CHEMISTRY (CHEM)

CHEM 010 Academic Based Community Service-Chemistry Outreach
Course usually offered in fall term
Activity: Lecture
1 Course Unit

CHEM 012 Environmental Chemistry
The course aims to teach chemical content and principles in the context of significant environmental issues. Topics to be covered include: composition of the atmosphere; protecting the ozone layer; chemistry of global warming; traditional hydrocarbon fuels and energy utilization; water supply, its contaminants, and waste water treatment; acid rain; nuclear energy; and new energy sources. Students will develop critical thinking ability, competence to better assess risks and benefits, and skills that will lead them to be able to make informed decisions about technology-based matters.
For BA Students: Physical World Sector
One-term course offered either term
Activity: Lecture
1 Course Unit
Notes: The course requires math literacy at the high school algebra level (2 years) and a willingness to learn Excel. Students must also have taken one year of high school chemistry.

CHEM 022 Structural Biology
This course will explain in non-mathematical terms how essentially all biological properties are determined by the microscopic chemical properties of proteins. It will also explain how research results, especially those of structural biology, are presented to its various audiences.
For BA Students: Natural Science and Math Sector
One-term course offered either term
Activity: Seminar
0.5 Course Units
Notes: Freshman Seminar

CHEM 025 Freshman Seminar: From Alchemy to Nanoscience
The imperative to transform matter, find its roots in alchemy and the search for the Philosopher's Stone, which was thought to contain the secret of turning base metals into gold and also the secret of immortality. We will examine the evolution of the way in which people have thought about matter and its transformations; from the manufacturing of explosives to dyestuffs to pharmaceuticals and perfumes. We will do some simple experiments that demonstrate some of these principles. We will follow the development of the chemical sciences from the works of early alchemists to Renaissance (Newton and Boyle) scientists and modern thinkers (Priestly, Lavoisier, Dalton, Mendeleev and others). This class, which is designed for non-science as well as potential science majors, will involve discussions on readings, as well as field trips to some Philadelphia locations that are notable in the history of chemistry.
Taught by: Jeffrey Winkler
Course usually offered in fall term
Activity: Seminar
1 Course Unit

CHEM 053 General Chemistry Laboratory I
A general laboratory course covering aspects of qualitative and quantitative analysis, determination of chemical and physical properties, and chemical synthesis.
One-term course offered either term
Activity: Laboratory
0.5 Course Units
Notes: Lab fee $150.

CHEM 054 General Chemistry Laboratory II
Continuation of CHEM 053.
One-term course offered either term
Activity: Laboratory
0.5 Course Units
Notes: Lab fee $150.

CHEM 101 General Chemistry I
Basic concepts and principles of chemistry and their applications in chemistry and closely-related fields. The first term emphasizes the understanding of chemical reactions through atomic and molecular structure. This is a university level course, treating the material in sufficient depth so that students can solve chemical problems and can understand the principles involved in their solution. It includes an introduction to condensed matter. This course is suitable for majors or non-majors and is recommended to satisfy either major or preprofessional requirements for general chemistry. This course is presented for students with high school chemistry and calculus. Students with a lesser background than this should take Chemistry 001.
For BA Students: Physical World Sector
One-term course offered either term
Activity: Lecture
1 Course Unit

CHEM 102 General Chemistry II
Continuation of Chemistry 101. The second term stresses the thermodynamic approach to chemical reactions, electrochemical processes, and reaction rates and mechanisms. It includes special topics in chemistry.
For BA Students: Physical World Sector
One-term course offered either term
Prerequisite: CHEM 101
Activity: Lecture
1 Course Unit

CHEM 114 Honors Chemistry I: Experimental Perspectives
This course will focus on introducing students to the following topics: the nature of the chemical bond (forces, potentials, and quantum mechanics), covalent and non-covalent interactions, properties of gasses, and interactions of molecules with light. In addition to covering these topics, students will also be introduced to both common and state-of-the-art experimental techniques. We will discuss how these techniques can be used to study and characterize different properties of molecules.
For BA Students: Physical World Sector
Course usually offered in fall term
Prerequisites: AP Chemistry in high school.
Corequisites: MATH 114 or higher.
Activity: Lecture
1 Course Unit
Notes: Freshman only

