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**

CHEM121F Chemophobia: Precaution or Panic? (FYS)
Chemophobia is an aversion to or prejudice against chemistry and chemicals. There is abundant evidence of this across the mass media, and while some important issues have been brought to the forefront in this way, the hype and misunderstanding surrounding other issues has had adverse effects on our society. This course will look at both sides of the debate surrounding chemicals in our everyday lives--in our food, in our consumer products, and in our environment. We will begin with a brief history of the environmental movement to see how we arrived at our current perceptions of chemistry, and then we will delve into the facts and science behind some of the topical issues of concern to differentiate between what is merely hype and what we ought to be concerned about. This course is intended for anyone interested in the topic, regardless of their current knowledge of chemistry.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **None**

CHEM134 Quantum Weirdness?
Chem 134 is a general education course open to first-year students, sophomores, juniors, and seniors. There is an enrollment limit of 19 students. There are no formal prerequisites for this course except for a keen intellect and an interest in modern science. In a lecture and discussion format, we will be exploring the "weirdness" and "paradoxes" inherent in the science of quantum mechanics. Full disclosure: the instructor is a scientific realist and is skeptical of fantasy physics. We will be reading articles from the archives of Scientific American, and from books such as "What is Real?" by Adam Becker, "Beyond Weird," by Philip Ball, and "Through Two Doors at Once: The Elegant Experiment That Captures the Enigma of Our Quantum Reality," by Anil Ananthaswamy. At the end of the course, students will be expected to present 15-minute talks on a topic of their choosing loosely adhering to the theme of the course.
Offering: **Host**
Grading: **Cr/U**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **None**

CHEM141 Introductory Chemistry I
CHEM 141 is the first half of an introductory course in general chemistry intended for science majors and for premedical studies. The topics covered will include measurement and dimensional analysis; atomic theory; chemical nomenclature; mass relationships and the mole concept; stoichiometry; aqueous reactions; gases; thermochemistry; the quantum mechanical model of the atom; periodic trends; bonding theory; and molecular geometry. The full-year course can be completed by continuing on to CHEM 142.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Prereq: **None**

CHEM142 Introductory Chemistry II
CHEM 142 is the second half of Introductory Chemistry and is intended for science majors and for premedical studies. This course will introduce theory as well as applications that involve significant amount of calculation. A strong familiarity with algebra is required. The topics covered will include intermolecular forces, acids and bases, solutions, their properties and equilibria, thermodynamics, free energy, electrochemistry and radioactivity. 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 some exposure to basic calculus, this course will emphasize the fundamental principles of chemistry and is recommended for students interested in pursuing majors in science or mathematics. The topical focus will be on the concepts of electronic structure, molecular geometry, and equilibrium thermodynamics, with applications to current research on, for example, the carbon cycle and nanomaterials. CHEM143 and CHEM144 provide the best basic foundation for further study of chemistry and is strongly recommended for Chemistry, MB&B, and NS&B majors. Completion of CHEM143 and CHEM144 also satisfies premedical general chemistry requirements.
Offering: **Host**
Grading: **A-F**

Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Prereq: **None**

CHEM144 Principles of Chemistry II
This second semester general chemistry course is a continuation of the Principles of Chemistry sequence that is recommended for science students. The focus of the course is the fundamentals of structure and bonding, with an emphasis on predicting reactivity. Major topical coverage includes the reactivity of ions in aqueous solution, kinetics, modern electronic structure, and the chemistry of transition metal complexes, with applications to current research on, for example, food chemistry, functional materials, and artificial photosynthesis.
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. It is required for Chemistry or MB&B majors and satisfies the general chemistry laboratory requirements for pre-medical studies. Chem 152 is usually taken concurrently with CHEM 141, 142, 143, or 144.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Prereq: **None**

CHEM241 Informal Science Education for Elementary School Students I
This service-learning course will focus on designing and implementing original, effective, and engaging science-based lesson plans for elementary age children in an afterschool program setting at five local elementary schools. The classroom component includes writing, testing, and critiquing lesson plans and organizing a once-a-semester event, Science Saturday. Members of the class are required to volunteer weekly, co-lead Science Saturday, complete individual work, and organize meetings for projects outside of class.
Offering: **Host**
Grading: **BMS**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **None**

CHEM242 Informal Science Education for Elementary School Students II
This service-learning course will focus on designing and implementing original, effective, and engaging science-based lesson plans for elementary age children in an afterschool program setting at five local elementary schools. The classroom component includes writing, testing, and critiquing lesson plans and organizing a once-a-semester event, Science Saturday. Members of the class are required to volunteer weekly, co-lead Science Saturday, complete individual work, and organize meetings for projects outside of class. This course is a continuation of CHEM241.
Offering: **Host**
Grading: **Cr/U**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B242**
Prereq: **None**

CHEM250 Pre-Organic Chemistry: Key Concepts and Fundamental Principles
This course is designed to assist students in the transition from CHEM 142 & CHEM 144 to CHEM 251. This course will review key General Chemistry concepts and apply them to organic molecules. Thematic presentation of material will use visual lecture and demonstration methods, small-group problem solving, peer-group workshops and lecture format. A broad understanding of Organic Chemistry terminology, structures, nomenclature, applications and basic concepts will provide students will a firm foundation for success in CHEM 251.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Prereq: **CHEM142 OR CHEM144**

