methodology of clinical chemistry. Laboratory experience in methodology and method development.

C 440 02(0-6-0). Advanced Organic Chemistry Laboratory. F. Prerequisite: C 343, C 344. Special fee, $20.

Advanced techniques in organic synthesis, mechanisms of reactions, structure determination.

C 461 03(3-0-0). Inorganic Chemistry. S. Prerequisite: C 261; C 476 or concurrent registration.

Concepts, models to explain structural, spectroscopic, magnetic, thermodynamic, and kinetic properties of inorganic compounds; symmetry, group theory.

C 462 02(0-6-0). Inorganic Chemistry Laboratory. S. Prerequisite: C 461 or concurrent registration.

Synthetic techniques and instrumental methods in inorganic chemistry.

C 471 04(4-0-0). Fundamentals of Physical Chemistry. F. Prerequisite: C 113; M/M CC 161 or M/M CC 255; PH/PHCC 122 or PH/PHCC 142. Credit not allowed for both C 471 and C 474.

Thermodynamics; electrolyte solutions; transport phenomena; kinetics, quantum theory, molecular structure, spectroscopy, statistical thermodynamics.

C 472 04(4-0-0). Physical Chemistry for Engineers. F. Prerequisite: C 113, M 261, PH/PHCC 142.

Methods and applications of physical chemistry including quantum chemistry, statistical mechanics, thermodynamics, and kinetics.

C 474 03(3-0-0). Physical Chemistry I. F. Prerequisite: C 113, M 261, PH/PHCC 142. Credit not allowed for both C 474 and C 471.

Quantum chemistry; applications to bonding, molecular structure, and spectroscopy.

C 476 03(3-0-0). Physical Chemistry II. S. Prerequisite: C 474.

Statistical thermodynamics; applications to phase and chemical equilibria; kinetics.

C 478 02(0-6-0). Physical Chemistry Laboratory. S. Prerequisite: C 471 or C 474; and C 332 or C 334 or CH 333.

Planning and execution of physicochemical experiments; interpretation and presentation of experimental data; formal laboratory reports.

C 487 Var. Internship. Prerequisite: C 476. Maximum of 12 credits allowed for any combination of C 384, C 487, C 495, C 498.

Supervised work experience in approved off-campus chemical laboratory setting. Consultation with faculty adviser/instructor.

C 493 02(0-0-2). Seminar. Prerequisite: C 474.

Critical analyses of selected literature; develop presentation of technical topic; required oral presentation.

C 495 Var [1-3]. Independent Study. Prerequisite: Twenty credits in chemistry, written consent of laboratory mentor and department chair. Maximum of 12 credits for any combination of C 384, C 487, C 495, C 498.

C 498 Var [1-3]. Research. Prerequisite: Twenty credits in chemistry, written consent of research mentor and department chair. Maximum of 12 credits for any combination of C 384, C 487, C 495, C 498.

Supervised laboratory research in chemistry; written report required.

C 511 03(3-0-0). Solid State Chemistry. F. Prerequisite: C 461, C 476.

Physical and descriptive chemistry of solids including characterization and synthetic methods.

***C 515 03(3-0-0). Polymer Chemistry.** S. Prerequisite: C 343, C 476.

Fundamentals of polymer chemistry: synthesis, characterization, physical properties.

***C 517 03(3-0-0). Chemistry of Electronic Materials.** F. Prerequisite: C 571 or concurrent registration.

Chemical aspects of preparation and processing of materials in electronic devices, "molecular electronics," and nanostructured materials.

C 531 03(3-0-0). Advanced Chemical Analysis I. F. Prerequisite: C 431 or concurrent registration.

Chemical equilibria, electrochemistry, analytical separations, introduction to molecular spectroscopy.

C 532 03(3-0-0). Advanced Chemical Analysis II. S. Prerequisite: C 431.

Advanced optics; instrumentation and methodology for analytical spectroscopy; computer applications.

***C 537 03(3-0-0). Electrochemical Methods.** S. Prerequisite: C 531.

Theory and methods of electrochemistry; applications of modern electrochemical techniques.

***C 539A-C 01(1-0-0). High Resolution NMR Analysis of Liquids.** S. Prerequisite: C 343, C 474.

A) Basic NMR principles. B) 1D and 2D NMR concepts and principles. C) Advanced NMR techniques.

C 541 03(3-0-0). Organic Spectroscopy. SS. Prerequisite: C 440.

Organic structure determination by spectroscopic methods.

