

# CHEMISTRY (CHEM)

## CHEM 821 Analytical Chemistry

**Crosslisted with:** CHEM 421

**Prerequisites:** CHEM 221 or CHEM 221A & CHEM 221L and MATH 106; parallel CHEM 423/823

**Description:** Chemical and physical properties applied to quantitative chemical analysis. Solution equilibria, stoichiometry, and instrumental theory and techniques.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Offered:** SPRING

**Prerequisite for:** CHEM 423, CHEM 823; CHEM 824; CHEM 825A; CHEM 825B; CHEM 825D; CHEM 825G; CHEM 825J; CHEM 991A

## CHEM 823 Analytical Chemistry Laboratory

**Crosslisted with:** CHEM 423

**Prerequisites:** CHEM 421/821 or parallel.

**Notes:** It is suggested that CHEM 423 be taken parallel with CHEM 421.

**Description:** Lab designed to accompany CHEM 421/821. Applications of analytical chemical principles to laboratory problems.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**Course and Laboratory Fee:** \$65

## CHEM 824 Applied Problems in Analytical Chemistry

**Prerequisites:** CHEM 821

**Description:** Selection and execution of analytical methods in the solution of typical academic and industrial chemical problems.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Prerequisite for:** CHEM 825A; CHEM 825B; CHEM 825D; CHEM 825E; CHEM 825G; CHEM 825J; CHEM 991A

## CHEM 825A Ionic Equilibria

**Prerequisites:** CHEM 821 or 824

**Description:** Survey of theory of ionic equilibrium systems of importance in chemical analysis.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**Offered:** FALL

**Prerequisite for:** CHEM 825K

## CHEM 825B Electrochemical Methods

**Prerequisites:** CHEM 821 or 824

**Description:** Survey of principles and applications of electroanalytical chemistry.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

## CHEM 825D Mass Spectrometry

**Prerequisites:** CHEM 821 or 824 or permission

**Description:** Comprehensive study of the fundamentals and applications of mass spectrometry including ionization methods, mass analyzers, hybrid instruments, and ion dissociation methods. Each topic will include illustrative examples involving a variety of analytes and application areas.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Offered:** SPRING

## CHEM 825E Data Handling and Statistics

**Prerequisites:** CHEM 824

**Description:** Application of statistical, graphical and numerical methods for the treatment of analytical chemical data.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**Offered:** SPRING

## CHEM 825G Chromatographic Separations

**Prerequisites:** CHEM 821 or 824

**Description:** Survey of principles and applications of modern chromatographic analysis including the general chemical and physical principles of chemical separations, gas or liquid chromatography, and electrophoretic methods. The applications and instrumentation in these methods are discussed, along with advanced separation techniques and hybrid methods.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Offered:** SPRING

## CHEM 825J Optical Methods of Analysis

**Prerequisites:** CHEM 821 or 824

**Description:** Survey of principles and analytical application of modern optical spectrometric methods.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

## CHEM 825K Introduction to Nuclear Magnetic Resonance

**Prerequisites:** CHEM 825A

**Description:** Introduction to the theory and techniques of nuclear magnetic resonance (NMR) spectroscopy with a particular application to the structure determination of organic compounds. Basic theory of NMR that includes chemical shifts, coupling constants and relaxation. Topics include the application and analysis of two-dimensional NMR spectra to determine chemical structures, the basic design and implementation of an NMR experiment or pulse sequence, and NMR instrumentations, RF pulses, experimental and processing parameters.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Prerequisite for:** CHEM 925

