Chemistry (CH)

Courses

CH 111. Introduction to Chemical Principles. 4 Credits.
Introduction to modern chemistry with emphasis on problem-solving skills and critical thinking. Fundamental mathematical techniques and skills are incorporated to illustrate the quantitative aspects of chemistry.
Requisites: Prereq: Satisfactory placement test score for MATH 111Z; Coreq: MATH 111Z.
Additional Information:
Science Area

CH 113. The Chemistry of Sustainability. 4 Credits.
Illustrates how chemistry provides innovative materials, processes, and consumer products that support sustainable solutions related to energy utilization, global warming and pollution prevention.
Requisites: Prereq: MATH 101 or higher; high school chemistry.
Additional Information:
Science Area

CH 196. Field Studies: [Topic]. 1-2 Credits.
A series of practical experiences on or off campus to understand principles or develop skills in performing selected tasks.
Repeatable 99 times

CH 198. Workshop: [Topic]. 1-2 Credits.
An intensive experience, limited in scope and time, in which a group of students focus on skills development rather than content mastery.
Repeatable 99 times

CH 199. Special Studies: [Topic]. 1-5 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 217. Chemistry Tools I. 1 Credit.
This course will introduce skills needed for success in chemistry and related sciences. Topics will include scientific writing, library and database searching, basic computer skills, the use of AI tools, and scientific ethics. This course is a sequence with CH 227Z, CH 228Z and CH 218, and CH 229Z and CH 219. Concurrent registration in CH 227Z required.
Requisites: Coreq: CH 227Z.

CH 218. Chemistry Tools II. 1 Credit.
This course is the second in a three-course sequence (CH 217/CH 218/CH 219) and will continue to develop skills needed for success in chemistry and related sciences. Topics will include data and error analysis, data presentation, library and database searching, and scientific writing. Concurrent registration in CH 228Z required.
Requisites: Coreq: CH 228Z.

CH 219. Chemistry Tools III. 1 Credit.
This course is the third in a three-course sequence (CH 217/CH 218/CH 219) and will further develop skills needed for success in chemistry and related sciences. Topics will include use of productivity and file management software, data and error analysis, presentation of scientific data, and scientific writing. Concurrent registration in CH 229Z required.
Requisites: Coreq: CH 229Z

CH 221Z. General Chemistry I. 4 Credits.
Explores and applies principles and applications of chemistry. Emphasis on measurement, components of matter, atomic and molecular structure, quantitative relationships including foundational stoichiometry, and major classes of chemical reactions. CH 221Z is a lecture course; CH 227Z is the laboratory component. Sequence with CH 222Z, CH 223Z.
Requisites: Prereq: CH 111 or satisfactory placement score; MATH 111Z. Coreq: MATH 112Z; CH 227Z recommended.
Equivalent to: CH 221, CH 224H
Additional Information:
Science Area

CH 222Z. General Chemistry II. 4 Credits.
Explores and applies principles presented in CH 221Z to the study of the solid, liquid, and gaseous states of matter. Principles of stoichiometry, thermochemistry, kinetics, and foundational equilibrium are explored and applied to the study of aqueous and gas-phase chemical reactions. CH 222Z is a lecture course; CH 228Z is the laboratory component. Sequence with CH 221Z, CH 223Z.
Requisites: Prereq: CH 221Z or CH 224H; MATH 112Z; Coreq: CH 228Z recommended.
Equivalent to: CH 222, CH 225H
Additional Information:
Science Area

CH 223Z. General Chemistry III. 4 Credits.
Builds upon the principles presented in CH 222Z, explores thermodynamics and chemical equilibrium, and applies them to the study of aqueous acid-base reactions, solubility, and electrochemistry. CH 223Z is a lecture course; CH 229Z is the laboratory component. Sequence with CH 221Z, CH 222Z.
Requisites: Prereq: CH 222Z or CH 225H; MATH 112Z; Coreq: CH 229Z recommended.
Equivalent to: CH 223, CH 226H
Additional Information:
Science Area