CHEM 115 Honors Chemistry I: Theoretical Perspectives
An advanced course for students who have had AP Chemistry in high school. Included in the course are: quantum mechanics of atoms, molecules and crystalline solids; statistical mechanics of gasses, liquids, and solids; and coordination chemistry.
For BA Students: Physical World Sector
Course usually offered in fall term
Prerequisites: AP Chemistry in high school.
Corequisites: MATH 114 or higher.
Activity: Lecture
1 Course Unit
Notes: Freshman only.
CHEM 116 Honors Chemistry II
An advanced course for students who have had very strong background in chemistry in High School (AP, IB, or equivalent). Advanced material from the general chemistry curriculum will be covered in the context of topics selected from current research areas. A continuation of CHEM 114/115, CHEM 116 will focus on topics in biochemistry and biophysical chemistry relating to thermodynamics, equilibrium, kinetics, and electrochemistry.
For BA Students: Physical World Sector
Course usually offered in spring term
Prerequisites: Advanced High School Chemistry (AP or equivalent).
Activity: Lecture
1 Course Unit

CHEM 221 Physical Chemistry I
Introductory quantum mechanics, atomic and molecular structure, chemical bonding, and microscopic understanding of physical and chemical properties of molecules.
Course usually offered in fall term
Prerequisites: CHEM 102, MATH 114, PHYS 150
Activity: Lecture
1 Course Unit

CHEM 222 Physical Chemistry II
Continuation of CHEM 221. Principles and applications of thermodynamics, and a molecular-based understanding of macroscopic properties.
Course usually offered in spring term
Prerequisites: CHEM 221, PHYS 151
Activity: Lecture
1 Course Unit

CHEM 223 Experimental Physical Chemistry I
Important methods, skills, and apparatus used for the acquisition and interpretation of quantitative information about chemical systems will be discussed in principle and used in the laboratory.
Course usually offered in spring term
Prerequisite: CHEM 221
Activity: Laboratory
1 Course Unit

CHEM 241 Principles of Organic Chemistry
Fundamental course in organic chemistry based upon the modern concepts of structure and mechanism of reactions.
One-term course offered either term
Prerequisite: CHEM 102
Activity: Lecture
1 Course Unit

CHEM 242 Principles of Organic Chemistry II
Continuation of CHEM 241.
One-term course offered either term
Prerequisite: CHEM 241
Activity: Lecture
1 Course Unit

CHEM 243 Organic Chemistry II: Principles of Organic Chemistry with applications in Chemical Biology
This course is functionally equivalent to Chem 242 as the second term of introductory Organic Chemistry, placing the content in the context of biology and medicine. Topics include: 1) alkyl compounds, ethers, epoxides and sulfides, in lipids; 2) carboxylic acids and amines in amino acids; 3) aromatic compounds and heterocycles in nucleic acids; and 4) ketones and aldehydes in carbohydrates. The synthesis and mechanism of action of pharmaceuticals that feature these functional groups will also be discussed.
Taught by: Dr. David Chenoweth & Dr. E. James Petersson
Course usually offered in spring term
Prerequisite: CHEM 241
Activity: Lecture
1 Course Unit

CHEM 245 Experimental Organic Chemistry
A basic laboratory course in which both the theoretical and practical aspects of a variety of organic reactions and multistep syntheses are emphasized. Modern chromatographic, instrumental, and spectroscopic techniques are applied to experimental organic chemistry. Course should be taken concurrently with CHEM 242 (or 243) or in the semester immediately following. PLEASE NOTE THE FOLLOWING: For the Summer and LPS offering of CHEM 245, it is a 2-semester course. Part 1 is taken in the first term for 0.0 CU and then Part 2 is taken in the second term immediately following the first for 1.0 CU.
One-term course offered either term
Prerequisite: CHEM 241
Corequisite: CHEM 242 or 243
Activity: Laboratory
1 Course Unit
Notes: Lab fee $300.