**CHEM 831 Biochemistry I: Structure and Metabolism****Crosslisted with:** BIOC 431, BIOC 831, BIOS 431, BIOS 831, CHEM 431**Prerequisites:** LIFE 120 with a grade of C or better; CHEM 252 or CHEM 262 with a grade of C or better.**Notes:** BIOS 201 or PLAS 215 is recommended. First course of a two-semester, comprehensive biochemistry course sequence.**Description:** Structure and function of proteins, nucleic acids, carbohydrates and lipids; nature of enzymes; major metabolic pathways of catabolism; and biochemical energy production.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**Offered:** FALL/SPR**Prerequisite for:** ASCI 820; ASCI 917; ASCI 925, NUTR 925; ASCI 926, NUTR 926; ASCI 927, NUTR 927; BIOC 305; BIOC 390; BIOC 432, BIOC 832, BIOS 432, CHEM 432, CHEM 832, BIOS 832; BIOC 433, BIOC 833, BIOS 433, BIOS 833, CHEM 433, CHEM 833; BIOC 433H; BIOC 440; FDST 470, FDST 870; NUTR 450; NUTR 455; NUTR 820, NUTR 420; NUTR 821; PLAS 434, BIOC 434, BIOS 434, CHEM 434, AGRO 834, BIOC 834, BIOS 834, CHEM 834; VBMS 410; VBMS 805; VBMS 950**CHEM 832 Biochemistry II: Metabolism and Biological Information****Crosslisted with:** BIOC 432, BIOC 832, BIOS 432, CHEM 432, BIOS 832**Prerequisites:** BIOC 431/831 with a grade of C or better; BIOS 201 or PLAS 215 with a grade of C or better.**Notes:** Continuation of BIOC 431/831.**Description:** Major metabolic pathways of anabolism, structural and biochemical aspects of biological information flow and use in biotechnology.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**Offered:** FALL/SPR**Prerequisite for:** ASCI 949, BIOC 949, NUTR 949; BIOC 435; BIOC 932, BIOS 932, CHEM 932; BIOC 933, BIOS 933, CHEM 933; BIOC 934, BIOS 934, CHEM 934; BIOC 935, BIOS 935, CHEM 935; BIOC 998; VBMS 919; VBMS 950; VBMS 951**CHEM 833 Biochemistry Laboratory****Crosslisted with:** BIOC 433, BIOC 833, BIOS 433, BIOS 833, CHEM 433**Prerequisites:** BIOC 431/831 or parallel; or CHEM 435/835.**Description:** Introduction to techniques used in biochemical and biotechnology research, including measurement of pH, spectroscopy, analysis of enzymes, chromatography, fractionation of macromolecules, electrophoresis, and centrifugation.**Credit Hours:** 2**Max credits per semester:** 2**Max credits per degree:** 2**Grading Option:** Grade Pass/No Pass Option**Offered:** FALL/SPR**Prerequisite for:** BIOC 437, BIOC 837, BIOS 437, BIOS 837; BIOC 898**Course and Laboratory Fee:** \$50**CHEM 834 Plant Biochemistry****Crosslisted with:** PLAS 434, BIOC 434, BIOS 434, CHEM 434, AGRO 834, BIOC 834, BIOS 834**Prerequisites:** BIOC/BIOS/CHEM 431/831.**Description:** Biochemical metabolism unique to plants. Relationships of topics previously acquired in general biochemistry to biochemical processes unique to plants. Biochemical mechanisms behind physiological processes discussed in plant or crop physiology.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**CHEM 835 Chemical Biology****Crosslisted with:** CHEM 435**Prerequisites:** CHEM 252 or 262, and CHEM 221A/CHEM 221L**Description:** Fundamentals of chemical biology with an emphasis on the underlying principles of biomolecular structures, macromolecular-small molecule interactions, including mechanistic aspects of enzymes and cofactors, use of modified enzymes to alter biochemical pathways, and the use of chemical tools for understanding biological processes.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**Offered:** FALL**Prerequisite for:** BIOC 433, BIOC 833, BIOS 433, BIOS 833, CHEM 433, CHEM 833; CHEM 437, CHEM 837**CHEM 836 Physical Basis of Macromolecular Function****Crosslisted with:** BIOC 836**Description:** Introduction to the theory and practice of biophysical characterization of macromolecules. The course will be based on primary research literature, although a supporting text will be used for in depth discussion of the methods.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**CHEM 837 Chemical Biology Laboratory****Crosslisted with:** CHEM 437**Prerequisites:** BIOC/BIOS/CHEM 431/831 or CHEM 435/835 or parallel**Description:** Introduction to techniques of chemical biology including the study of biological macromolecules and their interaction with small molecule ligands and effectors. Explore modern methods for macromolecular isolation, characterization, and for kinetic analysis and modeling.**Credit Hours:** 2**Max credits per semester:** 2**Max credits per degree:** 2**Grading Option:** Graded**Offered:** SPRING**Course and Laboratory Fee:** \$65