CH 224H. Advanced General Chemistry I. 4 Credits.
First-year university chemistry for students with excellent backgrounds in high school chemistry, physics, and mathematics. Chemical structure, reactions, stoichiometry, thermochemistry, and an introduction to quantum chemistry. Students cannot receive credit for both CH 221Z and CH 224H. Sequence with CH 225H, CH 226H.
Requisites: Prereq: satisfactory placement test score; MATH 112Z. Coreq: one from MATH 241, MATH 246, MATH 251Z, MATH 261.
Equivalent to: CH 221Z
Additional Information:
Science Area

CH 225H. Advanced General Chemistry II. 4 Credits.
First-year university chemistry for students with excellent backgrounds in high school chemistry, physics, and mathematics. Chemical bonding, states of matter, solutions, kinetics, and nuclear chemistry. Students cannot receive credit for both CH 222Z and CH 225H. Sequence with CH 224H, CH 226H.
Requisites: Prereq: CH 221Z or CH 224H; one from MATH 241, MATH 246, MATH 251Z, MATH 261. Coreq: one from MATH 242, MATH 247, MATH 252Z.
Equivalent to: CH 222Z
Additional Information:
Science Area

CH 226H. Advanced General Chemistry III. 4 Credits.
First-year university chemistry for students with excellent backgrounds in high school chemistry, physics, and mathematics. Chemical equilibrium, acid-base chemistry, thermodynamics, and electrochemistry. Students cannot receive credit for both CH 223Z and CH 226H. Sequence with CH 224H, CH 225H.
Requisites: Prereq: CH 222Z or CH 225H; one from MATH 242, MATH 247, MATH 252Z. Coreq: one from STAT 243Z, MATH 247, MATH 253Z.
Equivalent to: CH 223Z
Additional Information:
Science Area

CH 227Z. General Chemistry I Laboratory. 1 Credit.
Experiments correspond to the topics covered in CH 221Z including the fundamentals of chemical measurements, quantitative relationships in chemical analysis, and understanding atomic and molecular structure. CH 227Z is the laboratory component; CH 221Z is the lecture course. Concurrent registration in CH 217 required.
Requisites: Prereq: MATH 111Z. Co-req: CH 217, MATH 112Z. Pre- or coreq: CH 221Z or CH 224H.
Equivalent to: CH 227

CH 228Z. General Chemistry II Laboratory. 1 Credit.
Experiments correspond to the topics covered in CH 222Z including the fundamentals of intermolecular interactions, stoichiometric relationships, chemical equilibria and their application to the synthesis, identification, and analysis of chemical compounds. CH 228Z is the laboratory component; CH 222Z is the lecture course. Concurrent registration in CH 218 required.
Requisites: Prereq: CH 227Z; MATH 112Z. Coreq: CH 218; CH 222Z or CH 225H.
Equivalent to: CH 228

CH 229. General Chemistry Laboratory. 2 Credits.
Third term of the three-term laboratory sequence: synthesis, equilibrium, acids and bases, volumetric analyses, electrochemistry, nuclear chemistry. Students cannot receive credit for both CH 229 and CH 329.
Requisites: Prereq: CH 228 or CH 238; MATH 112Z; coreq: CH 223 or CH 226H.
Equivalent to: CH 229Z, CH 329

CH 229Z. General Chemistry III Laboratory. 1 Credit.
Experiments correspond to the topics covered in CH 223Z including the principles of chemical equilibria and their application to chemical analysis using volumetric and electrochemical methods. CH 229Z is the laboratory component; CH 223Z is the lecture course. Students cannot receive credit for both CH 229Z and CH 329. Concurrent registration in CH 219 required.
Requisites: Prereq: CH 228Z; MATH 112Z. Coreq: CH 219; CH 223Z or CH 226H.
Equivalent to: CH 229, CH 329

CH 299. Special Studies: [Topic]. 1-5 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 329. Research Immersion Laboratory. 3 Credits.
Research lab immersion focused on developing basic concepts and practices of formulating and answering research questions based on data collected. Focus on applying concepts learned in general chemistry lecture classes to understand, collect and analyze research data. Students cannot receive credit for both CH 329 and CH 229Z.
Requisites: Prereq: CH 222Z or CH 225H; CH 228Z.
Equivalent to: CH 229, CH 229Z

CH 331. Organic Chemistry I. 4 Credits.
Structure, properties, and bonding of organic molecules.
Requisites: Prereq: CH 223Z or CH 226H with a grade of D- or better. Concurrent CH 337 recommended.
Equivalent to: CH 341

