CHEMISTRY (CHEM)

CHEM118 DNA
This course provides an interdisciplinary view of the DNA molecule and its impact upon medicine, law, philosophy, agriculture, ethics, politics, and society at large. The course has two parts. In the first part, we will learn the chemistry and physics of DNA and the processes by which the information stored in DNA is expressed. In the second part of the course, we will discuss what DNA has done and still can do for us—for example, treat and prevent genetic diseases, improve our food through genetic engineering, achieve criminal justice through genetic fingerprinting, understand the evolutionary origin of humans, and enrich our idea of what it is to be human. The course assumes basic knowledge of chemistry and biology at the general high school level. Independent exploration and inquiry are encouraged.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM119 Biology and Chemistry in the Modern World: A Survey of Drugs and Disease
This course will cover a wide range of topics of current interest that are at the intersection of biology and chemistry. In particular, the molecular basis of issues related to drugs and disease will form a focus of the course. Topics to be discussed will include psychoactive and performance-enhancing drugs, mad cow, cancer, viral and bacterial diseases, and the chemistry of foods.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B119
Prereq: None

CHEM120 Science and Humanity
This course will provide an introduction to the important concepts of writing in science. We will discuss the major components of scientific writing while viewing scientific issues from an analytical and interdisciplinary perspective. We will discuss contemporary problems influenced by technological advantages and the effects they have on science and humanity. This course assumes basic knowledge in chemistry and biology at the high school level.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM125 Chemistry and Society
An introductory course for non-science majors emphasizing the role of chemistry in environmental and technological problems of concern to society such as air and water pollution, current energy sources and alternatives, nuclear chemistry, household chemicals, pharmaceuticals, plastics and recycling, and food and agriculture.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM132 Seminars in Physical Science
Each student will give one 50-minute talk on a topic they choose in chemistry, physics, astronomy, or mathematics. Students will consult with the instructor on the choice of their topic and in the organization of their presentation. Possible topics might include (chosen at random): the origin of the periodic table; the transition from alchemy to chemistry; cold fusion; various Nobel Prize in Chemistry or Physics topics; dark matter, dark energy; the nature of galaxies; why stars shine; the roles of amateurs in modern astronomical research; visualizing the fourth dimension; Einstein's "greatest blunder"; Bose-Einstein condensates; the race toward absolute zero; the interaction of radiation and matter; the Heisenberg Uncertainty Principle; how prime numbers are used in cryptology; the discovery of C60; the list is almost inexhaustible.
Offering: Host
Grading: Cr/U
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM141 Introductory Chemistry I
This course emphasizes rigorous descriptive reasoning. While intended for students with little or no previous background in chemistry, the course is taught at a relatively high level. The topical coverage emphasizes the relationships between electronic structure, chemical reactivity, and the physical properties of the elements and their compounds.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: None

CHEM142 Introductory Chemistry II
This course is a continuation of CHEM141. CHEM152, the associated laboratory course, may be taken concurrently. The lab should be taken by those who plan to take more than one year of chemistry.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM141

CHEM143 Principles of Chemistry I
An introduction to chemistry intended for motivated students with a solid high school chemistry background and exposure to calculus, this course will emphasize the fundamental principles of chemistry and is recommended for students interested in pursuing majors in science or mathematics. This course will focus on the concepts of equilibrium, thermodynamics, and kinetics with applications. This course provides the best basic foundation for further study of chemistry and is strongly recommended for chemistry and MB&B majors. CHEM143, with CHEM144, satisfies premedical general chemistry requirements.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM141

CHEM144 Principles of Chemistry II
This second semester of the general chemistry course is recommended for science students. The focus of the course is the fundamentals of structure and bonding, with an emphasis on predicting reactivity.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM143

CHEM152 Introductory Chemistry Laboratory
This course provides an introduction to the application of chemical concepts in the laboratory. The course will focus on practical aspects of fractional distillation,
CHEM258 is normally elected concurrently but is not required.

**emphasis on the chemistry of important functional groups. The laboratory course**

This course is a continuation of the chemistry of carbon compounds with

CHEM252 Principles of Organic Chemistry II

Prereq:

Gen Ed Area:

Credits:

Grading:

Offering:

course CHEM258 is normally elected concurrently but is not required.