**CHEM 838 Computational Chemical Biology**

**Crosslisted with:** CHEM 438

**Description:** Introduction to computational chemistry applications including molecular dynamics simulations, density functional theory optimizations, and computational docking of small molecules to protein targets.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Offered:** SPRING

**CHEM 841 Inorganic Chemistry**

**Crosslisted with:** CHEM 441

**Prerequisites:** CHEM 221 or CHEM 221A & CHEM 221L with a minimum grade of C; CHEM 252 or 262.

**Notes:** CHEM 443 is recommended to be taken parallel.

**Description:** CHEM 441/841 and the accompanying lab course, CHEM 443/843, constitute a basic course in inorganic chemistry. Structure, bonding, properties, and reactions of inorganic compounds with emphasis on the relationships and trends that are embodied in the periodic table of the elements.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Prerequisite for:** CHEM 845

**CHEM 843 Inorganic Chemistry Laboratory**

**Crosslisted with:** CHEM 443

**Prerequisites:** CHEM 252 or 262, and 264; parallel: CHEM 841

**Notes:** It is suggested that CHEM 443 be taken in parallel with CHEM 441.

**Description:** Introduction to typical inorganic chemistry laboratory techniques through the preparation and characterization of inorganic compounds.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**Prerequisite for:** CHEM 845

**Course and Laboratory Fee:** \$65

**CHEM 845 Modern Inorganic Chemistry**

**Prerequisites:** CHEM 841, 843, and 882

**Description:** Topics in inorganic chemistry such as bioinorganics, catalysis, organometallic, materials and solid state chemistry. Theoretical principles and practical applications, and on correlating the physical and chemical properties of the chemical elements and inorganic chemical compounds.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Prerequisite for:** CHEM 943; CHEM 945; CHEM 991B

**CHEM 853 Biosynthetic Pathways**

**Crosslisted with:** CHEM 453

**Prerequisites:** CHEM 251 or CHEM 261

**Description:** Biosynthetic pathways for bioactive natural products and pathway engineering with an emphasis on those that are medicinally significant, including the biosynthesis of fatty acids, polyketides, phenylpropanoids, terpenoids, steroids, alkaloids, non-ribosomal peptides, and carbohydrates.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Offered:** SPRING

**CHEM 855 Advanced Organic Chemistry**

**Prerequisites:** CHEM 252 or 262 or equivalent

**Description:** Survey of modern concepts of structure/bonding, acidity/basicity, stereochemistry, and reaction mechanisms. Introduction to the fundamental tools used to investigate reaction mechanism (transition state theory, elementary Huckel theory, linear free energy relationships, rate laws and kinetic isotope effects). Mechanistic examples emphasize the major classes of organic reactions, particularly concerted, carbanionic and carbocationic. Development of reasoning skills.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Prerequisite for:** CHEM 865A; CHEM 865B; CHEM 865E; CHEM 952; CHEM 953; CHEM 954; CHEM 964; CHEM 991E

**CHEM 863 Advanced Organic Preparations**

**Crosslisted with:** CHEM 463

**Prerequisites:** CHEM 252 and CHEM 254.

**Notes:** For students who wish additional laboratory work in organic chemistry.

**Credit Hours:** 1-5

**Min credits per semester:** 1

**Max credits per semester:** 5

**Max credits per degree:** 5

**Grading Option:** Grade Pass/No Pass Option

**CHEM 865A Organic Reactions**

**Prerequisites:** CHEM 855

**Description:** Modern reactions and methodology for organic synthesis. Carbon-carbon bond-forming reactions; alkene synthesis; oxidation; reductions; function group interconversion; use of protecting groups; and organometallic reagents.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**CHEM 865B Advanced Organic Reactions**

**Prerequisites:** CHEM 855 and permission

**Description:** Additional reactions of importance for organic synthesis. Examples of topics which may be covered include cycloadditions, rearrangements, and radical-based transformations.