CH 335. Organic Chemistry II. 4 Credits.
Reactions and mechanisms of organic chemistry.
Requisites: Prereq: CH 331 or CH 341 with a grade of D- or better. Concurrent CH 338 recommended.
Equivalent to: CH 342

CH 336. Organic Chemistry III. 4 Credits.
Organic chemistry of biomolecules with a focus on chemical aspects.
Requisites: Prereq: CH 335 or CH 342 with a grade of D- or better.
Equivalent to: CH 343

CH 337. Organic Chemistry Laboratory. 3 Credits.
Principles and techniques of laboratory practice in organic chemistry.
Requisites: Prereq: CH 229Z; pre- or coreq: CH 331.

CH 338. Organic Chemistry Laboratory. 3 Credits.
Principles and techniques of laboratory practice in organic chemistry.
Requisites: Prereq: CH 331 or CH 341 with a grade of D- or better; CH 337 with a grade of D- or better; pre- or coreq: CH 335.

CH 341. Majors Track Organic Chemistry I. 4 Credits.
Structure, properties, and bonding of organic molecules. Provides a rigorous foundation appropriate for chemistry and biochemistry majors as they become chemical practitioners. Sequence with CH 342, CH 343.
Requisites: Prereq: CH 223Z or CH 226H. Concurrent CH 337 recommended.
Equivalent to: CH 331

CH 342. Majors Track Organic Chemistry II. 4 Credits.
Focuses on mechanisms and reactions of common organic functional groups. Sequence with CH 341, CH 343.
Requisites: Prereq: CH 331 (with a grade of B– or better) or CH 341. Concurrent CH 348 recommended.
Equivalent to: CH 335

CH 343. Majors Track Organic Chemistry III. 4 Credits.
Incorporates topics from the recent chemistry literature. Sequence with CH 341, CH 342.
Requisites: Prereq: CH 335 (with grade of B– or better) or CH 342. Concurrent CH 349 recommended.
Equivalent to: CH 336

CH 347. Majors Organic Chemistry Laboratory I. 3 Credits.
Organic chemistry laboratory techniques, theory and practice. Sequence with CH 348, CH 349.
Requisites: Prereq: CH 223Z, CH 229Z.

CH 348. Organic Chemistry Laboratory for Majors. 4 Credits.
Problem solving in the organic chemistry laboratory. Sequence with CH 337, CH 349.
Requisites: Prereq: CH 337; CH 331 or CH 341; coreq: CH 342.

CH 349. Organic Chemistry Lab for Majors. 4 Credits.
Organic chemistry laboratory projects. Two-dimensional nuclear magnetic resonance techniques. Sequence with CH 337, CH 348.
Requisites: Prereq: CH 348; coreq: CH 343.

CH 360. Physiological Biochemistry. 4 Credits.
For preprofessional health science students. Topics include protein structure and function, enzyme mechanisms, central metabolism and bioenergetics, integration and regulation of metabolism by hormone action. Students cannot receive credit for both CH 360 and CH 462.
Requisites: Prereq: CH 336 or CH 343; BI 214 or BI 282H recommended.
Equivalent to: CH 462

CH 399. Special Studies: [Topic]. 1-5 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 399L. Special Studies: [Topic]. 3 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 401. Research: [Topic]. 1-21 Credits.
Introduction to methods of chemical investigation. For advanced undergraduates by arrangement with individual faculty members.
Repeatable 99 times

CH 403. Thesis. 1-12 Credits.
Open to students eligible to work for a bachelor's degree with honors in chemistry or biochemistry.
Repeatable 99 times

CH 405. Reading and Conference: [Topic]. 1-21 Credits.
A particular selection of material read by a student and discussed in conference with a faculty member.
Repeatable 99 times

CH 406. Field Studies: [Topic]. 1-21 Credits.
A series of practical experiences on or off campus to understand principles or develop skills in performing selected tasks.
Repeatable 99 times

CH 407. Seminar: [Topic]. 1-5 Credits.
Biochemistry seminar for undergraduates who have completed or are enrolled in CH 461, CH 462, CH 463. No graduate credit.
Repeatable 99 times

CH 408. Laboratory Projects: [Topic]. 1-12 Credits.
An experience in a lab setting in which a group of students focus on skills development rather than content master.
Repeatable 99 times

CH 409. Capstone. 1-12 Credits.
A culminating academic project that demonstrates a student's mastery of their field of study.
Repeatable 99 times

CH 410. Experimental Course: [Topic]. 1-5 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 410L. Experimental Course: [Topic]. 4 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 411. Physical Chemistry. 4 Credits.
Methods of physics applied to chemical problems, including inorganic, organic, and biochemistry. Introduction to chemical thermodynamics.
Requisites: Prereq: two years of college chemistry (except for physics majors); a grade of D- or better in PHYS 203 or PHYS 253; MATH 253Z with a grade of D- or better; MATH 256, MATH 281, MATH 282 strongly recommended.