**emphasis on the relationship between structure and reactivity. The laboratory**

CHEM254 Honors Organic Chemistry

Offering:

Credits:

Gen Ed Area:

CHEM257 General Chemistry Laboratory

Normally taken along with CHEM251, this course provides laboratory work

**In quantitative chemical procedures and introductory chemical laboratory**

CHEM258 Organic Chemistry Laboratory

Offering:

Credits:

Gen Ed Area:

CHEM309 Molecular and Cellular Biophysics

This course is an integrated consideration of the biophysics and biophysical

chemistry of biological systems from molecules to cells. The objective is to
CHEM320 Scientific Research Ethics

This course involves critical consideration of the ethical issues that arise in the conduct of scientific research. The course will begin with an overview of the ethical issues commonly encountered in research, including what is and is not an ethical issue and how ethical issues are dealt with in principle and in practice. Initial topics include record keeping, conflict of interest, responsible authorship, ownership of projects, policies for handling misconduct, policies regarding the use of human and animal subjects, and data management and distribution. The course proceeds to consider a series of case studies based on instances in the recent scientific literature in which ethical problems were encountered.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM520
Prereq: None

CHEM321 Biomedical Chemistry

This course is designed to explore the molecular basis of disease and treatment options. Topics will reflect the importance of chemistry and biochemistry in the advancement of medicine today and will include treatment of metabolic disorders, rational drug design, and mode of drug action. A large portion of the course will be dedicated to learning computer programs used in computational drug design as part of a final drug design project.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B321
Prereq: (CHEM251 AND [CHEM383 or MB&B383])

CHEM325 Introduction to Biomolecular Structure

This course will be dedicated to learning computer programs used in computational biology. It is designed for students with college-level general and organic chemistry background. Topics include protein structure, DNA, and RNA structure, protein-nucleic acid interactions, signal transduction systems, and regulatory processes. This course is suitable for chemistry, biology, and pre-medical students who wish to learn about biological applications of molecular and cellular biology. The course emphasizes structural modules and topological patterns in major structures of proteins, nucleic acids, and their complexes. The first half of the course emphasizes structural modules and topological patterns in major classes of proteins and nucleic acids. The second part of the course covers novel structural motifs, such as helix-turn-helix, zinc-finger, and leucine zipper, that are responsible for recognition of specific nucleotide sequences in nucleic acids by proteins. Analysis of structures using tools available on the Web and independent exploration of protein and nucleic acid databases is strongly encouraged.

Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B325
Prereq: [MB&B181 or BIOL181] OR [MB&B191 or BIOL191]

CHEM337 Physical Chemistry I: Quantum Mechanics and Spectroscopy

A rigorous introduction to quantum mechanics, this course covers wave mechanics, operator methods, matrix mechanics, perturbation theory, angular momentum, molecular vibrations, atomic and molecular structure, symmetry, and spectroscopy.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: (CHEM141 AND CHEM142 AND CHEM251 AND CHEM257) OR (CHEM143 AND CHEM144 AND CHEM251 AND CHEM257)

CHEM338 Physical Chemistry II: Thermodynamics, Statistical Mechanics, and Kinetics

This course investigates chemical aspects of statistical mechanics and the laws of thermodynamics including free energy, chemical potential and chemical equilibria, and rates of chemical reactions.

Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: (CHEM141 AND CHEM142 AND MATH121 AND MATH122) OR (CHEM143 AND CHEM144 AND MATH121 AND MATH122)

CHEM340 Physical Chemistry IV: Introduction to Quantum Chemistry

This course is an introduction to modern concepts of atomic and molecular quantum mechanics, molecular orbital theory, and qualitative and quantitative concepts of molecular electronic structure. The second half of the course will emphasize numerical calculations with commonly used approximations in many quantum chemistry methods.
electron calculations on atomic and molecular systems using currently popular computer programs.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CHEM  
**Prereq:** CHEM337 OR PHYS214

**CHEM341 Physical Chemistry IVB: Quantum Chemistry**
This survey of lab initio electronic structure theory studies basis sets, many-body perturbation theory, coupled cluster theory, and density functional methods. These methods will be applied to molecular geometry optimizations, calculations of vibrational frequencies, NMR spectra, and thermochemistry including transition states for chemical reactions. The thermochemical methods covered include the complete basis set (CBS) models.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 0.50  
**Gen Ed Area:** NSM-CHEM  
**Prereq:** CHEM337 OR PHYS214 OR [PHYS315 or PHYS515]