CHEM 246 Advanced Synthesis and Spectroscopy Laboratory
Advanced laboratory work on the synthesis, structure, and properties of organic and inorganic compounds. Infrared, ultraviolet, and nuclear magnetic resonance spectroscopy. Lectures cover the theoretical basis and applications of modern spectroscopic methods.
Course usually offered in fall term
Prerequisites: CHEM 242 and 245
Corequisite: CHEM 261 should be taken concurrently or previously completed successfully
Activity: Laboratory
1 Course Unit
Notes: Lab fee $300.

CHEM 251 Principles of Biological Chemistry
Fundamentals of biological chemistry, including the structure of biological macromolecules and their mechanism of action, intermediary metabolism, and the chemical basis of information transfer. Course can be taken concurrently with CHEM 242 or CHEM 243.
One-term course offered either term
Prerequisites: CHEM 102 and 241
Corequisites: CHEM 242 or 243 required.
Activity: Lecture
1 Course Unit
CHEM 261 Inorganic Chemistry I
An introductory survey of the bonding, structure, and reactions of important metal and nonmetal compounds.
Course usually offered in fall term
Corequisites: completion of CHEM 241 and 242.
Activity: Lecture
1 Course Unit

CHEM 299 Directed Study and Seminar
Independent project under the direction of a faculty member conducting chemistry research.
One-term course offered either term
Prerequisites: Permission of undergraduate chairman.
Activity: Independent Study
1 Course Unit

CHEM 399 Independent Research
Independent project under the direction of a faculty member conducting chemistry research.
One-term course offered either term
Prerequisites: Permission of undergraduate chairman; a B average in Chemistry, Mathematics, and Physics.
Activity: Independent Study
1 Course Unit

CHEM 441 Organic Reaction Mechanisms
Study of important types of reactions and functional groups, with emphasis on synthetic usefulness, mechanisms, and stereoelectronic principles.
Course usually offered in fall term
Prerequisite: CHEM 242
Activity: Lecture
1 Course Unit

CHEM 443 Modern Organic Synthesis
Introduction to advanced organic synthesis. Study of important synthetic reactions including: oxidations, reductions, and methods for the formation of carbon-carbon bonds, with an emphasis on chemoselectivity, stereoselectivity and asymmetric synthesis. Survey of modern methods for the synthesis of small, medium and large ring systems. Analysis of modern synthetic strategies, with illustrative examples from total synthesis of natural and unnatural products.
Course usually offered in fall term
Prerequisites: CHEM 241 and 242
Activity: Lecture
1 Course Unit

CHEM 451 Biological Chemistry I
Structure, dynamics, and function of biological macromolecules. Properties of macromolecular assemblies, membranes and their compartments. (Formerly, CHEM 450-I).
Course usually offered in fall term
Prerequisites: CHEM 242, 221 (may be concurrent), and 251 or permission of instructor
Activity: Lecture
1 Course Unit

CHEM 452 Biological Chemistry II
Physical and chemical description of macromolecular information transfer. Gene organization, replication, recombination, regulation and expression. (Formerly, CHEM 450-II).
Course usually offered in spring term
Prerequisites: CHEM 242, 221, and 251 or permission of instructor
Activity: Lecture
1 Course Unit

CHEM 462 Inorganic Chemistry II
A detailed treatment of the theory and application of modern physical methods for the elucidation of structure and mechanism in inorganic and organometallic chemistry. An introduction to symmetry and group theory is followed by the application of these concepts to vibrational and electronic spectroscopy of inorganic complexes. Magnetic resonance is discussed in detail, including topics such as EPR, fourier transform methods, dynamic systems, and 2-dimensional NMR.
One-term course offered either term
Prerequisites: CHEM 261 or its equivalent and permission of instructor
Activity: Lecture
1 Course Unit

