CHEM 821 Analytical Chemistry
Crosslisted with: CHEM 421
Prerequisites: CHEM 471/871 or 481/881; 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
Format: LEC

CHEM 823 Analytical Chemistry Laboratory
Crosslisted with: CHEM 423
Prerequisites: Same as for CHEM 421/821.
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
Format: LAB

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
Format: LEC

CHEM 825A Ionic Equilibria
Prerequisites: or parallel: CHEM 821 or *824
Description: Survey of theory of ionic equilibrium systems of importance in chemical analysis.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

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
Format: LEC

CHEM 825D Mass Spectrometry
Prerequisites: CHEM 821 or *824
Description: Survey of the fundamentals (1 cr) and applications (1 cr) of mass spectrometry.
Credit Hours: 1-2
Min credits per semester: 1
Max credits per semester: 2
Max credits per degree: 2
Format: LEC

CHEM 825E Data Handling
Prerequisites: or parallel: CHEM 821 or *824
Description: Application of statistical, graphical and numerical methods for the treatment of analytical chemical data.
Credit Hours: 1
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CHEM 825G Chromatographic Separations
Prerequisites: CHEM 821 or *824
Description: Survey of principles and applications of modern chromatographic analysis.
Credit Hours: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC

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
Format: LEC

CHEM 831 Structure and Metabolism
Crosslisted with: BIOC 431, BIOC 831, BIOS 431, BIOS 831, CHEM 431
Prerequisites: CHEM 252 or CHEM 262 with a grade of C or better.
LIFE 120 and BIOS 206 are recommended.
Notes: 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
Format: LEC
Prerequisite for: BIOC 435; BIOC 934, BIOS 934, CHEM 934

CHEM 832 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 206 or AGRO 215.
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
Format: LEC
Prerequisite for: BIOC 435; BIOC 934, BIOS 934, CHEM 934
CHEM 833 Biochemistry Laboratory
Crosslisted with: BIOC 433, BIOC 833, BIOS 833, CHEM 433
Prerequisites: CHEM 431/831 (or concurrent enrollment) 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
Format: LEC

CHEM 843 Inorganic Chemistry Laboratory
Crosslisted with: CHEM 443
Prerequisites: CHEM 252 or 262, and 264; parallel: CHEM 841
Notes: Parallel: CHEM 441/841 or permission.
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
Format: LEC

CHEM 834 Plant Biochemistry
Crosslisted with: AGRO 434, BIOC 434, BIOS 434, CHEM 434, AGRO 834,
BIOS 834, BIOC 434, BIOS 834
Prerequisites: BIOC/BIOS/CHM 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
Format: LEC

CHEM 835 Modern Inorganic Chemistry
Prerequisites: CHEM 252 or 262, and 871 or 881
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
Format: LEC

CHEM 848 Redox Biochemistry
Crosslisted with: BIOC 848
Prerequisites: 3 hrs BIOC and 3 hrs inorganic chemistry
Description: Redox (oxidation and reduction)-based biochemical
processes (energy generation, oxygen transfer, enzyme catalysis,
signaling, gene regulation, and diseases). Recent progress in these
areas. Roles of metals in biochemical reactions, metal homeostasis,
biosynthesis of metal cofactors and metal sites. Biochemistry
and pathophysiology of redoxactive species and radicals. Antioxidant
molecules and enzymes.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CHEM 845 Modern Inorganic Chemistry
Prerequisites: CHEM 841, 843, and 882 or permission
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
Format: LEC

CHEM 841 Inorganic Chemistry
Crosslisted with: CHEM 441
Prerequisites: CHEM 252 or 262, and 264; parallel CHEM 843
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
Format: LEC

CHEM 844 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 Hückel 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
Format: LEC

CHEM 842 Advanced Physical Chemistry
Prerequisites: CHEM 252 or 262 or equivalent
Description: Topics in physical 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
Format: LEC

CHEM 843 Physical Basis of Macromolecular Function
Crosslisted with: CHEM 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
Format: LEC

