CHEMISTRY

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The Chemistry Department at Creighton University is certified by the American Chemical Society (ACS) and offers four degree choices: an ACS-certified major with tracks in Chemistry or Biochemistry, a comprehensive (but not certified) major, and a major designed for students interested in teaching high school chemistry.

Majors in Chemistry

Specific Requirements for Admission to the Chemistry Major

Satisfactory completion of two lecture courses within the Creighton chemistry department and completion of MTH 245 Calculus I. MTH 246 Calculus II and General Physics I (PHY 201 General Physics for the Life Sciences or PHY 213 General Physics for the Physical Sciences I or PHY 221 Advanced General Physics I:Modeling the Physical World) are prerequisites for CHM 341 Physical Chemistry I; General Physics II (PHY 202 General Physics for the Life Sciences II or PHY 222 Advanced General Physics II:Modeling the Physical World) is prerequisite or co-requisite for CHM 341 Physical Chemistry I.

- B.S., Major in Chemistry: Generalist Track (http://catalog.creighton.edu/undergraduate/arts-sciences/chemistry/chemistry-generalist-bs)
- B.S., Major in Chemistry: Chemistry Education Track (http://catalog.creighton.edu/undergraduate/arts-sciences/chemistry/chemistry-education-track)
- B.S. Chem., Chemistry Track (Professional Degree) (http://catalog.creighton.edu/undergraduate/arts-sciences/chemistry/chemistry-bschm)
- B.S. Chem, Biochemistry Track (Professional Degree) (http://catalog.creighton.edu/undergraduate/arts-sciences/chemistry/biochemistry-bschm)

Courses

CHM 105. Introductory Chemistry. 3 credits. SP, SU
A one-semester introduction to the concepts and theories basic to the science of chemistry. Recommended as an entry-level course for those who have had no high school chemistry or who consider their high school preparation in chemistry weak. Topics covered include problem solving, scientific method, measurements, calculations, matter, energy, the periodic table, atomic theory, chemical nomenclature, chemical reactions, chemical composition, mole calculations, ionic and covalent bonding.

CHM 111. Fundamentals of General Chemistry. 3 credits. FA
A one-semester survey of general chemistry for nursing students. Topics covered include electronic structure and periodicity, molecular structure, chemical reactions, states of matter, acid-base chemistry, and nuclear chemistry. P: Registration in Nursing Program or IC.

CHM 112. Fundamentals Of Biological Chemistry. 3 credits. SP
Survey of organic and biological chemistry for nursing students. Includes the study of organic functional groups and reactivity, plus the chemistry of biomolecules such as proteins, carbohydrates, lipids, and nucleic acids. P: CHM 111 or equivalent with a grade of "C" or better and Registration in Nursing Program or IC; CO: CHM 113.

CHM 113. Fundamentals Of Chemistry Laboratory. 1 credit. SP
Laboratory course to be taken in conjunction with CHM 112 which demonstrates basic chemical tools and illustrates basic chemical principles. P: CHM 111 or equivalent with a grade of "C" or better and Registration in Nursing Program; CO: CHM 112.

CHM 201. Chemistry of Consumer Products. 3 credits.
Course in chemistry of consumer products. Topics include basic concepts of chemistry, molecular structure and chemical properties as related to consumer products including foods, paints, cleaning products, lawn and garden products, preservatives, petroleum products, plastics and materials and cosmetics.

CHM 203. General Chemistry I. 3 credits. FA, SU
Course in introductory chemistry which includes basic concepts: atomic structure, the mole, stoichiometry, gas laws, bonding theories, molecular structure and properties, thermochemistry, and some common reactions. This is the first half of a two semester sequence. P: ACT Math of 24 or SAT Math 560 or MTH 245 with a grade of 'C' or better or CHM 105 with a grade of 'C' or better or So. stdg. CO: CHM 204.

CHM 204. General Chemistry I Laboratory. 1 credit. FA, SU
Laboratory portion of Chemistry 203. Experiments relevant to the content of CHM 203 are performed. CO: CHM 203.