CHEM 495 High Throughput Discovery: A Multidisciplinary Approach to Cancer.
The newly developed massively parallel technologies have enabled the simultaneous analysis of many pathways. There are several large scale international efforts to probe the genetics and drug sensitivity of cancer cell lines. However, there are some rare cancers that have not been analyzed in depth. One of these rare cancers is malignant peripheral nerve sheet tumors (MPNST). MPNST, although a rare cancer, are common in patients with neurofibromatosis type. In the course, students will take part in a high throughput discovery effort in two phases. Phase 1 is a training phase, which will consist of quantitative profiling the sensitivity of MPNST cell lines to a library of >120 common and experimental cancer drugs. These will be conducted in the UPenn High Throughput Screening Core. (http://www.med.upenn.edu/cores/High-ThroughputScreeningCore.shtml). While we call this a training phase, the data from this will be subject to rigorous quality control for eventual publication and development of a public database for rare tumors. Phase 2 is an independent research project. Examples of projects include, but are not limited to: Combinatorial screens (synthetic lethal); siRNA screens; novel compound screens; determining mechanisms of cell death; developing tools for data analysis and database development. During phase 2, students will also modify compounds of interest using the Penn Chemistry: Upenn/Merck High Throughput Experimentation Laboratory (https://www.chem.upenn.edu/content/penn-chemistry-upennmerck-high-throughput-experimentation-laboratory), and then retest them for activity to determine structure activity relationships. We will sponsor phase 2 projects relevant to neurofibromatosis. However, in phase two students can also research other areas if they develop sponsorships from professors. We expect the course to be a hypothesis engine that generates ideas for further research. Prerequisites include a strong foundation in biology and chemistry. Students will prepare an abstract proposal by week three on their phase 2 project, and a report, in scientific paper style, due on the last day of the semester.
Taught by: Dr’s Jeffrey Field, David Schultz, and Simon Berritt
Course usually offered in spring term
Also Offered As: PHRM 495
Activity: Laboratory
1 Course Unit

CHEM 521 Statistical Mechanics I
Principles of statistical mechanics with applications to systems of chemical interest.
Course usually offered in fall term
Prerequisite: CHEM 222
Activity: Lecture
1 Course Unit
CHEM 522 Statistical Mechanics II
A continuation of CHEM 521. The course will emphasize the statistical mechanical description of systems in condensed phases.
Course usually offered in spring term
Prerequisite: CHEM 521
Activity: Lecture
1 Course Unit

CHEM 523 Quantum Chemistry I
The principles of quantum theory and applications to atomic systems.
Course usually offered in fall term
Prerequisite: CHEM 222
Activity: Lecture
1 Course Unit

CHEM 524 Quantum Chemistry II
Approximate methods in quantum theory and applications to molecular systems.
Course usually offered in spring term
Prerequisite: CHEM 523
Activity: Lecture
1 Course Unit

CHEM 525 Molecular Spectroscopy
This course is broken into two sections: (1) optics, and (2) theory of spectroscopy including the discussion of techniques and examples.
In the first section you will be introduced to both linear and nonlinear optics, through thinking about how to design optical components in the laboratory setting. The second part of the course is a more traditional spectroscopy course, where different spectroscopies in the visible and infrared spectral region will be discussed. This part of the course will focus on understanding what we can learn from using spectroscopy and what sort of dynamical processes can be observed with different spectroscopic techniques. Topics to be covered include, but are not limited to: optics, time-dependent perturbation theory, lineshapes, density matrix, group theory, selection rules.
One-term course offered either term
Activity: Lecture
1 Course Unit