**CHEM342 Molecules to Medicine**
This course will explore the process and equipment of drug development, including target selection, lead discovery using computer-based methods and combinatorial chemistry/high-throughput screening, organic synthesis, bioavailability, clinical trials, and other factors (some economics and politics) involved in bringing a drug to the marketplace. Critical consideration of the variables to contend with at each step will be described and discussed, including aspects of research ethics and patent law. The basic science of molecular recognition, computer-aided drug design, and the role of factors from synthetic chemistry to toxicology will be presented. Case studies of the development of drugs recently successful in making the journey from molecule to medicine will be discussed, as well as the story of some that did not, and why. Emerging new design strategies such as fusion-protein therapies, crisper technology, and enhanced use of rational design and combinatorial methods will be emphasized, and how pharmaceutical research is evolving in the postgenomic era, particularly with biologics. Job opportunities in the pharmaceutical industry will be discussed.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CHEM  
**Prereq:** CHEM141 OR CHEM143 OR CHEM251

**CHEM353 Applications of Spectroscopic Methods in Organic Chemistry**
The use of NMR infrared and mass spectroscopy in structure determinations will be discussed.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CHEM  
**Prereq:** (CHEM251 AND CHEM252)

**CHEM358 Structure and Mechanism**
This course will cover several important aspects of traditional and contemporary physical organic and mechanistic chemistry, including frontier molecular orbital theory and pericyclic reactions, organic photochemistry reactive intermediates (carbocations, carbanions, radicals, and carbenes), the thermodynamics and kinetics of organic reactions, and polymer chemistry.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CHEM  
**Prereq:** (CHEM251 AND CHEM252)

**CHEM359 Advanced Organic Synthesis**
The control of reactivity and selectivity to achieve specific syntheses is one of the overarching goals of organic chemistry. This course is intended to provide advanced undergraduate and graduate students in chemistry with a sufficient foundation to comprehend and use research literature in organic chemistry. Concentrating on the most important reactions and efficient synthetic methods used for organic synthesis, this course presents the material by reaction type. The planning and execution of multistep synthesis will also be included.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CHEM  
**Prereq:** None

**CHEM361 Advanced Inorganic Chemistry**
This course is a survey of the chemistry of the inorganic elements, focusing on the relationship between electronic structure, physical properties, and reactivity across the periodic table.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CHEM  
**Prereq:** CHEM252

**CHEM375 Integrated Chemistry Laboratory I**
This advanced laboratory course in chemistry involves work from the major subdisciplines: organic, inorganic, biochemistry, physical, and instrumental. Emphasis will be placed on integrating aspects of chemical synthesis, spectroscopic characterization, and determination of physical properties in each exercise.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CHEM  
**Prereq:** (CHEM251 AND CHEM252 AND CHEM257 AND CHEM258)

**CHEM376 Integrated Chemistry Laboratory II**
This advanced laboratory course in chemistry involves work from the major subdisciplines: organic, inorganic, biochemistry, physical, and instrumental. Emphasis will be placed on integrating aspects of chemical synthesis, spectroscopic characterization, and determination of physical properties in each exercise.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CHEM  
**Prereq:** CHEM375

**CHEM377 Chemistry of Materials and Nanomaterials**
This course will provide an introduction to materials chemistry, with a special emphasis on nanomaterials. Topics covered will include colloidal metal nanomaterials; semiconductors and quantum dots; carbon nanotubes, fullerenes, and graphene; metal-organic frameworks; self-assembly and metamaterials; electron and scanning probe microscopies; and lithography. The course will also discuss applications of these materials and techniques in areas such as plasmonics and sensing, catalysis, energy generation, and medicine.

**Offering:** Host  
**Grading:** A-F  
**Credits:** 1.00  
**Gen Ed Area:** NSM-CHEM  
**Identical With:** PHYS377  
**Prereq:** CHEM251
CHEM379 Nanomaterials Lab
This course will be a combination of weekly lecture and laboratory exercises designed to introduce students to new developments in the chemistry of materials and nanomaterials. Concepts and theoretical background will be discussed during weekly lectures. Students will then apply those concepts to the preparation of materials/nanomaterials in weekly lab sections. Students will synthesize quantum dots, build solar cells, pattern surfaces using both photolithography and soft lithography, make conductive carbon nanofiber films, prepare high-temperature superconductors, and learn scanning probe microscopy techniques.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: (CHEM257 AND CHEM258)