**Credit Hours:** 1

**Max credits per semester:** 1

**Max credits per degree:** 1

**Grading Option:** Grade Pass/No Pass Option

**CHEM 865E Bioconjugate Reactions****Prerequisites:** CHEM 855 and permission**Description:** Organic reactions of particular relevance to interdisciplinary research in analytical/bioanalytical chemistry, biochemistry, and the life sciences. Formation of esters, thioesters, and amides; surface functionalization of inorganic or polymer supports; methods for cross-linking, conjugation, or immobilization of chemicals and biomolecules.**Credit Hours:** 1**Max credits per semester:** 1**Max credits per degree:** 1**Grading Option:** Grade Pass/No Pass Option**CHEM 871 Physical Chemistry****Crosslisted with:** CHEM 471**Prerequisites:** CHEM 221 or CHEM 221A & CHEM 221L; MATH 107; and PHYS 142 or 212. Credit toward the degree may be earned in only one of CHEM 471 or 481.**Description:** Conceptual and mathematical foundations of classical and statistical thermodynamics. Applications of thermodynamics to phase and chemical equilibria. Thermodynamics of solutions of small molecules and of polymers. Biological applications of thermodynamics. Introduction to chemical and biochemical spectroscopy.**Credit Hours:** 4**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Grade Pass/No Pass Option**Prerequisite for:** BIOC 486, BIOC 886, CHEM 486, CHEM 886**CHEM 874 Topics in Chemical Pedagogy****Crosslisted with:** TEAC 874**Description:** Topical chemistry content for high school teachers organized according to the National Science Education Standards. A maximum combined total of 12 hours from TEAC \*869 and/or \*874 may be counted toward a masters degree. Credit in this course will not count towards a graduate degree in chemistry. Courses are Web-based.**Credit Hours:** 1-3**Min credits per semester:** 1**Max credits per semester:** 3**Max credits per degree:** 12**Grading Option:** Grade Pass/No Pass Option**CHEM 874L Topics in Chemical Pedagogy - Addressing Misconceptions****Crosslisted with:** TEAC 874L**Description:** Topical chemistry content for high school teachers organized according to the National Science Education Standards. A maximum combined total of 12 hours from TEAC \*869 and/or \*874 may be counted toward a masters degree. Credit in this course will not count towards a graduate degree in chemistry. Courses are Web-based.**Credit Hours:** 1-3**Min credits per semester:** 1**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**CHEM 875 Chemical Pedagogy in the High School Laboratory****Crosslisted with:** TEAC 875**Description:** Laboratory-based courses addressing specific issues connected with teaching laboratory work in high school chemistry programs. Credit in this course will not count towards a graduate degree in chemistry.**Credit Hours:** 1-3**Min credits per semester:** 1**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**CHEM 881 Physical Chemistry I****Crosslisted with:** CHEM 481**Prerequisites:** CHEM 221 or CHEM 221A & CHEM 221L with grade of at least C; MATH 208; PHYS 212. Credit toward the degree may be earned in only one of CHEM 471 or 481.**Description:** CHEM 481/881 and 482/882 with accompanying lab 484/884 form a continuous basic course in physical chemistry for students interested in chemistry as a profession. Introduction to quantum mechanics and statistical mechanics; application to problems in atomic and molecular structure and to spectroscopy.**Credit Hours:** 4**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Grade Pass/No Pass Option**Prerequisite for:** BIOC 486, BIOC 886, CHEM 486, CHEM 886; CHEM 482, CHEM 882; CHEM 484, CHEM 884; CHEM 484A, CHEM 884A; CHEM 991J; PHYS 422, PHYS 822, ECEN 422, ECEN 822**CHEM 882 Physical Chemistry II****Crosslisted with:** CHEM 482**Prerequisites:** CHEM 481/881.**Notes:** This course should parallel CHEM 484/884. Continuation of CHEM 481/881.**Description:** Thermodynamics and statistical mechanics and their application to the study of solids, liquids, gases, solutions, phase equilibria, and chemical equilibria. Chemical kinetics and reaction dynamics.**Credit Hours:** 4**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Grade Pass/No Pass Option**Prerequisite for:** CHEM 484, CHEM 884; CHEM 484A, CHEM 884A; CHEM 845; CHEM 987A; CHEM 987B; CHEM 991J; CHME 925; MATL 962; MATL 972**CHEM 884 Physical Chemical Measurements****Crosslisted with:** CHEM 484**Prerequisites:** CHEM 481/881; CHEM 482/882 or parallel.**Notes:** It is suggested that CHEM 484/884 be taken in parallel with CHEM 482/882.**Description:** Applications of physical measurements and principles to study chemical systems and processes.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**Course and Laboratory Fee:** \$65