CHEM 526 Chemical Dynamics
Theoretical and experimental aspects of important rate processes in chemistry.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 527 Chemical Reaction Kinetics
Study of the rates of chemical reactions and the factors that influence them.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 528 Physical Organic Chemistry
Undergraduate organic chemistry is a prerequisite. Overview of the principles governing organic bonding, structure, and properties. Quantum calculations as well as laboratory thermodynamic and kinetic measurements used in understanding organic chemical reactions will be surveyed. Mechanisms will be discussed but will not be covered in detail. As such, registration in Chem 441 (Mechanisms) or the completion of it's equivalent is strongly recommended (see instructor).
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 529 Chemical Thermodynamics
Chemical concentrations and their effects on reaction rates.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 530 Physical Chemistry
Theoretical and experimental aspects of important physical processes.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 531 Physical Chemistry II
Continuation of CHEM 530. The course will emphasize the physical aspects of systems in condensed phases.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 532 Physical Chemistry III
Continuation of CHEM 531. The course will emphasize the physical aspects of systems in condensed phases.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 533 Physical Chemistry IV
Continuation of CHEM 532. The course will emphasize the physical aspects of systems in condensed phases.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 534 Physical Chemistry V
Continuation of CHEM 533. The course will emphasize the physical aspects of systems in condensed phases.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 535 Physical Chemistry VI
Continuation of CHEM 534. The course will emphasize the physical aspects of systems in condensed phases.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 536 Physical Chemistry VII
Continuation of CHEM 535. The course will emphasize the physical aspects of systems in condensed phases.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 537 Physical Chemistry VIII
Continuation of CHEM 536. The course will emphasize the physical aspects of systems in condensed phases.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 538 Physical Chemistry IX
Continuation of CHEM 537. The course will emphasize the physical aspects of systems in condensed phases.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 539 Chemical Engineering
The principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 540 Chemical Engineering II
Continuation of CHEM 539. The course will emphasize the principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 541 Physical Organic Chemistry
Undergraduate organic chemistry is a prerequisite. Overview of the principles governing organic bonding, structure, and properties. Quantum calculations as well as laboratory thermodynamic and kinetic measurements used in understanding organic chemical reactions will be surveyed. Mechanisms will be discussed but will not be covered in detail. As such, registration in Chem 441 (Mechanisms) or the completion of it's equivalent is strongly recommended (see instructor).
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 542 Physical Organic Chemistry II
Continuation of CHEM 541. The course will emphasize the principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 543 Physical Organic Chemistry III
Continuation of CHEM 542. The course will emphasize the principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 544 Physical Organic Chemistry IV
Continuation of CHEM 543. The course will emphasize the principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 545 Physical Organic Chemistry V
Continuation of CHEM 544. The course will emphasize the principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 546 Physical Organic Chemistry VI
Continuation of CHEM 545. The course will emphasize the principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 547 Physical Organic Chemistry VII
Continuation of CHEM 546. The course will emphasize the principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 548 Physical Organic Chemistry VIII
Continuation of CHEM 547. The course will emphasize the principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 549 Physical Organic Chemistry IX
Continuation of CHEM 548. The course will emphasize the principles and applications of chemical engineering.
Course usually offered in spring term
Activity: Lecture
1 Course Unit

CHEM 550 Macromolecular Crystallography: Methods and Applications
The course is broken up into three parts: (1) Principles of macromolecular X-ray crystallography (2) Workshop on macromolecular structure determination (3) Student presentations on X-ray crystal structures from the recent literature.
Course usually offered in fall term
Also Offered As: BMB 554
Activity: Lecture
1 Course Unit

CHEM 555 Mechanisms of Biological Catalysis
Reaction mechanisms in biological (enzymes, abzymes, ribozymes) and biomimetic systems with emphasis on principles of catalysis, role of coenzymes, kinetics, and allostery control.
One-term course offered either term
Prerequisites: One year of organic chemistry and a biochemistry course, or permission of instructor
Activity: Lecture
1 Course Unit

CHEM 557 Organometallics
This course is focused on molecular species that contain metal-carbon bonds, and the role of these compounds in catalytic processes and organic synthesis. Aspects of the synthesis, structure and reactivity of important classes of organometallic compounds such as metallo alkyl, aryl, alkene, alkylidene and alkylidyne complexes are surveyed for the d and f block metals. Emphasis is placed on general patterns of reactivity and recurring themes for reaction mechanisms.
One-term course offered either term
Activity: Lecture
1 Course Unit

CHEM 558 Main Group Chemistry
This course encompasses a comprehensive survey of the chemistry and properties of the p-block elements of the periodic table. Topics include syntheses, structures and reactivities of important compounds. In addition, alternative bonding theories which have been used to explain the unique properties of these compounds are critically examined.
One-term course offered either term
Activity: Lecture
1 Course Unit