C 543 03(3-0-0). Structure/Mechanisms in Organic Chemistry. F. Prerequisite: C 343.

Structure including stereochemistry and conformational isomerism; reactivity and mechanisms in organic chemistry.

C 545 03(3-0-0). Synthetic Organic Chemistry I. S. Prerequisite: C 543.

Reactions and synthesis in organic chemistry.

C 547 03(3-0-0). Physical Organic Chemistry. S. Prerequisite: C 543.

Mechanisms, theory, kinetics, and thermodynamics.

C 549 03(3-0-0). Synthetic Organic Chemistry II. F. Prerequisite: C 545.

Modern synthetic methods. Strategies for total synthesis of natural products.

C 551 03(3-0-0). Organometallic Chemistry. F, S. Prerequisite: C 343.

Descriptive and mechanistic organometallic chemistry applied to homogeneous catalysis and organic synthesis.

C 561 03(3-0-0). Inorganic Synthesis. F, S. Prerequisite: Written consent of instructor.

Chemistry of compounds of representative elements and transition metals.

C 563A-F 01(1-0-0) Physical Methods in Inorganic Chemistry. F, S. Prerequisite: C 561.

A) Group theory. B) Vibrational spectroscopy. C) Electronic structure and magnetism. D) Magnetic spectroscopies. E) Advanced nuclear magnetic resonance spectroscopy. F) Other structural methods.

***C 565 03(3-0-0). Inorganic Mechanisms.** F. Prerequisite: C 476 or written consent of instructor.

Fundamental tools, key principles, selected classic case histories of inorganic and organometallic mechanistic chemistry, emphasizing kinetic methods.

C 567 01(1-0-0). Crystallographic Computation. F, S, SS. Prerequisite: C 476.

Theory and practice of structural computations using single crystal X-ray diffraction data.

***C 569 03(3-0-0). Chemical Crystallography.** S. Prerequisite: C 476.

Theory and practice of determination of crystal and molecular structure by single crystal X-ray and neutron diffraction.

C 570 03(3-0-0). Chemical Bonding. F. Prerequisite: C 476.

Chemical bonding models; basis set expansion approach; origins of perturbation methods; electron correlation.

C 571 03(3-0-0). Advanced Physical Chemistry. F. Prerequisite: C 476.

Quantum chemistry: simple systems, symmetry, approximation methods, molecular structure. Statistical mechanics: molecular thermodynamics, absolute rate theory.

***C 575 03(3-0-0). Chemical Thermodynamics.** F. Prerequisite: C 476.

Thermodynamic concepts and their applications to chemical problems.

C 576 03(3-0-0). Statistical Mechanics. S. Prerequisite: C 476 or written consent of instructor.

Principles of statistical mechanics with application in the chemical sciences.

EC 577 03(3-0-0). Surface Chemistry. S. Prerequisite: C 472 or C 476.

Capillarity; interfacial thermodynamics, electrical aspects of surface chemistry, adsorbed layers.

EC 579 03(3-0-0). Chemical Kinetics. F. Prerequisite: C 476.

Elementary reactions, unimolecular reactions, reactions in solution, gas phase ion chemistry, photochemistry, and kinetic modeling.

C 641 02(2-0-0). Organic Reaction Mechanisms. S. Prerequisite: C 545.

Organic reaction mechanisms, including using arrows to show electron movement; heterolytic, radical, and pericyclic reactions.

C 651A-D Var [1-4]. Special Topics in Chemistry. F, S. Prerequisite: Written consent of instructor.

A) Analytical chemistry. B) Inorganic chemistry. C) Organic chemistry. D) Physical chemistry.

C 695 Var [1-3]. Independent Study.

C 699 Var [1-15]. Thesis.

C 702 01(0-0-1). Independent Research Proposal. F, S. Prerequisite: Admission to Ph.D. candidacy.

Preparation, submission, and defense of an independent research proposal; creative and original thinking about research problems in modern chemistry.

C 751 01(1-0-0). Methods of Chemistry Laboratory Instruction. F.

Basic materials, methods, and skill development related to teaching undergraduate chemistry laboratory courses.

C 752 01(0-0-1). Advanced Methods of Chemistry Instruction. S. Prerequisite: C 751 or written consent of instructor.
Advanced materials, methods, and presentation skills development related to teaching undergraduate chemistry courses.

EC 771 03(3-0-0). Quantum Mechanics I-Chemical Bonding. S. Prerequisite: C 571.
Principles; Hartree-Fock approach; Roothaan's equations; molecular orbital methods; approximation techniques.

