

# Chemistry and Biochemistry (CHEM)

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## Courses

### **CHEM 5050V. Special Topics in Chemistry. 1-4 Hour.**

Potential topics include: advanced spectroscopic methods, bioanalytical chemistry, bioinorganic chemistry, bioorganic chemistry, biophysical chemistry, chemical sensors, drug discovery and design, nanomaterials, pharmaceutical chemistry, process analytical chemistry, and protein folding and design. Graduate degree credit will not be given for both CHEM 4050V and CHEM 5050V. Prerequisite: Instructor consent. (Typically offered: Irregular)

### **CHEM 51001. Introduction to Research. 1 Hour.**

This eight week course introduces new graduate students to research opportunities and skills in chemistry and biochemistry. Meets 2 hours per week in the first half of the semester. Safety and ethics in research and scholarship are discussed. Students learn about research programs in the department to aid in choosing an advisor. (Typically offered: Fall)

### **CHEM 51203. Advanced Inorganic Chemistry. 3 Hours.**

Reactions and properties of inorganic compounds from the standpoint of electronic structure and the periodic table. Emphasis on recent developments. Knowledge comparable to material in CHEM 34603 is recommended. (Typically offered: Fall)

### **CHEM 51403. Advanced Inorganic Chemistry II. 3 Hours.**

Chemistry of metallic and non-metallic elements emphasizing molecular structure, bonding and the classification of reactions. Knowledge of inorganic chemistry comparable to material in CHEM 41203 and CHEM 51203 is recommended. (Typically offered: Irregular)

### **CHEM 51503. Structural Chemistry. 3 Hours.**

Determination of molecular structure by diffraction, spectroscopic, and other techniques. Illustrative examples will be chosen from inorganic chemistry and biochemistry. (Typically offered: Irregular)

### **CHEM 52103. Instrumental Analysis. 3 Hours.**

Provides students, especially those in the physical, agricultural, and biological sciences, with an understanding of the theory and practice of modern instrumental techniques of analysis. Lecture 3 hours per week. Knowledge comparable to material in CHEM 22673 and CHEM 36053 is recommended. (Typically offered: Fall and Spring)

### **CHEM 52303. Chemical Separations. 3 Hours.**

Modern separation methods including liquid chromatography (adsorption, liquid-liquid partition, ion exchange, exclusion) and gas chromatography. Theory and instrumentation is discussed with emphasis on practical aspects of separation science. (Typically offered: Fall Even Years)

### **CHEM 52403. Electrochemical Methods of Analysis. 3 Hours.**

Topics will include diffusion, electron transfer kinetics, and reversible and irreversible electrode processes followed by a discussion of chronoamperometry, chronocoulometry, polarography, voltammetry, and chronopotentiometry. Knowledge of analytical chemistry comparable to material in CHEM 42203 is recommended. (Typically offered: Spring Even Years)

### **CHEM 52503. Spectrochemical Methods of Analysis. 3 Hours.**

Principles and methods of modern spectroscopic analysis. Optics and instrumentation necessary for spectroscopy is also discussed. Topics include atomic and molecular absorption and emission techniques in the ultraviolet, visible, and infrared spectral regions. Knowledge of analytical chemistry comparable to material in CHEM 42203 is recommended. (Typically offered: Fall Odd Years)

### **CHEM 52803. Energy Conversion and Storage. 3 Hours.**

Fundamental and applied concepts of energy storage and conversion with sustainability implications. Chemical reactions (kinetics, thermodynamics, mass transfer), emphasizing oxidation-reduction, electrochemical, and interfacial processes, and impact on performance of fuel and biofuel cells, batteries, supercapacitors, and photochemical conversion. (Typically offered: Fall Even Years)

### **CHEM 54403. Physical Chemistry of Materials. 3 Hours.**

Physical and chemical characteristics of materials and discussion of the science behind materials engineering and performance. Topics include theory, principles of characterization methods, modeling, and applications in the context of materials. Knowledge comparable to material in CHEM 35204 and CHEM 35004 or CHEM 34603 or CHEG 37103 or MEEG 24003 is recommended. (Typically offered: Irregular)