CHM 205. General Chemistry II. 3 credits. SP, SU
Continuation of CHM 203. Concepts and theories covered include thermodynamics, kinetics, chemical equilibria, and applications of equilibrium theory to solubility, acids and bases, oxidation-reduction, and coordination chemistry. P: CHM 203 with a grade of "C" or better. CO: CHM 206.

CHM 206. General Chemistry II Laboratory. 1 credit. SP, SU
Laboratory portion of Chemistry 205. Experiments relevant to the content of CHM 205 are performed. P: CHM 203 and CHM 204 with grades of "C" or better; CO: CHM 205.

CHM 285. Advanced General Chemistry II. 3 credits. SP
A second-semester general chemistry course designed for potential chemistry majors and for those students interested in the health sciences who want an advanced treatment of general chemistry topics. The course will focus on kinetics, thermodynamics, and expressions of solution equilibria with applications to quantitative chemical analysis. The approach will be from a conceptual understanding of solution chemistry leading into a quantitative treatment of solution phenomena. P: CHM 203 with a grade of "B" or better. CO: CHM 286.

CHM 286. Chemical and Statistical Analysis Laboratory. 2 credits. SP
A laboratory-based course covering the theories and methods used in classical chemical analysis. Topics include statistical methods for evaluating and interpreting data, theory of chemical analysis and sources of error, and experiments based upon the principles of stoichiometry and equilibrium as applied to titration, precipitation, electrochemistry, and spectroscopy. P: CHM 203, CHM 204; Magis Mathematical Reasoning course. CO: CHM 285.

CHM 297. Directed Research. 0-2 credits. FA, SP, SU
Participation in a research project under the direction of a member of the faculty. This course can be repeated for a total of 3 credits. P: IC.

CHM 315. Quantitative and Statistical Analysis. 4 credits. SP
An integrated lecture and laboratory course that presents the theories and chemical methods for solving a variety of real problems in chemical analysis. Topics covered include: statistical methods for evaluating and interpreting data, sources of error in chemical analysis, principles of stoichiometry and equilibrium as applied to precipitation, acid-base, complexometric, electrochemical, and spectroscopic analysis. Three hours of lecture and three hours of laboratory per week. P: CHM 205; CHM 206; One Magis Core Mathematical Reasoning course.

CHM 321. Organic Chemistry I. 3 credits. FA, SU
Study of the structure and properties of organic compounds, as exemplified by alkenes, alkynes, alcohols, and alkyl halides. Stereochemistry, molecular structure, principles of reaction theory, and reaction mechanisms. P: CHM 205 or CHM 285 with a grade of "C" or better. CO: CHM 322.

CHM 322. Organic Chemistry I Laboratory. 1 credit. FA, SU
Fundamental techniques of experimental organic chemistry. Isolation, purification, and organic synthetic methods. P: CHM 205 and CHM 206 or CHM 285 and CHM 286 with grades of "C" or better; CO: CHM 321.

CHM 323. Organic Chemistry II. 3 credits. SP, SU
Continuation of Chemistry 321. Further study of the principles of organic structure and reaction theory, including delocalized systems. Exploration of the chemistry of aromatic compounds, carbonyl compounds, and others, with additional emphasis on organic synthesis and structural analysis by spectroscopic methods. P: CHM 321 with a grade of "C" or better. CO: CHM 324.

CHM 324. Organic Chemistry II Laboratory. 1 credit. SP, SU
Further study of practical organic reactions, the use of spectroscopic methods (NMR and IR) to elucidate and confirm organic structures, and multistep organic synthesis. P: CHM 321 and CHM 322 with grades of "C" or better; CO: CHM 323.

CHM 341. Physical Chemistry I. 3 credits. FA
An introduction to thermodynamics including equations of state, the first and second laws of thermodynamics, heat capacity, enthalpy, adiabatic processes, entropy, and Gibbs free energy. An introduction to kinetics including the Maxwell-Boltzmann distribution, collision frequency, mean free path, reaction rates, collision density, elementary reactions, and approximate rate laws. The additional mathematics required to understand these topics will also be covered. P: MTH 246 or MTH 249 and PHY 201 or PHY 213 or PHY 221. P or CO: PHY 202 or PHY 214 or PHY 222.

