

# Chemistry and Biochemistry (CHEM)

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## Courses

### **CHEM 505V. Special Topics in Chemistry. 1-4 Hour.**

(Formerly CHEM 405V.) 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 405V and CHEM 505V. Prerequisite: Instructor consent. (Typically offered: Irregular)

### **CHEM 5101. 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 5123. 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 3453 is recommended. (Typically offered: Fall)

### **CHEM 5143. 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 4123 and CHEM 5123 is recommended. (Typically offered: Irregular)

### **CHEM 5153. 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 5213. 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 2263 and CHEM 3603 is recommended. (Typically offered: Spring)

### **CHEM 5233. 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 5243. 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 4213 is recommended. (Typically offered: Spring Even Years)

### **CHEM 5253. 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 4213 is recommended. (Typically offered: Fall Odd Years)

### **CHEM 5283. 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 5383. Chemometrics. 3 Hours.**

Chemometrics is the process of extracting relevant information from chemical data by mathematical and statistical tools. These tools allow for designing optimal experimental procedures, extracting important information from complex chemical systems, and better understanding of complex chemical systems. (Typically offered: Spring Even Years)

### **CHEM 5443. 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 3514 and CHEM 3504 or CHEM 3453 or CHEG 3713 or MEEG 2403 is recommended. (Typically offered: Irregular)

### **CHEM 5453. 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 3504 is recommended. (Typically offered: Spring Odd Years)

### **CHEM 5473. 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 3514 is recommended. (Typically offered: Spring)

### **CHEM 5573. 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 3514 is recommended. (Typically offered: Irregular)

### **CHEM 5603. 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 3613, CHEM 3613H, CHEM 3713 and CHEM 3514 is recommended. (Typically offered: Fall)

### **CHEM 5633. 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 3603 is recommended. (Typically offered: Irregular)

### **CHEM 5723. 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 3613 is recommended. (Typically offered: Fall)

### **CHEM 5753. 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 3603 is recommended. (Typically offered: Fall)

**CHEM 5813. 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 3613 is recommended. (Typically offered: Fall)

**CHEM 5843. Biochemistry II. 3 Hours.**

A continuation of CHEM 5813 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 3613 is recommended. Prerequisite: CHEM 5813. (Typically offered: Spring)

**CHEM 600V. 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 6011. 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 619V. 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 6283. 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 629V. 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 649V. 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 6633. 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 5603 and CHEM 5633. (Typically offered: Irregular)

**CHEM 6643. 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 3713 and CHEM 3514 is recommended. (Typically offered: Irregular)

**CHEM 669V. 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 6823. 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 5813. (Typically offered: Fall Even Years)

**CHEM 6863. Enzymes. 3 Hours.**

Isolation, characterization, and general chemical and biochemical properties of enzymes. Kinetics, mechanisms, and control of enzyme reactions. Prerequisite: CHEM 5813 and CHEM 5843. (Typically offered: Fall Odd Years)

**CHEM 6873. 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 5813 and CHEM 5843. (Typically offered: Spring Odd Years)

**CHEM 6883. 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 5813 and CHEM 5843. (Typically offered: Spring Even Years)

**CHEM 700V. 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.