CHEM 559 Bi-inorganic Chemistry
The course covers selected topics in bioinorganic chemistry; special emphasis is placed on dioxygen chemistry and electron transfer processes. Course topics include: (i) oxygen uptake and utilization; (ii) diatomic oxygen transport; (iii) diatomic and monoatomic oxygen incorporation into substrates; (iv) metalloenzyme-catalyzed C-C bond formation; (v) the metallobiochemistry of DNA; (vi) metal-sulfide proteins; (vii) manganese-containing metalloproteins; (viii) Photosystem II: light-driven electron transfer and the biological water-splitting reaction; (ix) biological electron transfer; (x) electron transfer theory; (xi) mechanisms of energy storage and release; and (xii) long-distance electron transfer reactions.
One-term course offered either term
Also Offered As: BMB 567
Activity: Lecture
1 Course Unit
CHEM 600 Tutorial Studies  
Readings and discussion on various topics with various faculty members.  
One-term course offered either term  
Activity: Independent Study  
1 Course Unit  
Notes: Both terms. May be repeated for credit with permission of instructor

CHEM 601 Adv Chemistry Sem  
This course examines the structure and organization of the chemical literature and introduces techniques of searching this literature, focusing on the logic and thought processes necessary for effective information retrieval. Each technique is illustrated using information tools available at the University of Pennsylvania, and we take an "under the hood" look at the organization and functionality of each tool introduced. Students should choose a course section based on their preferred area of chemistry research: organic, inorganic, biological, and physical chemistry; all four sections are taught at a level appropriate for graduate students and advanced undergraduates. Topics vary by section, but all students learn the basics of subject, author, structure, and reaction searching, and a unit on ethics in publication and scholarly communication completes the course.  
One-term course offered either term  
Activity: Lecture  
0.5 Course Units

CHEM 652 Proposal Writing for Biological and Physical Chemists  
Students will learn the key components in proposal writing and develop the skills needed to prepare a compelling and original graduate research proposal. The course involves significant writing, in-class discussions and presentations.  
Course usually offered in fall term  
Activity: Lecture  
0.5 Course Units

CHEM 662 Proposal Writing for Inorganic and Organic Chemists  
Students will learn the key components in proposal writing and develop the skills needed to prepare a compelling and original graduate research proposal. The course involves significant writing, in-class discussions and presentations.  
Course usually offered in fall term  
Activity: Lecture  
0.5 Course Units

CHEM 708 Modern Topics in Photochemistry  
This course, for graduate students, encompasses topics in fundamental and applied photochemistry and photophysics from the fields of organic and inorganic chemistry. Key topics and concepts will include basic electronic structure, interactions of light with matter/electronic transitions, UV-Vis absorption and emission spectroscopy, energy transfer, kinetics/dynamics, Jablonski diagrams, electron transfer, and chemical reactivity. These topics and concepts will be covered in the context of frontier applications including OLEDs, photoredox catalysis, energy conversion, solar fuels, and artificial photosynthesis, organic photosynthesis, molecular imaging, and optogenetic tools among others.  
One-term course offered either term  
Activity: Lecture  
1 Course Unit

CHEM 712 Mathematics for Chemistry  
This course examines the basic mathematics needed for physical chemistry, including (but not limited to) a brief review of linear algebra, Fourier transforms, delta functions, optimization, and the residue theorem. Depending on the year, selected other topics will also be included.  
One-term course offered either term  
Activity: Lecture  
1 Course Unit

CHEM 723 Dynamics of Polymers  
This course discussed the structure of polymers from a statistical physics point of view as well as dynamical response of polymeric systems such as mechanical response of polymer melts, polymer glass transition, properties of polymers in solutions, and properties of block copolymers and ionomers.  
One-term course offered either term  
Activity: Lecture  
0.5 Course Units

CHEM 741 Spectroscopy  
The course will provide a continuation of material covered in Chemistry 441 and Chemistry 541, as well as spectroscopy of organic compounds focused mainly on NMR. Topics will include advanced organic mechanisms, electronic structure calculations of organic molecules related to their structure, reactivity, and spectroscopic properties, and Organic Spectroscopic methods for the determination of structure using NMR.  
One-term course offered either term  
Prerequisites: CHEM 441 and CHEM 541  
Activity: Lecture  
1 Course Unit

CHEM 742 Medicinal Chemistry and Drug Design  
This course focuses on concepts and strategies in medicinal chemistry, and how it is applied to modern drug discovery and development. Topics include the drug discovery process, drug targets (GRCR?s, enzymes, channels etc.), physical chemistry of molecular interactions between drug and target, drug design, methods for hit and lead identification, lead optimization, chemical biology, natural products chemistry and combinatorial and diversity oriented synthesis. This course is geared to upper level undergraduate students in chemistry or biochemistry, and first year chemistry graduate students. A strong understanding of organic chemistry is required.  
Taught by: DONNA HURYN  
One-term course offered either term  
Activity: Lecture  
0.5 Course Units