CHEM 846 Inorganic Chemistry Laboratory
Crosslisted with: CHEM 444
Prerequisites: CHEM 252 or 262, and 264; parallel: CHEM 841
Notes: Parallel: CHEM 441/841 or permission.
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
Format: LEC

CHEM 847 Physical Basis of Macromolecular Function
Crosslisted with: CHEM 837
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
Format: LEC

CHEM 848 Redox Biochemistry
Crosslisted with: BIOC 848
Prerequisites: 3 hrs BIOC and 3 hrs inorganic chemistry
Description: Redox (oxidation and reduction)-based biochemical
processes (energy generation, oxygen transfer, enzyme catalysis,
signaling, gene regulation, and diseases). Recent progress in these
areas. Roles of metals in biochemical reactions, metal homeostasis,
biosynthesis of metal cofactors and metal sites. Biochemistry
and pathophysiology of redoxactive species and radicals. Antioxidant
molecules and enzymes.
Credit Hours: 3
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CHEM 849 Advanced Physical 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 Hückel 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
Format: LEC
CHEM 863 Advanced Organic Preparations
Crosslisted with: CHEM 463
Prerequisites: CHEM 252 or 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
Format: LAB

CHEM 865A Organic Reactions
Prerequisites: CHEM 855 and permission
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: 2
Max credits per semester: 2
Max credits per degree: 2
Format: LEC

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
Format: LEC

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
Format: LEC

CHEM 871 Physical Chemistry
Crosslisted with: CHEM 471
Prerequisites: CHEM 114 and 116, or 221, with a grade of 'C' or better; MATH 106 and 238, or 107; one year college physics.
Notes: Credit may not be earned in both CHEM 471/871 and CHEM 481/881.
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
Format: LEC

CHEM 871E 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
Format: LEC

CHEM 874A Topics in Chemical Pedagogy - Green Chemistry
Crosslisted with: TEAC 874A
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: 2-3
Min credits per semester: 2
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CHEM 874D Topics in Chemical Pedagogy - Demonstrations for High School Chemistry
Crosslisted with: TEAC 874D
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
Format: LEC

CHEM 874E Topics in Chemical Pedagogy - Experiments for High School Chemistry
Crosslisted with: TEAC 874E
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
Format: LEC
CHEM 874J Topics in Chemical Pedagogy - Developing a Safety Culture
Crosslisted with: TEAC 874J
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
Max credits per semester: 1
Max credits per degree: 1
Format: LEC

CHEM 874K Topics in Chemical Pedagogy - Chemistry of Life Processes: Biomolecules
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: 2-3
Min credits per semester: 1
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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
Format: LEC

CHEM 874M Topics in Chemical Pedagogy - Mathematics Integration
Crosslisted with: MATH 874M, TEAC 874M
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. May be counted towards the MAT and MSct degrees in mathematics and statistics, not the MA, MS, or PhD. Courses are Web-based.
Credit Hours: 2-3
Min credits per semester: 2
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

CHEM 874N Topics in Chemical Pedagogy - Inquiry Strategies
Crosslisted with: TEAC 874N
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
Format: LEC

CHEM 874P Topics in Chemical Pedagogy - Chemistry in the Workplace
Crosslisted with: TEAC 874P
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
Format: LEC

CHEM 874Y Topics in Chemical Pedagogy - Graphing Calculator Activities
Crosslisted with: TEAC 874Y
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: 2-3
Min credits per semester: 2
Max credits per semester: 3
Max credits per degree: 3
Format: LEC

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
Format: LEC

CHEM 875A Chemical Pedagogy in the High School Laboratory - Small-scale Experiments
Crosslisted with: TEAC 875A
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
Format: LEC
CHEM 875B Chemical Pedagogy in the High School Laboratory - Technology Integration
Crosslisted with: TEAC 875B
**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:** 3-6
**Min credits per semester:** 3
**Max credits per semester:** 6
**Max credits per degree:** 6
**Format:** LEC

CHEM 875E Chemical Pedagogy in the High School Laboratory - Inquiry Experiments
Crosslisted with: TEAC 875E
**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
**Format:** LEC

