

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 100 Introduction to General Chemistry

This course is equivalent to Chemistry 101 but is intended for students with less preparation in high school chemistry and mathematics, and moves more methodically through the introductory chapters. The course covers most of the same topics as Chem101 and is designed to provide students with the skills needed to succeed in Chem102. In Chem100 there is a strong emphasis on problem-solving that is fundamental to all physical science. Topics will include: introduction to fundamental chemical ideas and their application to chemical reactions, stoichiometry and ideal gases. Also provided is an overview of the periodic table and classical ideas of chemical bonding using Lewis structures. Quantum theory will be introduced - focusing on its role in understanding atomic structure, the periodic table, and chemical bonding. Topics from mathematics and physics that are necessary to chemical problem-solving will be included as needed.

For BA Students: Physical World Sector

Course usually offered in spring term

Activity: Lecture

1 Course Unit

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 115 Honors Chemistry I

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, liquids, and solids. Students in section 001 will be introduced to modern computational chemistry methods and section 002 introduces students to modern experimental techniques.

For BA Students: Physical World Sector

Course usually offered in fall term

Prerequisites: AP Chemistry exam score of 5.

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 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

Notes: Lab fee \$300.

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. Additionally, Chem 243 makes use of 3D structure tutorials, recitation sections and visits from biomedical scientists who make use of chemistry in their work.

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 or 243 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.

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

Prerequisites: CHEM 241 and 242 or 243.

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 in 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 or 243

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 or 243, 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 or 243, 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 sheath 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

0.5 Course Units

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

0.5 Course Units

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 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 its equivalent is strongly recommended (see instructor).

Course usually offered in spring term

Activity: Lecture

1 Course Unit

CHEM 551 Methods for in vivo biochemical discovery

One-term course offered either term

Activity: Lecture

0.5 Course Units

CHEM 555 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 557 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 allosteric 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 558 Biomolecular Spectroscopy and Microscopy

One-term course offered either term

Activity: Lecture

0.5 Course Units

CHEM 564 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 565 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 567 Bio-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 601 Chemical Information

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

The ability to communicate original, written research proposals is essential to the modern chemist. This course, for graduate students in the organic and inorganic divisions, will promote development of proposal writing skills. Students will develop original ideas, practice written work, graphic design and peer review. Outcomes of the course will include writing (and submission, when eligible) of an NSF GRFP application and a 'proposed work' section of a candidacy exam report.

Course usually offered in fall term

Activity: Lecture

0.5 Course Units

CHEM 721 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

0.5 Course Units

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 (GPCRs, 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. Joulie

One-term course offered either term

Activity: Lecture

0.5 Course Units

CHEM 744 Bioinspired Synthesis. Methods, Tactics, and Strategies.

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

The focus of this course comprise the development of two synthetic strategies to access architecturally complex natural products of biological significance exploiting innovative chemistry. Lectures towards this end are given. As a project, each student is given a different complex natural product and expected at the end of the course to develop two strategies, one based on asymmetric induction to provide the absolute stereochemical structure, the second where the absolute stereochemistry derives from commercially available starting materials.

Taught by: Amos B. Smith III

One-term course offered either term

Activity: Lecture

0.5 Course Units

CHEM 746 Intermediate Organic Chemistry

This course will include a review of basic reaction mechanisms, stereoelectronic effects, functional groups and acid-base chemistry. The course will emphasize the writing of mechanisms using the curved-arrow notation and organic reactions. Bonding and electronic structure theories and more involved mechanisms will be discussed. Students are expected to have a good working knowledge of reactions, functional groups, stereochemistry and mechanisms from undergraduate organic chemistry. Students will be expected to review basic concepts in Organic Chemistry and spectroscopy. The course will include lectures and recitations, and students are expected to attend and participate.

One-term course offered either term

Activity: Lecture

1 Course Unit

Notes: MCS and PhD students only.

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 advances 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

This course will focus on the structure-property relationships in materials chemistry on length scales from atomic dimension up to the microscale and then core concepts to Chemical design that underpins future, "Energy and Environmental Sustainability." We will introduce the "12 Principles of Green Chemistry" and "12 Principles of Green Engineering" as a guide to modern materials chemistry design and then follow a trajectory that proceeds with increasing length scales of ordering in the solid state. We will introduce techniques of x-ray, neutron, electron, and ion beam based scattering, real space imaging and spectroscopies and use these to explore non-crystalline materials (amorphous, glasses, and time permitting quasicrystals and aperiodic systems) and crystalline solids. Studies will proceed from atomic scales through nanoscale, mesoscale, and micro-scale discussing the emergence of band structure and delocalized electronic and optical properties that emerge due to the finite scale of ordering and influence of the surface. We will then focus on how these foundations of materials chemistry are shaping advances in solar energy utilization with photochemistry and photoelectrochemistry and materials for photovoltaic and enabling advances electrochemical energy conversion and storage.

Taught by: C.Murray

One-term course offered either term

Activity: Lecture

1 Course Unit

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