CHEM381 Physical Chemistry for the Life Sciences
The course is concerned with the basic physicochemical principles and model systems essential to understanding, explaining, and predicting the behavior of biological systems in terms of molecular forces. The course integrates fundamental concepts in thermodynamics, kinetics, and molecular spectroscopy with the structures, functions, and molecular mechanisms of biological processes. The objectives of the course are to (1) familiarize life science students at the advanced undergraduate and beginning graduate level with basic physicochemical laws, theories, and concepts important to the life sciences; (2) provide a working knowledge of mathematical methods useful in life science research; (3) develop a critical perspective on explanation of biological processes and understanding biological systems; and (4) survey the main applications of physical chemistry in the life sciences with an emphasis on spectroscopy and microscopy. Theory, methodology, and biophysical concepts are distributed throughout the course and are presented in the context of case studies including respiration, light harvesting and photosynthesis, ATP hydrolysis, NAD/NADH redox, energy transfer, FRET spectroscopy, with an emphasis on single molecule as well as ensemble experiments and their interpretation.
Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B381, MB&B581
Prereq: (CHEM141 AND CHEM142 AND MATH117 AND CHEM251) OR (CHEM143 AND CHEM144 AND MATH121 AND CHEM251)

CHEM382 Practical NMR
This course will cover how a spectrometer works as well as the theory and application of NMR experiments. The topics will include one-dimensional proton and heteronuclear experiments as well as decoupling. The course will begin with how the spectrometer works and how data processing is carried out, as well as how to calibrate the spectrometer and shim the magnet. The one-dimensional TOCSY and NOESY experiments will then be covered. The course will also cover heteronuclear and homonuclear two-dimensional NMR experiments. The experiments will include two-dimensional DQF COSY, TOCSY, NOESY, and ROESY proton experiments as well as heteronuclear experiments to correlate the chemical shifts of protons and heteronuclei, as well as how to select heteronuclear resonances on the basis of the number of directly attached protons.

The course will consist of lectures as well as a laboratory component in which the Mercury 300 will be used to obtain data that will be analyzed using the methods developed in the lecture part of the course. This course is specifically aimed at general users of the Mercury spectrometer who wish to learn how to carry out and analyze advanced one-dimensional and two-dimensional NMR experiments.
Offering: Host
Grading: A-F

CHEM383 Biochemistry
This introductory course to the principles and concepts of contemporary biochemistry presents both the biological and chemical perspectives. The major themes will be the structure of proteins and the basis of enzymatic activity, cellular metabolism and the generation and storage of metabolic energy, and general principles of the biosynthesis of cellular components.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B383
Prereq: (CHEM251 AND CHEM252)

CHEM385 Advanced Biochemistry: Enzyme Kinetics
This course presents an introduction to the theory and practice of enzyme kinetics, both steady-state and presteady-state.
Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B385
Prereq: [CHEM383 or MB&B383]

CHEM386 Biological Thermodynamics
This course is addressed to undergraduate and graduate students interested in biological chemistry and structural biology. The course presents thermodynamic methods currently used to relate structure to function in biological molecules. Topics include binding curves, chemical ligand linkages, binding polynomial, cooperativity, site-specific binding processes, and allosteric effects. Several models for allosteric systems, such as the Monod-Wyman-Changeux model, the induced-fit model, and the Pauling model, are analyzed in detail. Applications of these models are illustrated for functional regulation of respiratory proteins and for protein-nucleic-acid complexes involved in control of gene expression.
Offering: Host
Grading: OPT
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: MB&B386
Prereq: (MATH121 AND MATH122)

CHEM387 Enzyme Mechanisms
The chemical mechanisms involved in the action of a series of typical enzymes will be considered.
Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: MB&B387
Prereq: [CHEM383 or MB&B383]

CHEM390 Practical Methods in Biochemistry
This course centers on currently used techniques for protein separation, characterization, and purification, such as ultracentrifugation, gel electrophoresis, and chromatography. These topics will be introduced within the general context of the behavior of macromolecules in solution. The relative stability of proteins in different media, the forces stabilizing protein structure, and the interaction of proteins will be discussed. We will explicitly consider different techniques used to study proteins. Relatively novel techniques to be discussed include surface plasmon resonance, microarray methods and mass spectrometry, and single molecule microscopy. In the course, we will go through
three or four different protein purification protocols and discuss the methods used in each one. We will also touch upon the commonly used spectroscopic techniques used to characterize proteins, including absorption, fluorescence, and circular dichroism. The course will focus on biochemical techniques and understanding the physical principles underlying these techniques and will also discuss tactics for optimizing established isolation and purification procedures and for isolating and characterizing an unknown protein.