### **CHEM 54503. Quantum Chemistry I. 3 Hours.**

Fundamental quantum theory: Hamiltonian formalism in classical mechanics, Schrodinger equation, operators, angular momentum, harmonic oscillator, barrier problems, rigid rotator, hydrogen atom, and interaction of matter with radiation. Knowledge of physical chemistry comparable to material in CHEM 35004 is recommended. (Typically offered: Spring Odd Years)

### **CHEM 54703. Chemical Kinetics. 3 Hours.**

Theory and applications of the principles of kinetics to reactions between substances, both in the gaseous state and in solution. Knowledge of physical chemistry comparable to material in CHEM 35204 is recommended. (Typically offered: Spring)

### **CHEM 55703. Statistical Thermodynamics. 3 Hours.**

Covers fundamentals in thermodynamics, molecular dynamics, Monte Carlo, phase transitions, behavior of gases and liquids and basic concepts in chemical kinetics and physical kinetics. Knowledge comparable to physical chemistry materials in CHEM 35204 is recommended. (Typically offered: Irregular)

### **CHEM 56003. Physical Organic Chemistry. 3 Hours.**

Introduction to the theoretical interpretation of reactivity, reaction mechanisms, and molecular structure of organic compounds. Application of theories of electronic structure; emphasis on recent developments. Knowledge of material comparable to CHEM 36203, CHEM 362H3, CHEM 37203 and CHEM 35204 is recommended. (Typically offered: Fall)

### **CHEM 56303. Organic Reactions. 3 Hours.**

The more important types of organic reactions and their applications to various classes of compounds. Knowledge of organic chemistry comparable to material in CHEM 36053 is recommended. (Typically offered: Irregular)

### **CHEM 56403. Chemistry of Carbohydrates. 3 Hours.**

Introduction to carbohydrate chemistry including structures of mono-, di- and oligosaccharides; properties including stereochemistry; characterization including spectroscopy, and molecular recognition; and real life examples including blood groups; current strategies, research groups and topics at the forefront in the field. (Typically offered: Spring Even Years)

### **CHEM 57203. Experimental Methods in Organic Chemistry. 3 Hours.**

Introduction to the application of synthetic and spectroscopic methods in organic chemistry, including mass spectrometry, infrared spectroscopy, and nuclear magnetic resonance spectrometry. Lecture 3 hours per week. Knowledge comparable to material in CHEM 36203 is recommended. (Typically offered: Fall)

### **CHEM 57503. Methods of Organic Analysis. 3 Hours.**

Interpretation of physical measurements of organic compounds in terms of molecular structure. Emphasis on spectroscopic methods (infrared, ultraviolet, magnet resonance, and mass spectra). Knowledge of organic chemistry comparable to material in CHEM 36053 is recommended. (Typically offered: Fall)

**CHEM 58103. Biochemistry I. 3 Hours.**

The first of a two-course series covering biochemistry for graduate students in biology, agriculture, and chemistry. Topics covered include protein structure and function, enzyme kinetics, enzyme mechanisms, and nucleic acid and carbohydrate structures. Knowledge of organic chemistry comparable to material in CHEM 36203 is recommended. (Typically offered: Fall)

**CHEM 58403. Biochemistry II. 3 Hours.**

A continuation of CHEM 58103 covering topics including biological membranes and bioenergetics, photosynthesis, lipids and lipid metabolism, nucleic acid and amino acid metabolism, and molecular biology. Knowledge of organic chemistry comparable to material in CHEM 36203 is recommended. Prerequisite: CHEM 58103. (Typically offered: Spring)

**CHEM 6000V. Master's Thesis. 1-6 Hour.**

Master's Thesis. Chemistry graduate students enroll in this course as needed until all CUMES are passed and the student is officially a doctoral candidate. Prerequisite: Chemistry graduate student. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.

**CHEM 60101. Chemistry Seminar. 1 Hour.**

Weekly discussion of current chemical research. Departmental and divisional seminars in analytical chemistry, biochemistry, inorganic, organic, and physical chemistry are held weekly. Seminar credit does not count toward the minimum hourly requirements for any chemistry graduate degree. (Typically offered: Fall and Spring) May be repeated for degree credit.