CHM 342. Physical Chemistry Laboratory. 2 credits. SP
Experiments explore topics from chemical thermodynamics, equilibrium, kinetics, quantum mechanics, spectroscopy, and statistical mechanics. Experimental results are analyzed and reported in a format appropriate for publication in a peer reviewed physical chemistry journal. CO: CHM 343. P: One Magis Core Contemporary Composition course.

CHM 343. Physical Chemistry II. 3 credits. SP
An introduction to chemical applications of quantum mechanics including the particle-in-a-box, the harmonic oscillator, the rigid rotor, the hydrogen atom, and approximate methods for atoms and molecules. An introduction to spectroscopy including selection rules, rotational, vibrational, rovibrational, and electronic spectra, and lasers. The additional mathematics required will also be covered. P: CHM 341; CO: CHM 342.

CHM 351. Descriptive Inorganic Chemistry. 2 credits. SP
A systematic study of the main-group elements with an emphasis on chemical reactions, properties, and processes important to the natural world. Lecture topics will be integrated with laboratory experiments to provide a broad introduction to descriptive inorganic chemistry and its key concepts. P: CHM 205 and CHM 206 or CHM 285 and CHM 286.

CHM 371. Biochemistry of Metabolism. 3 credits. FA, SP, SU
A one-semester survey of biochemistry for pre-health professions. (Students with a declared major in Chemistry should take CHM 381, as CHM 371 does not fulfill the requirements for any of the Chemistry major tracks.) Topics covered include structure and function of biomolecules, metabolism and bioenergetics. An emphasis will be placed on medical/clinical examples. P: BIO 202, CHM 323 with a grade of "C" or better.

CHM 381. Fundamentals of Biochemistry. 3 credits. FA
A mechanistic approach to biochemistry for chemistry and biochemistry majors. Topics include structural approaches to biomolecule function, mechanistic investigations of intermediary metabolism, biogenic synthesis of nucleotides and proteins, and applications of bioenergetics. P: CHM 323 with a grade of "C" or better; Open to chemistry/biochemistry majors or IC.

CHM 382. Biochemistry Laboratory. 2 credits. FA, SP
A one-semester laboratory course designed to support CHM 381, Fundamentals of Biochemistry. Introduction to methods and instrumentation for biochemical measurements: analysis and isolation of biologically-important compounds, strategies for assaying biological activity, cloning and purification techniques for DNA/RNA. P or CO: CHM 371 or CHM 381 or IC.

CHM 392. Forensic Chemistry. 3 credits.
A one semester laboratory course designed to investigate topics in forensic biochemistry, this class will focus on the processing techniques for: biological, chemical, drug, hair, and other evidentiary items found in crime scenes; as well as the instruments used in processing; FTIR, GCMS, and Bioanalyzer. P: CHM 371 or 381.

CHM 421. Selected Topics In Organic Chemistry. 3 credits. OD
Study of classes of compounds and reactions of organic chemistry not covered in the regular two-semester sequence (CHM 321, 323). Possible topics include sterochemistry, natural products, computational methods in organic chemistry, physical organic chemistry, photochemistry and other topics of current interest. P: CHM 323.

CHM 445. Chemical Thermodynamics. 2 credits. OD
This course will provide a more extensive introduction to classical thermodynamic theory, including treatments of the laws of thermodynamics, conditions of equilibrium, thermodynamics of gases and solutions, and ideal and non-ideal behavior. P: CHM 343.

CHM 446. Statistical Mechanics. 2 credits. OD
The mathematical study of the connection between quantum mechanical behavior of individual atoms and molecules and their consequent macroscopic properties and phenomena. P: CHM 343.

CHM 448. Group Theory. 2 credits. OD
This course will present an introduction to the theory of group representations. Topics will include the mathematical foundations of abstract group theory, including reducible and irreducible representations. Physical applications of group theory will include crystallographic point groups, group theoretical techniques in quantum mechanics, angular momentum, and vibrational spectroscopy. P: CHM 343.