CH 412. Physical Chemistry. 4 Credits.
Methods of physics applied to chemical problems, including inorganic, organic, and biochemistry. Introduction to statistical mechanics and rate processes.
Requisites: Prereq: CH 411 with a grade of D- or better; MATH 256, MATH 281, MATH 282 strongly recommended.

CH 413. Physical Chemistry. 4 Credits.
Methods of physics applied to chemical problems, including inorganic, organic, and biochemistry. Introduction to quantum chemistry.
Requisites: Prereq: CH 412 with a grade of D- or better; MATH 256, MATH 281, MATH 282 strongly recommended.

CH 417. Physical Chemistry Laboratory. 4 Credits.
Experiments in thermodynamics, modern electronic measurements, computer modeling, and data reduction.
Requisites: Pre- or coreq: CH 411.

CH 418. Physical Chemistry Laboratory. 4 Credits.
Experiments in statistical mechanics, chemical kinetics, plasma chemistry, and mass spectrometry.
Requisites: Prereq: CH 417; pre or coreq: CH 412.

CH 419. Physical Chemistry Laboratory. 4 Credits.
Experiments molecular spectroscopy, quantum chemistry, and laser-excited chemical and physical processes to illustrate theoretical principles.
Requisites: Prereq: CH 417; pre or coreq: CH 413.

CH 420. Physical Organic Chemistry I. 4 Credits.
Modern physical organic chemistry including chemical bonding, acid-base chemistry, thermochemistry, noncovalent interactions, and introduction to computational chemistry. Sequence with CH 421.
Requisites: Prereq: CH 336.

CH 421. Physical Organic Chemistry II. 4 Credits.
Modern physical organic chemistry including tools to study reaction mechanisms, kinetic analysis, isotope effects, and qualitative molecular orbital theory. Sequence with CH 420.
Requisites: Prereq: CH 420.

CH 429. Instrumental Analysis. 5 Credits.
Use of instrumental methods for quantitative determinations of unknown chemical samples.
Requisites: Prereq: CH 417.

CH 431. Inorganic Chemistry. 4 Credits.
Introduction to group theory for molecular symmetry; syntheses, structures, reactions, and reaction mechanisms of coordination complexes and organometallic complexes.

CH 432. Inorganic Chemistry. 4 Credits.
Bioinorganic chemistry: metals in biological systems; coordination chemistry, reactions, spectroscopy, metalloclusters, and synthetic modeling.
Requisites: Prereq: CH 431 recommended.

CH 433. Inorganic Chemistry. 4 Credits.
Solid-state inorganic chemistry: solid-state structure and its determination; the electrical, magnetic, and mechanical properties of materials and their physical description.
Requisites: Prereq: CH 431 recommended.

CH 441. Quantum Chemistry. 4 Credits.
The principles of time-independent quantum mechanics and their application to model atomic and molecular systems.
Requisites: Prereq: CH 413 with a grade of D- or better.

CH 442. Quantum Chemistry and Spectroscopy. 4 Credits.
Molecular structure theory, perturbation theory, time-dependent quantum mechanics, theory of spectra, selection rules.
Requisites: Prereq: CH 441 with a grade of D- or better.

CH 443. Quantum Chemistry and Spectroscopy. 4 Credits.
Experimental spectra of atomic and molecular systems and surfaces.
Requisites: Prereq: CH 442 with a grade of D- or better.

CH 445. Statistical Mechanics. 4 Credits.
Molecular basis of thermodynamics. Applications to the calculation of the properties of noninteracting and weakly interacting systems.
Requisites: Prereq: CH 413 with a grade of D- or better.