CHEM 875K Chemical Pedagogy in the High School Laboratory - At-home Experiments
Crosslisted with: TEAC 875K
**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
**Format:** LEC

CHEM 875P Chemical Pedagogy in the High School Laboratory - Probe Experiments
Crosslisted with: TEAC 875P
**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
**Format:** LEC

CHEM 875T Chemical Pedagogy in the High School Laboratory - Traditional Experiments
Crosslisted with: TEAC 875T
**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
**Format:** LEC

CHEM 881 Physical Chemistry I
Crosslisted with: CHEM 481
**Prerequisites:** CHEM 221 with grade of at least C; MATH 208; PHYS 212.
**Notes:** Credit may not be earned in both CHEM 471/871 and 481/881.
**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
**Format:** LEC

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
**Format:** LEC

CHEM 884 Physical Chemical Measurements
Crosslisted with: CHEM 484
**Prerequisites:** CHEM 481/881. Parallel with CHEM 482/882.
**Notes:** Lab designed to accompany CHEM 482.
**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
**Format:** LAB

CHEM 884A Physical Chemical Measurements
Crosslisted with: CHEM 484A
**Notes:** Parallel with CHEM 482/882.
**Credit Hours:** 2
**Max credits per semester:** 2
**Max credits per degree:** 2
**Format:** LAB

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
**Format:** LEC
**CHEM 886 Advanced Topics in Biophysical Chemistry**  
*Crosslisted with: BIOC 486, BIOC 886, BIOS 486, BIOS 886, CHEM 486*  
**Prerequisites:** CHEM 471/871 or 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  
**Format:** LEC

**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  
**Format:** LEC

**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  
**Format:** LEC

**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  
**Min credits per semester:** 1  
**Max credits per semester:** 1  
**Max credits per degree:** 1  
**Format:** IND

**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  
**Min credits per semester:** 1  
**Max credits per semester:** 1  
**Max credits per degree:** 1  
**Format:** IND

**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  
**Format:** IND

**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  
**Format:** LEC

**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  
**Format:** LEC

**CHEM 934 Genome Dynamics and Gene Expression**  
*Crosslisted with: BIOC 934, BIOS 934*  
**Prerequisites:** BIOC/BIOS/CHEM 832 or permission  
**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  
**Format:** LEC

**CHEM 935 Metabolic Function and Dysfunction**  
*Crosslisted with: BIOC 935, BIOS 935*  
**Prerequisites:** BIOC/BIOS/CHEM 832 or 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  
**Format:** LEC

**CHEM 936 Molecular Biology Methods**  
**Prerequisites:** CHEM 431/831, or CHEM 835, or with instructor permission  
**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  
**Format:** LEC

**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  
**Format:** LEC

**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  
**Format:** LEC
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
Format: LEC

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
Format: LEC

CHEM 947 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
Format: LEC

CHEM 956 Advanced Synthetic Strategy
Prerequisites: CHEM 855
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
Format: LEC

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
Format: LEC

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
Format: LEC

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
Format: LEC

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
Format: LEC

CHEM 965 Advanced Synthetic Strategy
Prerequisites: CHEM 855
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
Format: LEC

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
Format: LEC

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
Format: LEC

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
Format: LEC

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
Format: LEC
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  
**Format:** LEC

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  
**Format:** LEC

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  
**Format:** LEC

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  
**Format:** LEC

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  
**Format:** LEC

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  
**Format:** LEC

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  
**Format:** LEC

CHEM 992A Graduate Seminar in Analytical/Bioanalytical 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  
**Format:** LEC

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

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  
**Format:** LEC

CHEM 992K Seminar in Biological Chemistry  
**Crosslisted with:** BIOC 992K  
**Prerequisites:** BIOC 832 or *839; and permission  
**Credit Hours:** 1-2  
**Min credits per semester:** 1  
**Max credits per semester:** 2  
**Max credits per degree:** 2  
**Format:** LEC

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  
**Format:** IND