CHEM 743 Heterocyclic Chemistry  
The course deals with topics in Heterocyclic Chemistry. It covers nitrogen-containing monocyclic hetero rings, examining the most recent syntheses, the reactions and their mechanisms. The course will focus on recent variations and improvements of known heterocycles as well as their synthetic utility. Students will be expected to read critically a recent article on heterocyclic chemistry and do a presentation to the class.  
Taught by: M. JOULLIE  
One-term course offered either term  
Activity: Lecture  
0.5 Course Units
This class will discuss selected topics related to Bioinspired synthesis, methods, tactics and strategies. Target molecules, methods and strategies are designed by using biological systems as models.
Taught by: VIRGIL PERCEC
One-term course offered either term
Activity: Lecture
0.5 Course Units

CHEM 745 Total Synthesis
Taught by: AMOS B. SMITH III
One-term course offered either term
Activity: Lecture
0.5 Course Units

CHEM 751 Chemical Biology
This course focuses on current topics in Chemical Biology, particularly experiments in which 1) chemical synthesis enables one to probe or control biological systems, or 2) manipulation of biological systems facilitates novel chemical syntheses. The course is broadly divided into two sections, one dealing with the study of individual proteins and nucleic acids, and one dealing with complex cellular systems. As the goal of the course is to familiarize students with innovative recent experimental approaches and to stimulate them to conceive of their own new methodology, students will be responsible for delivering presentations on topics selected from the literature, designing experiments to address currently unsolved problems in Chemical Biology (in take-home examinations), and generating several novel research proposal ideas, one of which will be elaborated into a full proposal.
Taught by: EJ PETERSSON
One-term course offered either term
Also Offered As: BMB 751
Activity: Lecture
1 Course Unit

CHEM 761 Coordination Chemistry
Ligands have a remarkable ability to alter the properties of metal ions, and the study of this coordination chemistry underlies many modern advances in science, including energy harvesting and storage, chemical catalysis, and sustainability. This course explores the relationships between the identities of ligands and the physical manifestations that result from their binding to metal centers. Topics to be covered include: symmetry and chirality in molecular complexes, variations in coordination number, ligand field effects, recent advanced in bonding theory, and inorganic reaction mechanisms.
Taught by: NEIL TOMSON
One-term course offered either term
Activity: Lecture
0.5 Course Units

CHEM 762 X-ray I
An introduction to the theory and practice of structure determination by X-ray crystallography. Topics discussed include point group and space group symmetry, structure factor theory, data collection methods and a survey of solution methods. The course culminates with a series of real-world structure determinations worked through in-class using the XSeed program package.
Taught by: P.Carroll
One-term course offered either term
Activity: Lecture
0.5 Course Units

CHEM 763 X-ray II
Continuation of X-ray I course, CHEM 741
Taught by: P.Carroll
One-term course offered either term
Prerequisite: CHEM 762
Activity: Lecture
0.5 Course Units

CHEM 764 Materials Chemistry
Taught by: C.Murray
One-term course offered either term
Activity: Lecture
0.5 Course Units

CHEM 765 Chemistry of the f-Block Elements
The course encompasses the descriptive chemistry, and topics related to, the f-block including the rare earth metals and actinides. Coverage includes coordination chemistry and periodic trends, electronic structure and magnetism, and modern applications of f-block chemistry including lanthanide ions as spectroscopic probes, separations chemistry, materials chemistry and applications, organo-f-element chemistry, the chemistry of the actinides and transactinides, and reactivity/catalysis with f-block compounds.
Taught by: E.Schelter
One-term course offered either term
Activity: Lecture
0.5 Course Units

CHEM 999 Independent Study and Research
(1) Advanced study and research in various branches of chemistry. (2) Seminar in current chemical research. (3) Individual tutorial in advanced selected topics.
One-term course offered either term
Activity: Independent Study
1 Course Unit
Notes: May be taken for multiple course unit credit