**CHEM 884A Physical Chemical Measurements**

**Crosslisted with:** CHEM 484A

**Prerequisites:** CHEM 481/881; CHEM 482/882 or parallel.

**Notes:** It is suggested that CHEM 484A/884A be taken in parallel with CHEM 482/882.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**Course and Laboratory Fee:** \$65

**CHEM 885 Survey of Modern Physical Chemistry**

**Description:** A one-semester survey course in modern physical chemistry, covering chemical thermodynamics, chemical kinetics, quantum chemistry, molecular structure and spectroscopy.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Prerequisite for:** CHEM 943; CHEM 972; CHEM 982; CHEM 983; CHEM 984; CHEM 987A; CHEM 987B; CHEM 991J

**CHEM 886 Advanced Topics in Biophysical Chemistry**

**Crosslisted with:** BIOC 486, BIOC 886, CHEM 486

**Prerequisites:** CHEM 471/871 or CHEM 481/881.

**Description:** Applications of thermodynamics to biochemical phenomena, optical properties of proteins and polynucleotides, and kinetics of rapid reactions.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**CHEM 898 Special Problems**

**Prerequisites:** Permission

**Credit Hours:** 1-24

**Min credits per semester:** 1

**Max credits per semester:** 24

**Max credits per degree:** 24

**Grading Option:** Grade Pass/No Pass Option

**CHEM 898A Introduction to Graduate Research**

**Prerequisites:** Admission to chemistry graduate program.

**Description:** Series of lectures and activities designed to prepare for graduate research and graduate studies in chemistry.

**Credit Hours:** 1-3

**Min credits per semester:** 1

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**CHEM 898B Research Update Interview**

**Description:** Preparation for and presentation of the Research Update Interview. Open to graduate students in Chemistry in the third semester of their program, or with instructor permission.

**Credit Hours:** 1

**Max credits per semester:** 1

**Max credits per degree:** 1

**Grading Option:** Pass No-Pass

**CHEM 898E Original Proposal Oral**

**Description:** Preparation for and presentation of an Original Research Proposal. Open to graduate students in Chemistry in the sixth semester of their program, or with instructor permission.

**Credit Hours:** 1

**Max credits per semester:** 1

**Max credits per degree:** 1

**Grading Option:** Pass No-Pass

**CHEM 899 Masters Thesis**

**Prerequisites:** Admission to masters degree program and permission of major adviser

**Credit Hours:** 1-10

**Min credits per semester:** 1

**Max credits per semester:** 10

**Max credits per degree:** 99

**Grading Option:** Grade Pass/No Pass Option

**CHEM 925 NMR Spectroscopy and Macromolecular Structures**

**Prerequisites:** CHEM 825K

**Description:** Advanced theory and techniques of nuclear magnetic resonance (NMR) spectroscopy and its application to the structural and dynamic analysis of macromolecules and macromolecule-ligand complexes.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Graded

**Offered:** FALL/SPR

**CHEM 932 Proteins**

**Crosslisted with:** BIOC 932, BIOS 932

**Prerequisites:** BIOC/BIOS/CHEM 832 or BIOC/BIOS/CHEM 839

**Description:** Protein structure and function.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**CHEM 933 Enzymes**

**Crosslisted with:** BIOC 933, BIOS 933

**Prerequisites:** BIOC/BIOS/CHEM 432/832, or BIOC/BIOS/CHEM 839

**Description:** Kinetics regulation and reaction mechanisms of enzymes.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**CHEM 934 Genome Dynamics and Gene Expression**

**Crosslisted with:** BIOC 934, BIOS 934

**Prerequisites:** BIOC/BIOS/CHEM 832

**Description:** Detailed examination of dynamic control mechanisms of genome maintenance and gene regulation. Mechanisms of transcription, translation, and replication based on analysis of current and seminal literature.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option