CH 446. Chemical Kinetics: [Topic]. 4 Credits.
Description and interpretation of the time evolution of chemical systems.
Requisites: Prereq: CH 413 with a grade of D- or better.
Repeatable 99 times

CH 447. Computational Chemistry. 4 Credits.
Introduction to modern computational methods used to understand the properties of molecules.
Requisites: Prereq: [CH 411, CH 412] or PHYS 353.

CH 451. Advanced Organic-Inorganic Chemistry. 4 Credits.
Principles of organic-inorganic reaction dynamics; kinetics and mechanisms, linear free-energy relationships, isotope effects, substitution reactions, dynamic behavior of reactive intermediates, electron transfer chemistry.
Requisites: Prereq: CH 336 or CH 343 with a grade of D- or better.

CH 452. Advanced Organic Chemistry—Stereochemistry and Reactions. 4 Credits.
Principles and applications of stereochemistry; reagents and reactions, with mechanisms, used in contemporary organic synthesis; examples taken from the current literature.

CH 454. Advanced Electrochemistry. 4 Credits.
Advanced topics in electrochemistry including fundamental concepts (thermodynamics, kinetics, transport) and applications (analytical techniques, electrolysis, batteries).
Requisites: Prereq: CH 411.

CH 461. Biochemistry. 4 Credits.
Structure and function of macromolecules.
Requisites: Prereq: CH 336 or CH 343 with a grade of D- or better.

CH 462. Biochemistry. 4 Credits.
Metabolism and metabolic control processes. Energy and sensory transduction mechanisms.
Requisites: Prereq: CH 461 with a grade of D- or better.
Equivalent to: CH 360

CH 463. Biochemistry. 4 Credits.
Mechanisms and regulation of nucleic acid and protein biosynthesis. Other current topics in biochemical genetics.
Requisites: Prereq: CH 461 with a grade of D- or better or CH 360 with a grade of B- or better.

CH 464. RNA Biochemistry. 4 Credits.
Introduction to the diverse field of RNA biochemistry.
Requisites: Prereq: CH 463.

CH 465. Physical Biochemistry. 4 Credits.
Physical chemical properties of biological macromolecules; forces and interactions to establish and maintain macromolecular conformations; physical bases of spectroscopic, hydrodynamic, and rapid-reaction investigative techniques. Offered alternate years.
Requisites: Prereq: CH 461.

CH 466. Structural Biochemistry. 4 Credits.
Protein and nucleic acid structures and energetics. Structure determination by x-ray crystallography and nuclear magnetic resonance. Computational methods for structural analysis. Offered alternate years.
Requisites: Prereq: CH 461.

CH 467. Biochemistry Laboratory. 4 Credits.
Methods of modern molecular biology and protein purification.
Requisites: Coreq: CH 461.

CH 468. Cellular Biochemistry. 4 Credits.
This course surveys scientific discovery at the interface between cell biology and biochemistry. Emphasis will be placed on understanding how scientists visualize, quantify, and interpret how biochemical reactions are orchestrated in complex biological systems. Relationships between protein structure, function, and emergent properties will be defined.
Requisites: Prereq: CH 461.

CH 503. Thesis. 1-16 Credits.
A written document resulting from study or research and submitted as a major requirement for a degree.
Repeatable 99 times

CH 507. Seminar: [Topic]. 1-5 Credits.
Biochemistry seminar for undergraduates who have completed or are enrolled in CH 461, 462, 463. No graduate credit.
Repeatable 99 times

CH 508. Workshop: [Topic]. 1-21 Credits.
An intensive experience, limited in scope and time, in which a group of students focus on skills development rather than content mastery.
Repeatable 99 times

CH 510. Experimental Course: [Topic]. 1-5 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 510L. Experimental Course: [Topic]. 4 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 511. Physical Chemistry. 4 Credits.
Methods of physics applied to chemical problems, including inorganic, organic, and biochemistry. Introduction to chemical thermodynamics.

CH 512. Physical Chemistry. 4 Credits.
Methods of physics applied to chemical problems, including inorganic, organic, and biochemistry. Introduction to statistical mechanics and rate processes.

CH 513. Physical Chemistry. 4 Credits.
Methods of physics applied to chemical problems, including inorganic, organic, and biochemistry. Introduction to quantum chemistry.

