CHEM 821 Analytical Chemistry
Crosslisted with: CHEM 421
Prerequisites: CHEM 471/871 or CHEM 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
Grading Option: Grade Pass/No Pass Option
Prerequisite for: CHEM 423, CHEM 823; CHEM 824; CHEM 825A; CHEM 825B; CHEM 825D; CHEM 825G; 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
Prerequisite for: CHEM 421, CHEM 821

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

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
Grading Option: Grade Pass/No Pass Option
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

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
CHEM 831 Biochemistry I: Structure and Metabolism

Crosslisted with: BIOC 431, BIOC 831, 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 206 or AGRO 215 is recommended.

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: AGRO 434, BIOC 434, BIOS 434, CHEM 434, AGRO 834, BIOC 834, BIOS 834, CHEM 834; AGRO 810, BIOC 810, HORT 810; ASCI 820; ASCI 917; ASCI 925, NUTR 925; ASCI 926, NUTR 926; ASCI 927, NUTR 927; BIOC 305; BIOC 432, BIOC 832, BIOC 432, CHEM 432, CHEM 832, BIOS 832; BIOC 433, BIOS 833, BIOS 833, CHEM 433, CHEM 833; BIOC 440; BIOS 879; BIOS 950, VBMS 950; FDST 470, FDST 870; NUTR 450; NUTR 455; NUTR 820; NUTR 821; VBMS 410; VBMS 805

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 206 or AGRO 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, BIOS 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; CHEM 998; BIOS 950, VBMS 950; VBMS 919; 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; CHEM 498

CHEM 834 Plant Biochemistry

Crosslisted with: AGRO 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 221

Notes: Credit toward the undergraduate or graduate degree cannot be earned in both CHEM 435/835 and 431/831 and/or CHEM 432/832 or their equivalents.

Description: Fundamentals of chemical biology with an emphasis on the underlying principles of biomolecular structures, macromolecule-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

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: 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: FALL
CHEM 841 Inorganic Chemistry
Crosslisted with: CHEM 441
Prerequisites: CHEM 221 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 421, CHEM 821; 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

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 848 Redox Biochemistry
Crosslisted with: BIOC 848
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, and 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
Grading Option: Grade Pass/No Pass Option

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; MATH 107; and PHYS 142 or 212.  
**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  
**Grading Option:** Grade Pass/No Pass Option  
**Prerequisite for:** CHEM 471/871; MATH 107; and PHYS 142 or 212  

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:** 3  
**Grading Option:** Grade Pass/No Pass Option  

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

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

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

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  
**Min credits per semester:** 1  
**Max credits per semester:** 3  
**Max credits per degree:** 3  
**Grading Option:** Grade Pass/No Pass Option  

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:** 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 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
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<td>CHEM 874M</td>
<td>Topics in Chemical Pedagogy - Mathematics Integration</td>
<td>MATH 874M, TEAC 874M</td>
<td>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.</td>
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<td>CHEM 874N</td>
<td>Topics in Chemical Pedagogy - Inquiry Strategies</td>
<td>TEAC 874N</td>
<td>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.</td>
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<td>CHEM 874P</td>
<td>Topics in Chemical Pedagogy - Chemistry in the Workplace</td>
<td>TEAC 874P</td>
<td>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.</td>
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<td>CHEM 874Y</td>
<td>Topics in Chemical Pedagogy - Graphing Calculator Activities</td>
<td>TEAC 874Y</td>
<td>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.</td>
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<td>CHEM 875</td>
<td>Chemical Pedagogy in the High School Laboratory</td>
<td>TEAC 875</td>
<td>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.</td>
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<td>CHEM 875A</td>
<td>Chemical Pedagogy in the High School Laboratory - Small-scale Experiments</td>
<td>TEAC 875A</td>
<td>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.</td>
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<td>CHEM 875B</td>
<td>Chemical Pedagogy in the High School Laboratory - Technology Integration</td>
<td>TEAC 875B</td>
<td>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.</td>
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<td>CHEM 875C</td>
<td>Chemical Pedagogy in the High School Laboratory - Inquiry Experiments</td>
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<td>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.</td>
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<td>CHEM 875K</td>
<td>Chemical Pedagogy in the High School Laboratory - At-home Experiments</td>
<td>TEAC 875K</td>
<td>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.</td>
<td>3</td>
<td>Grade Pass/No Pass Option</td>
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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
Grading Option: Grade Pass/No Pass Option

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
Grading Option: Grade Pass/No Pass Option

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 CHEM 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
Grading Option: Grade Pass/No Pass Option
Prerequisite for: BIOC 486, BIOC 886, BIOS 486, BIOS 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

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

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, BIOS 486, BIOS 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 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 937 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 938 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 939 Organic Chemistry
Prerequisites: CHEM 835
Description: The fundamentals of organic chemistry and applications. The fundamentals include methods for synthesis, purification, analysis, and reaction mechanisms of organic compounds. The applications include the production of organic compounds and therapeutic agents etc. with a focus on the organic chemistry of biological 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 940 Stereochemistry of Organic Compounds
Prerequisites: CHEM 855
Description: Types of stereoisomerism in organic compounds. Steric strain and 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 956 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 991E Special Topics in Organic Chemistry
Prerequisites: CHEM 895
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 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 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