**CHEM 935 Metabolic Function and Dysfunction****Crosslisted with:** BIOC 935, BIOS 935**Prerequisites:** BIOC/CHEM/BIOS 432/832 and permission**Description:** Current metabolic research at the bioenergetic, metabolomic, and molecular level. The normal metabolic processes that go awry in cancer, obesity, and oxidative stress.**Credit Hours:** 3**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**CHEM 936 Molecular Biology Methods****Prerequisites:** CHEM 431/831, or CHEM 835**Description:** The fundamentals of molecular biology and biotechnology and applications. The fundamentals include methods for DNA cloning, sequencing, annotation, recombination, mutagenesis, and expression. The applications include the production of molecular diagnostics and therapeutic agents etc. with a focus on the molecular biotechnology of microbial systems.**Credit Hours:** 2-3**Min credits per semester:** 2**Max credits per semester:** 3**Max credits per degree:** 3**Grading Option:** Grade Pass/No Pass Option**CHEM 943 Solid-State Chemistry****Prerequisites:** CHEM 845 and 885**Description:** Advanced course dealing with the structure, bonding, properties, and reactions of inorganic solid materials.**Credit Hours:** 2**Max credits per semester:** 2**Max credits per degree:** 2**Grading Option:** Grade Pass/No Pass Option**CHEM 945 Advanced Inorganic Chemistry****Prerequisites:** CHEM 845**Description:** Chemistry of the metallic compounds.**Credit Hours:** 2**Max credits per semester:** 2**Max credits per degree:** 2**Grading Option:** Grade Pass/No Pass Option**CHEM 946 Organometallic Chemistry****Description:** The chemistry of compounds that occupy the boundary between inorganic and organic chemistry.**Credit Hours:** 1-6**Min credits per semester:** 1**Max credits per semester:** 6**Max credits per degree:** 6**Grading Option:** Grade Pass/No Pass Option**CHEM 952 Stereochemistry of Organic Compounds****Prerequisites:** CHEM 855**Description:** Types of stereoisomerism in organic compounds. Steric strain and certain other steric effects in reactions of organic substances.**Credit Hours:** 2-4**Min credits per semester:** 2**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Grade Pass/No Pass Option**CHEM 953 Organic Reaction Mechanisms****Prerequisites:** CHEM 855**Description:** Classes of reaction mechanisms and the methods whereby mechanisms may be studied. Kinetic and equilibrium studies; isotopic labeling; activation parameters; linear free energy relationships; stereochemistry; NMR and other spectroscopic methods as applied to reaction mechanisms, including direct observation of reactive intermediates; interpreting the results of semi-empirical calculations of reaction pathways; and studies of acid- and base-catalysis mechanisms.**Credit Hours:** 2-4**Min credits per semester:** 2**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Grade Pass/No Pass Option**CHEM 954 Physical Organic Chemistry****Prerequisites:** CHEM 855**Description:** Elementary aspects of molecular orbital (MO) theory. Selected concepts in molecular symmetry and topology. Applications of MO calculations to reaction mechanisms and elucidation of electronic structure for organic molecules: calculations vs. experiment. Introduction to selected interdisciplinary topics.**Credit Hours:** 2-4**Min credits per semester:** 2**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Grade Pass/No Pass Option**CHEM 963 Metals in Organic Synthesis****Prerequisites:** CHEM 865**Description:** Use of organometallic reagents and catalysts in organic synthesis.**Credit Hours:** 2-4**Min credits per semester:** 2**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Grade Pass/No Pass Option**CHEM 964 Bioorganic Chemistry****Prerequisites:** CHEM 855**Description:** Organic chemistry of biological systems with particular emphasis on the molecular mechanisms of action of enzymes and their associated cofactors.**Credit Hours:** 2-4**Min credits per semester:** 2**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Grade Pass/No Pass Option**CHEM 965 Advanced Synthetic Strategy****Prerequisites:** CHEM 865**Description:** Strategy and execution of organic synthesis. Retrosynthetic analysis; total synthesis of natural and unnatural products; methods for asymmetric synthesis; and applications of pericyclic reactions.**Credit Hours:** 2-4**Min credits per semester:** 2**Max credits per semester:** 4**Max credits per degree:** 4**Grading Option:** Grade Pass/No Pass Option

**CHEM 972 Quantum Chemistry I**

**Prerequisites:** CHEM 885

**Description:** Basic principles of quantum mechanics applied to problems in molecular structure and chemical bonding.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Prerequisite for:** CHEM 987A; CHEM 987B

**CHEM 982 Chemical Thermodynamics**

**Prerequisites:** CHEM 885

**Description:** Principles of thermodynamics, with applications to chemical systems and processes, and illustrations from current literature.