CH 517. Physical Chemistry Laboratory. 4 Credits.
Experiments in thermodynamics, modern electronic measurements, computer modeling, and data reduction.
Requisites: Pre- or coreq: CH 511.

CH 518. Physical Chemistry Laboratory. 4 Credits.
Experiments in statistical mechanics, chemical kinetics, plasma chemistry, and mass spectrometry.
Requisites: Pre- or coreq: CH 512.

CH 519. Physical Chemistry Laboratory. 4 Credits.
Experiments in molecular spectroscopy, quantum chemistry, and laser-excited chemical and physical processes to illustrate theoretical principles.
Requisites: Pre- or coreq: CH 513.

CH 520. Physical Organic Chemistry I. 4 Credits.
Modern physical organic chemistry including chemical bonding, acid-base chemistry, thermochemistry, noncovalent interactions, and introduction to computational chemistry. Sequence with CH 521.

CH 521. Physical Organic Chemistry II. 4 Credits.
Modern physical organic chemistry including tools to study reaction mechanisms, kinetic analysis, isotope effects, and qualitative molecular orbital theory. Sequence with CH 520.
Requisites: Prereq: CH 520.

CH 531. Inorganic Chemistry. 4 Credits.
Introduction to group theory for molecular symmetry; syntheses, structures, reactions, and reaction mechanisms of coordination complexes and organometallic complexes.

CH 532. Inorganic Chemistry. 4 Credits.
Bioinorganic chemistry: metals in biological systems; coordination chemistry, reactions, spectroscopy, metalloclusters, and synthetic modeling.
Requisites: Prereq: CH 531 recommended.

CH 533. Inorganic Chemistry. 4 Credits.
Solid-state inorganic chemistry: solid-state structure and its determination; the electrical, magnetic, and mechanical properties of materials and their physical description.
Requisites: Prereq: CH 531 recommended.

CH 541. Quantum Chemistry. 4 Credits.
The principles of time-independent quantum mechanics and their application to model atomic and molecular systems.
Requisites: Prereq: CH 513 or equivalent.

CH 542. Quantum Chemistry and Spectroscopy. 4 Credits.
Molecular structure theory, perturbation theory, time-dependent quantum mechanics, theory of spectra, selection rules.
Requisites: Prereq: CH 541 or equivalent.

CH 543. Quantum Chemistry and Spectroscopy. 4 Credits.
Experimental spectra of atomic and molecular systems and surfaces.
Requisites: Prereq: CH 542 or equivalent.

CH 545. Statistical Mechanics. 4 Credits.
Molecular basis of thermodynamics. Applications to the calculation of the properties of noninteracting and weakly interacting systems.
Requisites: Prereq: CH 513 or equivalent.

CH 546. Chemical Kinetics: [Topic]. 4 Credits.
Description and interpretation of the time evolution of chemical systems.
Requisites: Prereq: CH 513 or equivalent.
Repeatable 99 times

CH 547. Computational Chemistry. 4 Credits.
Introduction to modern computational methods used to understand the properties of molecules.

CH 551. Advanced Organic-Inorganic Chemistry. 4 Credits.
Principles of organic-inorganic reaction dynamics; kinetics and mechanisms, linear free-energy relationships, isotope effects, substitution reactions, dynamic behavior of reactive intermediates, electron transfer chemistry.
Requisites: Prereq: CH 336 or equivalent.

CH 552. Advanced Organic Chemistry—Stereochemistry and Reactions. 4 Credits.
Principles and applications of stereochemistry; reagents and reactions, with mechanisms, used in contemporary organic synthesis; examples taken from the current literature.

CH 554. Advanced Electrochemistry. 4 Credits.
Advanced topics in electrochemistry including fundamental concepts (thermodynamics, kinetics, transport) and applications (analytical techniques, electrolysis, batteries).

CH 561. Biochemistry. 4 Credits.
Structure and function of macromolecules.

CH 562. Biochemistry. 4 Credits.
Metabolism and metabolic control processes. Energy and sensory transduction mechanisms.
Requisites: Prereq: CH 561.

CH 563. Biochemistry. 4 Credits.
Mechanisms and regulation of nucleic acid and protein biosynthesis. Other current topics in biochemical genetics.
Requisites: Prereq: CH 561.

CH 564. RNA Biochemistry. 4 Credits.
Introduction to the diverse field of RNA biochemistry.