***C 773 03(3-0-0). Quantum Mechanics II-Spectroscopy.** S. Prerequisite: C 571.
Time-dependent perturbation theory; selection rules; vibrational, rotational, and electronic spectroscopy; magnetic resonance.

C 784 Var [1-2]. Supervised College Teaching. F, S, SS.

C 793 01(0-0-1). Seminar.

C 795A-D Var [1-5]. Independent Study.
A) Inorganic chemistry. B) Analytical chemistry. C) Biological chemistry. D) Physical chemistry.

C 798 Var. Research.
Proposal preparation outlining an original research idea.

C 799 Var [1-15]. Dissertation.

CIVIL ENGINEERING COURSES

Department of Civil Engineering
College of Engineering

CE 104 01(0-3-0). Surveying. F. Prerequisite: M/M CC 125.
Surveying fundamentals for civil engineering applications; leveling, horizontal and vertical control, horizontal curves, instrument operation, errors.

CE 105 01(1-0-0). Civil Engineering Computing. F, S.
Equation solver software with emphasis on TK Solver and applications in civil engineering.

CE 106 02(2-0-0). Introduction to Engineering Computer Graphics. F, S. Prerequisite: M/M CC 125.
Creation and production of engineering drawings using AutoCad, including layering, annotated, and three-dimensional drawings.

CE 108 03(2-3-0). Civil Engineering Principles I. F.
Civil engineering profession, computer applications and programming related to civil engineering; introduction to surveying.

CECC 192 03(2-2-0). Civil Engineering Principles II. S. Prerequisite: CE 108.
Introduction to the profession and academia; principles of civil engineering design; graphical, oral, and written communication; team projects.

CE 204/EV 204 03(2-2-0). Agricultural and Environmental Measurements. S. Prerequisite: PH/PHCC 110 or PH/PHCC 141. Credit not allowed for both CE 204 and EV 204.
Measurement techniques for analysis and design of agricultural and environmental systems based on engineering principles.

CECC 208 03(2-2-0). Civil Engineering Analysis I. F. Prerequisite: CE 109/ CECC 192.
Theory and use of measurements and mapping: infrastructure basics and design tools; risks and statistical variabilities in civil engineering.

CE 209 03(2-2-0). Civil Engineering Analysis II. S. Prerequisite: C/C CC 111, CE 208, CE 260.
Behavior and properties of construction materials, instrumentation, use of statistical tools, material standards, material selection, quality control.

CE 260 03(3-0-0). Engineering Mechanics-Statics. F, S. Prerequisite: M/M CC 160, PH/PHCC 141.
Forces using vector notation; static equilibrium of rigid bodies; friction, virtual work, centroids, and moments of inertia.

CE 261 03(3-0-0). Engineering Mechanics-Dynamics. F, S. Prerequisite: CE 260; CE 108 or CBCC/CHCC 192 or ME 101/ MECC 192.
Kinematics and kinetics of particles and rigid bodies; concepts of work-energy and impulse-momentum; computer applications; vector notation.

CE 262 04(3-2-0). Engineering Mechanics. F. Prerequisite: M/M CC 161, PH/PHCC 141.
Forces, static equilibrium, mass center, moments of inertia, kinematics and kinetics of particles and rigid bodies.

CE 300 04(3-3-0). Fluid Mechanics. F, S. Prerequisite: CE 261 or CE 262, ME 237.
Fluid properties; statics, kinematics, and dynamics of fluid motion including viscous and gravitational effects.

CE 308 03(2-2-0). Civil Engineering Synthesis I. F. Prerequisite: CE 209; concurrent registration in CE 300.
Civil engineering systems, simulation and optimization techniques, statistical tools and their use in civil engineering, risk analysis.

CE 309 03(2-2-0). Civil Engineering Synthesis II. S. Prerequisite: CE 308.
Civil engineering infrastructure systems, numerical and decision analysis techniques, statistical and risk analysis, project management.

CE 322/EV 322 03(3-0-0). Basic Hydrology. F, S. Prerequisite: CE 300 or CH 331 or ER 416, ST/STCC 301 or ST/STCC 309 or CE 308; or written consent of instructor. Credit not allowed for both CE 322 and EV 322.
Hydrologic cycle, soil moisture, groundwater, runoff processes, water contamination, applications in water resources and environmental engineering.

CE 350 03(2-3-0). Soil Engineering for Nonengineers. F, S. Prerequisite: CE 359.
Concepts of soil mechanics and soil behavior, elementary application to compaction, seepage, earth pressure, foundations, and slopes.