**CHEM 6190V. Special Topics in Inorganic Chemistry. 1-3 Hour.**

Topics which have been covered in the past include: technique and theory of x-ray diffraction, electronic structure of transition metal complexes, inorganic reaction mechanisms, and physical methods in inorganic chemistry. (Typically offered: Irregular) May be repeated for degree credit.

**CHEM 62803. Mass Spectrometry. 3 Hours.**

This course is devoted to the fundamental principles and applications of analytical mass spectrometry. Interactions of ions with magnetic and electric fields and the implications with respect to mass spectrometer design are considered, as are the various types of mass spectrometer sources. Representative applications of mass spectrometry in chemical analysis are also discussed. Prerequisite: Graduate standing. (Typically offered: Spring Odd Years)

**CHEM 6290V. Special Topics in Analytical Chemistry. 1-3 Hour.**

Topics that have been presented in the past include: electroanalytical techniques, kinetics of crystal growth, studies of electrode processes, lasers in chemical analysis, nucleosynthesis and isotopic properties of meteorites, thermoluminescence of geological materials, early solar system chemistry and analytical cosmochemistry. (Typically offered: Irregular) May be repeated for degree credit.

**CHEM 6490V. Special Topics in Physical Chemistry. 1-3 Hour.**

Topics which have been covered in the past include advanced kinetics, solution chemistry, molecular spectra, nuclear magnetic resonance spectroscopy, and methods of theoretical chemistry. (Typically offered: Irregular) May be repeated for degree credit.

**CHEM 66303. Chemistry of Organic Natural Products. 3 Hours.**

Selected topics concerned with structure elucidation and synthesis of such compounds as alkaloids, antibiotics, bacterial metabolites, plant pigments, steroids, terpenoids, etc. Prerequisite: CHEM 56003 and CHEM 56303. (Typically offered: Irregular)

**CHEM 66403. Organometallic Chemistry. 3 Hours.**

Theories and principles of organometallic chemistry. Concepts include bonding, stereochemistry, structure and reactivity, stereochemical principles, conformational, steric and stereoelectronic effects. Transition metal catalysis of organic reactions will also be described. Knowledge of material comparable to CHEM 37203 and CHEM 35204 is recommended. (Typically offered: Irregular)

**CHEM 6690V. Special Topics in Organic Chemistry. 1-3 Hour.**

Topics which have been presented in the past include heterogeneous catalysis, isotope effect studies of organic reaction mechanisms, organometallic chemistry, stereochemistry, photochemistry, and carbanion chemistry. (Typically offered: Irregular) May be repeated for degree credit.

**CHEM 68203. Physical Biochemistry. 3 Hours.**

Physical chemistry of proteins, nucleic acids, and biological membranes. Ultracentrifugation, absorption and fluorescent spectrophotometry, nuclear magnetic resonance spectroscopy, x-ray diffraction, and other techniques. Prerequisite: CHEM 58103. (Typically offered: Fall Even Years)

**CHEM 68603. Enzymes. 3 Hours.**

Isolation, characterization, and general chemical and biochemical properties of enzymes. Kinetics, mechanisms, and control of enzyme reactions. Prerequisite: CHEM 58103 and CHEM 58403. (Typically offered: Fall Odd Years)

**CHEM 68703. Molecular Biochemistry. 3 Hours.**

Nucleic acid chemistry in vitro and in vivo, synthesis of DNA and RNA, genetic diseases, cancer biochemistry and genetic engineering. Prerequisite: CHEM 58103 and CHEM 58403. (Typically offered: Spring Odd Years)

**CHEM 68803. Bioenergetics and Biomembranes. 3 Hours.**

Cellular energy metabolism, photosynthesis, membrane transport, properties of membrane proteins, and the application of thermodynamics to biological systems. Prerequisite: CHEM 58103 and CHEM 58403. (Typically offered: Spring Even Years)

**CHEM 7000V. Doctoral Dissertation. 1-12 Hour.**

Doctoral Dissertation. For chemistry graduate students who have passed all CUMES and have officially been admitted to doctoral candidacy. Prerequisite: Chemistry graduate student. (Typically offered: Fall, Spring and Summer) May be repeated for degree credit.