**Credit Hours:** 3

**Max credits per semester:** 3

**Max credits per degree:** 3

**Grading Option:** Grade Pass/No Pass Option

**Prerequisite for:** CHEM 983; CHEM 984; CHME 825

**CHEM 983 Statistical Thermodynamics**

**Prerequisites:** CHEM 885 or 982

**Description:** Application of equilibrium statistical mechanics to problems of chemical interest. Calculation of thermodynamic functions from molecular structure data. Molecular theories of gases, liquids, and solutions.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**CHEM 984 Chemical Kinetics**

**Prerequisites:** CHEM 885 or 982

**Description:** Concepts and equations; successive, competing, and reversible reactions; equilibrium, collision, and activated-complex theories; reaction mechanism; heterogeneous reactions; current literature.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**CHEM 987A Molecular Spectroscopy**

**Prerequisites:** CHEM 482/882 or 885 or 972; and permission.

**Description:** A quantitative treatment of the principal methods of electronic, optical, and magnetic resonance spectroscopy.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**CHEM 987B Scattering**

**Prerequisites:** CHEM 482/882 or 885 or 972; and permission.

**Description:** A quantitative treatment of the principal methods of light, electron and neutron scattering.

**Credit Hours:** 2

**Max credits per semester:** 2

**Max credits per degree:** 2

**Grading Option:** Grade Pass/No Pass Option

**CHEM 990 Seminar in Chemistry**

**Description:** CHEM 990 consists of monthly lectures presented by guest speakers from other colleges and universities, the government, and industry. Registration in CHEM 990 is required of all full-time CHEM graduate students. Current topics of chemical interest.

**Credit Hours:** 1-5

**Min credits per semester:** 1

**Max credits per semester:** 5

**Max credits per degree:** 5

**Grading Option:** Grade Pass/No Pass Option

**CHEM 991A Selected Topics in Analytical Chemistry**

**Prerequisites:** CHEM 821 or 824, or parallel

**Credit Hours:** 1-6

**Min credits per semester:** 1

**Max credits per semester:** 6

**Max credits per degree:** 6

**Grading Option:** Grade Pass/No Pass Option

**CHEM 991B Special Topics in Inorganic Chemistry**

**Prerequisites:** CHEM 845 and permission

**Credit Hours:** 1-6

**Min credits per semester:** 1

**Max credits per semester:** 6

**Max credits per degree:** 6

**Grading Option:** Grade Pass/No Pass Option

**CHEM 991E Special Topics in Organic Chemistry**

**Prerequisites:** CHEM 855

**Description:** Topics of special interest in modern organic chemistry.

**Credit Hours:** 2-4

**Min credits per semester:** 2

**Max credits per semester:** 4

**Max credits per degree:** 4

**Grading Option:** Grade Pass/No Pass Option

**CHEM 991J Special Topics in Physical Chemistry**

**Prerequisites:** CHEM 881 and 882, or 885

**Credit Hours:** 1-6

**Min credits per semester:** 1

**Max credits per semester:** 6

**Max credits per degree:** 6

**Grading Option:** Grade Pass/No Pass Option

**CHEM 992A Graduate Seminar in Analytical/Bioanalytical Chemistry**

**Prerequisites:** Graduate student enrollment in Chemistry

**Credit Hours:** 1-6

**Min credits per semester:** 1

**Max credits per semester:** 6

**Max credits per degree:** 6

**Grading Option:** Grade Pass/No Pass Option

**CHEM 992E Graduate Seminar in Organic Chemistry/Chemical Biology**

**Prerequisites:** Graduate student enrollment in Chemistry

**Credit Hours:** 1-6

**Min credits per semester:** 1

**Max credits per semester:** 6

**Max credits per degree:** 6

**Grading Option:** Grade Pass/No Pass Option

**CHEM 992J Graduate Seminar in Physical/Inorganic/Materials Chemistry**

**Prerequisites:** Graduate student enrollment in Chemistry, or permission.

**Credit Hours:** 1-6

**Min credits per semester:** 1

**Max credits per semester:** 6

**Max credits per degree:** 6

**Grading Option:** Grade Pass/No Pass Option

**CHEM 999 Doctoral Dissertation**

**Prerequisites:** Admission to doctoral degree program and permission of supervisory committee chair

**Credit Hours:** 1-24

**Min credits per semester:** 1

**Max credits per semester:** 24

**Max credits per degree:** 99

**Grading Option:** Grade Pass/No Pass Option