CHM 451. Inorganic Chemistry I. 3 credits. FA
Relation of atomic and molecular structure to chemical and physical properties. Periodicity and descriptive chemistry of inorganic classes and groups. Topics covered include group theory, MO theory, molecular and ionic structures, redox reactions, acid/base theories, and coordination compounds. P: CHM 343.

CHM 456. Instrumental Analysis. 3 credits. FA
A senior level course on instrumental techniques used in analytical chemistry. Emphasis will be on modern instrumentation theory and applications in spectroscopy, electrochemistry, and chromatography. P: CHM 343; CO: CHM 466.

CHM 466. Instrumental Analysis Laboratory. 2 credits. FA
A laboratory-based course covering the theories and methods used in modern instrumental analysis. Topics include the theory and practice of instrumental techniques, statistical methods for evaluating and interpreting data, sources of noise and error, and experimental methods in spectroscopy, electrochemistry, and chromatography. One hour of recitation and three hours of laboratory per week. P: CHM 286 or CHM 315; CO: CHM 456.

CHM 492. Industrial Internship. 1-3 credits. FA, SP
Each student will spend one day per week or its equivalent in an industrial plant or laboratory. Registration must be preceded by the student submitting a resume, a letter of application, and arranging for a personal interview with one or more industrial concerns prior to the registration date. Each student must be accepted by or have worked for an industrial employer prior to registration. P: CHM 315 or CHM 285, and CHM 286.

CHM 493. Directed Independent Readings. 0-3 credits. FA, SP, SU
Assigned reading in a special area of interest. The course is repeatable for a max of 4 credits.

CHM 495. Directed Independent Study. 1-3 credits. FA, SP, SU

CHM 496. Directed Independent Research I. 0-2 credits. FA, SP, SU
Initial participation in a pre-approved independent research project under the direction of a member of the department faculty. The course is repeatable for a max of 8 credits. P: CHM 324 or CHM 285, CHM 286; IC; One Magis Core Ethics course.

CHM 497. Directed Independent Research II. 1-2 credits. FA, SP, SU
Continuation in a pre-approved independent research project under the direction of a member of the department faculty. Students register for this course in their final semester of research. They are required to give a public presentation of their work and submit a research report. Research projects in chemistry conducted outside the department may also be acceptable. The course is repeatable for a max of 2 credits. P: CHM 324 or CHM 285, CHM 286; IC; One Magis Core Oral Communication course.

CHM 498. Directed Independent Research - Special. 0-2 credits.
Participation in a pre-approved independent research project conducted outside the Creighton University Chemistry Department. The course is repeatable for a max of 6 credits. P: CHM 324 or CHM 285; CHM 286; IC.

CHM 502. Inorganic Chemistry II. 3 credits. SP
Additional topics in inorganic chemistry. Emphasis on organometallic chemistry of transition metals, synthesis and chemical reactivities of inorganic and organometallic compounds. P: CHM 451.

CHM 515. Green and Sustainable Chemistry Laboratory. 2 credits.
Green chemistry is a set of ideals that considers human beings and the environment when designing a chemical reaction, experiment, or process. This laboratory-based course implements the twelve principles of green chemistry to various areas of chemistry. The experiments focus on pollution prevention, energy minimization, and safety. A one-hour recitation where theories are presented and discussed accompanies the laboratory.

CHM 521. Advanced Organic Chemistry: Synthetic Organic Methods. 3 credits. OD
A contemporary survey of the analysis, design, and execution of new methods and innovative total syntheses in organic chemistry. Approaches and techniques for critical reading, discussion, and application of the literature of organic chemistry will be introduced and developed. P: CHM 323; Magis Core Ethics course; Magis Core Contemporary Composition course; Magis Core Oral Communication course.

CHM 523. Bioorganic Chemistry. 3 credits. OD
A survey of current topics at the interface of organic chemistry and biology, with emphasis on a chemical understanding of biological infrastructure, the interactions of small organic molecules within biochemical systems, structure-activity relationship profiling of natural and synthetic drugs, and the relevance of small molecule therapeutics in modern society. P: CHM 381.