CH 565. Physical Biochemistry. 4 Credits.
Physical chemical properties of biological macromolecules; forces and interactions to establish and maintain macromolecular conformations; physical bases of spectroscopic, hydrodynamic, and rapid-reaction investigative techniques. Offered alternate years.

CH 566. Structural Biochemistry. 4 Credits.
Protein and nucleic acid structures and energetics. Structure determination by x-ray crystallography and nuclear magnetic resonance. Computational methods for structural analysis. Offered alternate years.
Requisites: Prereq: CH 561.

CH 567. Biochemistry Laboratory. 4 Credits.
Methods of modern molecular biology and protein purification.

CH 568. Cellular Biochemistry. 4 Credits.
This course surveys scientific discovery at the interface between cell biology and biochemistry. Emphasis will be placed on understanding how scientists visualize, quantify, and interpret how biochemical reactions are orchestrated in complex biological systems. Relationships between protein structure, function, and emergent properties will be defined.

CH 601. Research: [Topic]. 1-16 Credits.
Disciplined inquiry of a topic with varying techniques and assignments suited to the nature and conditions of the problem being investigated. Often pursued in relation to a dissertation or thesis.
Repeatable 99 times

CH 603. Dissertation. 1-16 Credits.
A written document resulting from study or research and submitted as a major requirement for a degree.
Repeatable 99 times

CH 605. Reading and Conference: [Topic]. 1-16 Credits.
A particular selection of material read by a student and discussed in conference with a faculty member.
Repeatable 99 times

CH 606. Field Studies: [Topic]. 1-16 Credits.
A series of practical experiences on or off campus to understand principles or develop skills in performing selected tasks.
Repeatable 99 times

CH 607. Seminar: [Topic]. 1-5 Credits.
Seminars offered in biochemistry, chemical physics, materials science, molecular biology, neuroscience, organic-inorganic chemistry, and physical chemistry.
Repeatable 99 times

CH 608. Workshop: [Topic]. 1-16 Credits.
An intensive experience, limited in scope and time, in which a group of students focus on skills development rather than content mastery.
Repeatable 99 times

CH 609. Terminal Project. 1-16 Credits.
A presentation incorporating the knowledge and skills acquired from course work completed for a degree.
Repeatable 99 times

CH 610. Experimental Course: [Topic]. 1-5 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 610L. Experimental Course: [Topic]. 4 Credits.
Experimental course - topic varies.
Repeatable 99 times

CH 623. Organic-Inorganic Chemistry Journal Club. 1-2 Credits.
Preparation and delivery of colloquium-style lectures in organic-inorganic chemistry based on papers from the literature.
Repeatable 99 times

CH 624. Physical Chemistry Journal Club. 1 Credit.
Preparation and delivery of colloquium-style lectures in physical chemistry based on papers from the literature.
Repeatable 11 times for a maximum of 12 credits

CH 662. Advanced Biochemistry. 4 Credits.
Detailed consideration of enzyme mechanisms, macromolecular structure, protein-nucleic acid interactions, and selected aspects of biological synthesis.

CH 667. Polymers: Synthesis, Characterization, Processing. 4 Credits.
Methods of polymer synthesis and characterization; kinetics and mechanisms of the principal polymerization reactions. Introduction to mechanical properties and fabrication techniques.

CH 668. Physical Chemistry of Polymers and Coatings. 4 Credits.
Statistical and thermodynamic models for the equilibrium configuration, conformation, structure, mechanical properties, and phase transitions of polymer solutions, dense melts, liquid crystals.

CH 669. Polymer Synthesis and Characterization Laboratory. 4 Credits.
Preparation and physical characterization of polymers; emphasis on polymers of commercial interest.

CH 670. Industrial Polymer Projects Laboratory. 4 Credits.
Polymer industry–focused projects with emphasis on formulation and optimization of adhesives, coatings, thermoplastics, thermosets, drug delivery systems, biopolymers, personal care products.
Requisites: Prereq: CH 667, CH 668, CH 669.

CH 677M. Semiconductor Device Physics. 4 Credits.
Introduction to the theory behind semiconductors. Elementary theory of inorganic solids; electronic structures and transport properties. Basic theory of devices including diodes, transistors, mosfets, and optoelectronic devices. Offered only in summer. Sequence with PHYS 678M, PHYS 679M. Multilisted with PHYS 677M.