The course content is appropriate for advanced undergraduates (juniors/seniors) and beginning graduate students from chemistry, biology, molecular biophysics or MB&B.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B340
Prereq: [MB&B208] OR [CHEM383 or MB&B383] OR (CHEM144 AND MATH122) OR (PHYS1111 AND PHYS1112) OR CHEM338

CHEM395 Structural Biology Laboratory
One of the major catalysts of the revolution in biology that is now under way is our current ability to determine the physical properties and three-dimensional structures of biological molecules by x-ray diffraction, nuclear magnetic resonance (NMR) spectroscopy, and other spectroscopic methods. This course is designed to familiarize students with current research techniques in biochemistry and molecular biophysics. Students will perform spectroscopic investigations on a protein that they have isolated and characterized using typical biochemical techniques, such as electrophoresis, enzyme extraction, and column chromatography. The course will provide hands-on experience with spectroscopic methods such as NMR, fluorescence, UV-Vis absorption, and Raman as well as bioinformatic computational methods. All of these methods will be applied to the study of biomolecular structure and energetics. This course provides a broad knowledge of laboratory techniques valuable for independent research at the undergraduate level and beyond.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-MBB
Identical With: MB&B395, PHYS395
Prereq: [(MB&B208 OR BIOL208) AND CHEM141 AND CHEM142] OR [(MB&B208 or BIOL208) AND CHEM143 AND CHEM144]

CHEM396 Molecular Modeling
The theory behind molecular modeling techniques will be discussed, along with hands-on experience using HyperChem. Techniques such as energy minimization, Monte Carlo, molecular dynamics, Brownian dynamics, and quantum simulations will be discussed in detail. Relevant statistical mechanical concepts will be reviewed. Algorithms, implementations, limitations, and problems associated with existing modeling techniques will then be examined. Theory and implementation of selected free-energy simulation techniques will be discussed. Hands-on session using HyperChem on a 486-PC will involve direct application of techniques such as performing EM on a molecule of choice.

Offering: Crosslisting
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM596
Prereq: CHEM337

CHEM401 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM402 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM407 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.
Offering: Host
Grading: A-F

CHEM408 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.
Offering: Host
Grading: A-F

CHEM409 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM410 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM411 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM412 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM419 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.
Offering: Host
Grading: Cr/U

CHEM420 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.
Offering: Host
Grading: Cr/U

CHEM421 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: Host
Grading: OPT

CHEM422 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: Host
Grading: OPT

CHEM423 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM424 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
This course is an integrated consideration of the biophysics and biophysical chemistry of biological systems from molecules to cells. The objective is to develop a critical sense of the quantitative data currently being obtained from microscopy to spectroscopy, considering both ensemble and single-molecule experiments, and to gain familiarity and facility with interpretation using mathematical and computational models. Biological systems are inherently complex, and some form of modeling is always involved in developing an explanation of how they work. However, these models typically involve only a few basic constructs (simple harmonic motion, ideal fluids, two-state Ising models, random walks, electrostatic interactions, classical dynamics, rate equations, QM energy levels, distribution functions, and network analysis) and only elementary aspects of linear algebra, calculus, differential equations, and statistics. This course deals with how these constructs are integrated in the framework of Boltzmann statistical mechanics to formulate mathematical models of biological phenomena, how these models are validated and refined, and how they are used to form explanations and make testable predictions. Model systems to be considered include the nucleosome, the ribosome, membrane dynamics and ion channels, molecular devices and motors, prototype signal transduction systems, and regulatory processes. This course is suitable for physics and chemistry students who wish to learn about biological applications and for molecular and cellular biology students to develop skills with quantitative physicochemical modes of inquiry applied to the life sciences.

Offering: Crosslisting
Grading: Cr/U
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: CHEM309, MB&B309, MB&B509, PHYS339, PHYS539
Prereq: (CHEM251 AND CHEM252)
CHEM520 Scientific Research Ethics
This course involves critical consideration of the ethical issues that arise in the conduct of scientific research. The course will begin with an overview of the ethical issues commonly encountered in research, including what is and is not an ethical issue and how ethical issues are dealt with in principle and in practice. Initial topics include record keeping, conflict of interest, responsible authorship, ownership of projects, policies for handling misconduct, policies regarding the use of human and animal subjects, and data management and distribution. The course proceeds to consider a series of case studies based on instances in the recent scientific literature in which ethical problems were encountered.
Offering: Crosslisting
Grading: A-F
Credits: 0.50
Gen Ed Area: NSM-CHEM
Identical With: CHEM320
Prereq: None

CHEM521 Chemistry Symposia I
Weekly seminars by distinguished national and international chemists.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Prereq: None

CHEM522 Chemistry Symposia II
Weekly seminars by distinguished national and international chemists.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Prereq: None