CHM 525. Organic Spectroscopic Analysis. 3 credits. OD
A study of infrared, nuclear magnetic resonance, and ultraviolet spectroscopy and mass spectrometry. Emphasis on both the theoretical basis of each method and the application of the methods to structure determination and other interesting chemical problems. P: CHM 324, CHM 343, or IC.

CHM 526. Practical Spectroscopy: NMR. 2 credits.
A practical course of NMR operation and experiment design. NMR probe tuning, shimming, determination of 90 degree pulses and relaxation times, advanced 1D and basic 2D experiments will be described and practiced. P: IC.

CHM 527. Polymer Chemistry. 3 credits. OD
The goal of this course is to expose students to the fundamentals of polymer chemistry. The course will focus on some of the key synthetic methods and physical properties of polymers. Practical applications of polymer chemistry in society will be a theme throughout the course. P: CHM 323 or IC.

CHM 528. Polymer Chemistry Laboratory. 1 credit.
The goal of this course is to expose students to the fundamentals of polymer syntheses and characterization. The course will focus on some of the key synthetic methods for making plastics and the characterization techniques for determining the physical properties of the polymers. Practical applications of polymer chemistry in society will be a theme throughout the course. P or CO: CHM 527.

CHM 532. Mathematical Concepts In Chemistry. 3 credits.
Applications utilizing statistics, mathematical operators, vectors, determinants, group theory, series expansions, and basic differential equations in the modeling of chemical systems. P: MTH 246.

CHM 543. Selected Topics In Physical Chemistry. 3 credits. OD
Selected topics from physical chemistry that match the interests of faculty and students will be discussed. The course will begin with review of related material from CHM 341 and CHM 343 and end with current research. P: CHM 343.

CHM 544. Quantum Chemistry. 2 credits. OD
This course is designed to teach the mathematical background of quantum chemistry. Topics covered include operator algebra, quantum mechanical postulates, rigid rotor and harmonic oscillator model systems, applications to chemical systems, and computational chemistry. P: CHM 343.

CHM 545. Advanced Kinetics. 2 credits. OD
This course is designed to teach the mathematical skills necessary for modeling kinetic systems in chemistry. Topics covered include differential equation techniques, elementary rate laws, composite rate laws, collision theory, transition state theory, reaction dynamics, and potential energy surfaces. P: CHM 343.

CHM 548. Chemical Applications of Spectroscopy. 2 credits.
This is a laboratory course designed to illustrate the theory and applications of spectroscopic analysis to chemical research. Techniques investigated will include IR, UV-Visible Fluorescence/Phosphorescence, Raman, and NMR spectroscopy. Both gas-phase and solution-phase problems will be studied. P: CHM 343.

CHM 549. Computational Chemistry. 2 credits.
This course is designed to introduce students to the applications of computational chemistry in chemical research. Students will learn about the variety of computational methods available including molecular mechanics, semi-empirical, Hartree-Fock, and density functional theory. Laboratory projects will include application of these methods to problems in organic, inorganic, and biological chemistry P: CHM 343.

CHM 556. Electrochemical Methods. 3 credits.
This lecture course covers the fundamentals of electrochemistry and the application of electrochemical methods to chemical problems. It describes electrochemical terms, electrode potentials and processes, along with a historical perspective of electrochemical methods. It covers specific electrochemical techniques and the role of electrochemistry when applied to other fields of science. P: CHM 456.

CHM 575. Nucleic Acid Biochemistry. 3 credits. OD
This course presents an in-depth investigation of the current research in nucleic acid biochemistry. The class will focus on the structure and function of nucleic acids, biochemical processes involving nucleic acids, interactions of nucleic acids with proteins and drug molecules, catalytic nucleic acids, and the genome and genetic engineering. The current literature will serve as source material for study and discussion. P: CHM 371 or CHM 381.

CHM 576. Protein Biochemistry. 3 credits.
This course will introduce students to current views of protein structure and function. Students will become educated consumers of the wealth of information available in protein sequence and structure databases and will develop knowledge of techniques required to characterize their own proteins in the laboratory. P: CHM 371 or CHM 381.