CH 678M. Semiconductor Processing and Characterization Technology. 4 Credits.
Introduction to the techniques required to make semiconductors and test their properties. Solid-state and surface chemistry of inorganic semiconductors as it pertains to microelectronic devices. Offered only in summer. Multilisted with PHYS 678M.
Requisites: Prereq: CH 677M.

CH 679M. Device Processing and Characterization Laboratory. 4 Credits.
Students use theory and techniques learned to design, fabricate, and test a device that performs a specific function, with an emphasis on wafer processing and device realization. Offered only in summer. Sequence with CH 677M, CH 678M. Multilisted with PHYS 679M.
Requisites: Prereq: CH 678M.

CH 680. Electronics and Vacuum Systems. 4 Credits.
Introduction to modern electronic components, circuits, basic vacuum theory, vacuum failure modes, measurement systems, and troubleshooting.

CH 681. Introduction to Electron Microscopy. 4 Credits.
Introduction to theory and best practices for applying scanning electron (SEM) and transmission electron microscopy (TEM) in materials science.

CH 682. Electron Microprobe Analysis. 4 Credits.
Introduction to the theory and operation of instrumentation for electron microprobe analysis (EPMA) in materials science and geochemistry.

CH 683. Surface Analysis. 4 Credits.
Introduction to theory and best practices for surface analysis techniques (XPS and ToF-SIMS), with focus on applications for materials science.

CH 685. Advanced Transmission Electron Microscopy. 4 Credits.
Advanced theory and practices for using transmission electron microscopy, as applied to materials science.
Requisites: Prereq: CH 681.

CH 686. Advanced Scanning Electron Microscopy. 4 Credits.
Advanced theory and practices for using focused ion beam and scanning electron microscopy in research and nanofabrication.
Requisites: Prereq: CH 681.

CH 687. Advanced Surface Analysis. 4 Credits.
Advanced theory and practices for surface analysis spectroscopy, as applied to materials science.
Requisites: Prereq: CH 683.

CH 689. Chemistry Professional Development. 1 Credit.
Students will develop their awareness of pathways for professional development in chemical technology and identify strategic areas for pursuing growth. Working with the instructors, they will design a plan to explore their strengths and interests and identify career opportunities.

CH 690. Numerical Simulation in Electrochemistry. 2 Credits.
Modern finite-element simulation software is widely used in engineering to predict system performance/properties or in science to understand complex system behavior. Students will learn use industry standard software suites to simulate electrochemical cells and devices to predict performance and develop an understanding of underlying phenomena.
Requisites: Pre- or coreq: CH 554.

CH 691. Analytical Electrochemistry Laboratory. 2 Credits.
This course will focus on typical three-electrode electrochemical experiments and laboratory techniques that form the basis for analytical electrochemistry and for building the basic electrochemistry knowledge and intuition with respect to thermodynamics, kinetics and mass transport.
Requisites: Pre- or coreq: CH 554.

CH 692. Electrochemical Device Engineering. 4 Credits.
This course examines the operational principles of electrochemical energy storage devices (batteries and capacitors), energy conversion devices (fuel cells, electrolyzers), and bioelectrochemical interfaces. The emphasis is on materials and device design based on fundamental chemistry and physics concepts that govern the properties and performance.
Requisites: Prereq: CH 554.

CH 693. Electrochemical Device Laboratory. 4 Credits.
Students will work in small teams to build battery devices, electrolyzers for the production of chemicals and/or fuels, fuel cells, and biological interfaces. They will test the performance and response of these devices compared to theory and modelling, applying experimental design and statistical analysis methods.
Requisites: Prereq: CH 554; pre- or coreq: CH 692.

CH 694. Applied Electrochemistry Projects Laboratory. 4 Credits.
This course requires students to work in teams to solve open-ended research and development projects in electrochemistry. The applied research and development projects for the course come from industry partners, national laboratories, and academic research laboratories.
Requisites: Prereq: CH 554.

CH 695. External Graduate Internship. 1-10 Credits.
Student will complete internships in industry, a national laboratory, or other research setting to provide opportunities to make connections between the theory and practice of academic study and the practical application of that study in a professional environment.
Repeatable 2 times for a maximum of 30 credits