CHEM540 Physical Chemistry IV: Advanced Quantum Chemistry
This course covers electron wave function theory, operator formalisms and second quantization; fundamentals of restricted and unrestricted Hartree-Fock theory; electron correlation methods; pair and coupled pair theories; many-body perturbation theory; and coupled-cluster theory. This course is suitable for advanced graduate students in physical chemistry and chemical physics.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: None
Prereq: CHEM340 OR [PHYS315 or PHYS515]

CHEM541 Physical Chemistry IV: Quantum Chemistry
Second half of the semester, computer lab.
Offering: Host
Grading: A-F
Credits: 0.50
Gen Ed Area: None
Prereq: CHEM337 OR PHYS214

CHEM545 Modern High-Resolution Spectroscopy
This is a graduate-level lecture/discussion course in selected topics in modern high-resolution spectroscopy. Topics to be covered include microwave spectroscopy, angular momentum theory, electronic spectroscopy of diatomic molecules, and vibrational normal mode analysis. While there are no formal prerequisites for this course, a working knowledge of quantum mechanics will be assumed.
Offering: Host
Grading: A-F
Credits: 0.25
Gen Ed Area: None
Prereq: CHEM251 AND CHEM252

CHEM547 Seminar in Chemical Physics
Weekly seminars presented jointly with the Department of Physics under the auspices of the Chemical Physics Program. These informal seminars will be presented by students, faculty, and outside visitors on current research and other topics of interest.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: PHYS587
Prereq: None

CHEM548 Seminar in Chemical Physics
Weekly seminars presented jointly with the Chemistry Department under the auspices of the Chemical Physics Program. These informal seminars will be presented by students, faculty, and outside visitors on current research and other topics of interest.
Offering: Crosslisting
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: PHYS588
Prereq: None

CHEM549 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM550 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: Host
Grading: OPT

CHEM557 Seminar in Organic and Inorganic Chemistry
This graduate-level seminar in organic and inorganic chemistry will include weekly presentations and discussions based on current research. Speakers will present the details of their topic using specific examples and will place the research in a broader context with respect to the current literature while also providing adequate background information and drawing concepts together with critical concluding analysis.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Prereq: None

CHEM558 Seminar in Organic and Inorganic Chemistry
This graduate-level seminar in organic and inorganic chemistry will include weekly presentations and discussions based on current research. Speakers will present the details of their topic using specific examples and will place the research in a broader context with respect to the current literature while also providing adequate background information and drawing concepts together with critical concluding analysis.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Prereq: None

CHEM561 Graduate Field Research
Research in the field, normally on thesis project.
Offering: Host
Grading: OPT

CHEM565 Physical Methods in Chemistry
An introduction to the use of physical methods to characterize the structures and dynamics of chemical systems with a particular emphasis on applications in inorganic chemistry. Topics will include a variety of spectroscopies (e.g., optical absorption, circular dichroic techniques, infrared and Raman spectroscopies, NMR techniques), small molecule X-ray crystallography, and magnetic susceptibility measurements. Group theoretical techniques will be used extensively to develop selection rules.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Prereq: CHEM361 OR CHEM337

CHEM587 Seminar in Biological Chemistry
This course involves weekly presentations and discussions based on current research.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: MB&B587
Prereq: (CHEM383 or MB&B383 or CHEM325 or MB&B325 or MB&B208) OR [CHEM383 or MB&B383]

CHEM588 Seminar in Biological Chemistry
This course involves weekly presentations and discussions based on current research.
Offering: Host
Grading: Cr/U
Credits: 0.25
Gen Ed Area: None
Identical With: MB&B588
Prereq: (CHEM383 or MB&B383 or CHEM325 or MB&B325 or MB&B208) OR [CHEM383 or MB&B383]

CHEM596 Molecular Modeling
The theory behind molecular modeling techniques will be discussed, along with hands-on experience using HyperChem. Techniques such as energy minimization, Monte Carlo, molecular dynamics, Brownian dynamics, and quantum simulations will be discussed in detail. Relevant statistical mechanical concepts will be reviewed. Algorithms, implementations, limitations, and problems associated with existing modeling techniques will then be examined. Theory and implementation of selected free-energy simulation techniques will be discussed. Hands-on session using HyperChem on a 486-PC will involve direct application of techniques such as performing EM on a molecule of choice.
Offering: Host
Grading: A-F
Credits: 1.00
Gen Ed Area: NSM-CHEM
Identical With: CHEM396
Prereq: CHEM337