CHEM251 Principles of Organic Chemistry I
This course offers an introduction to the chemistry of carbon compounds with emphasis on the relationship between structure and reactivity. The laboratory course CHEM257 is normally elected concurrently but is not required.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Prereq: **CHEM142 OR CHEM144**

CHEM252 Principles of Organic Chemistry II
This course is a continuation of the chemistry of carbon compounds with emphasis on the chemistry of important functional groups. The laboratory course CHEM258 is normally elected concurrently but is not required.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Prereq: **CHEM251**

CHEM257 General Chemistry Laboratory
Normally taken along with CHEM251, this course provides laboratory work in quantitative chemical procedures and introductory chemical laboratory practices. This course is required by most medical, dental, and veterinary schools and is a prerequisite for CHEM258.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Prereq: **(CHEM141 AND CHEM142 AND CHEM152) OR (CHEM143 AND CHEM144 AND CHEM152)**

CHEM258 Organic Chemistry Laboratory
This course presents laboratory techniques of organic chemistry.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Prereq: **(CHEM251 AND CHEM257)**

CHEM307 Molecular Biophysics Journal Club I
This course includes presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from journals including but not limited to the Biophysical Journal, Biopolymers, Current Opinion iIn Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B507, MB&B307, CHEM507, PHYS317, PHYS517**
Prereq: **None**

CHEM308 Molecular Biophysics Journal Club II
Presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from the Biophysical Journal, Biopolymers, Current Opinion in Structural Biology, Journal

of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B508, MB&B308, CHEM508, PHYS318, PHYS518**
Prereq: **None**

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 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: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B309, CHEM509, MB&B509, PHYS339, PHYS539**
Prereq: **(CHEM251 AND CHEM252)**

CHEM314 Environmental Chemistry
This course is designed for students with college-level general and organic chemistry background. Examples of topics to be covered include energy production and consumption, chemical pollution and environmental clean-up, among others. Analysis and criticism of environmental literature are included.
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)**

CHEM317 Analytical Chemistry
This course is an overview of the broad subject of analytical chemistry, with an emphasis on quantitative chemical analysis. This course will focus on classical methods of chemical analysis, rather than instrumental analysis.

The course format will be a hybrid lecture/lab sequence, with lecture time spent investigating the background of each laboratory experiment.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Prereq: **(CHEM142 AND CHEM152) OR (CHEM144 AND CHEM152)**

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: **0.50**
Gen Ed Area: **NSM-CHEM**
Identical With: **CHEM520**
Prereq: **None**

CHEM321 Biomedicinal 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])**

CHEM323 Biochemistry of Neurodegenerative Disease
Broadly defined, neurodegenerative disease occurs when a specific class of neuron dies and thus fails in its biological action. In this course, we will delve into the many different, intricate ways neuron death can occur and cause disease. From the chemistry of neurotransmitters, aggregation of proteins, and the collapse of neuromuscular junctions, many areas of the neurobiology can go awry.

The focus of the course will be on understanding the complex interplay of small molecules and proteins that keep neurons healthy and functional. In this course, we will use current primary literature and lecture to understand the varied topics. This course aims to improve skills in reading and analysis of primary literature as well as the written and oral presentation of scientific findings.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Identical With: **NS&B323**
Prereq: **BIOL181 AND CHEM252**

CHEM325 Introduction to Biomolecular Structure
This course aims to provide a framework for understanding three-dimensional 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 are 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]**

CHEM335 Protein Folding: From Misfolding to Disease
Amyloidogenesis, the process by which proteins and peptides misfold to form amyloid fibers, is at the root of several different diseases, including Parkinson's disease, Alzheimer's disease, mad cow disease, and type II diabetes to name a few. This course will focus on current research in the field that seeks to understand why a functional, well-folded protein adopts the misfolded amyloid form. In the course of discussing the misfolded nature of these proteins, we will review central elements of protein structure and stability to better understand the protein-folding landscape and the process of misfolding. We will also discuss how the process of misfolding leads to the different diseases and disease pathologies. We will read current literature that studies the molecular nature of these diseases and discuss the strategies used to detect, identify and study these misfolded proteins in the body and in the test-tube.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B535, MB&B335, CHEM535**
Prereq: **MB&B208 OR MB&B325**

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 MATH121 AND MATH122) OR (CHEM143 AND CHEM144 AND MATH121 AND MATH122)**

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: **(MATH121 AND MATH122 AND CHEM141 AND CHEM142) OR (MATH121 AND MATH122 AND CHEM143 AND CHEM144)**

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 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**

CHEM342 Molecules to Medicine
This course will explore the process 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**
Identical With: **BIOL342, CIS342, MB&B342**
Prereq: **CHEM252 OR MBB208**

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: **CHEM251 AND CHEM252**

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. Theory, methodology, and biophysical concepts are distributed throughout the course.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B381, MB&B581**
Prereq: **(CHEM251 AND MATH117) OR (CHEM251 AND MATH120) OR (CHEM251 AND MATH121)**

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 DQFCOSY, 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**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B382**
Prereq: **None**

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)**

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]**

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 and Design
This course will introduce students to the practical and theoretical aspects of computationally modeling and designing biological macromolecules, with a particular emphasis on protein structures. Students will run molecular dynamics simulations with Gromacs (http://www.gromacs.org) and do protein structure predication/design with Rosetta (https://www.rosettacommons.org). Over the course of the semester students will embark on a group research project, likely related to redesigning proteins that show potential for use as drugs. Both Gromacs and Rosetta use the Mac/Linux command-line, so having some familiarity with that prior to the course would be helpful but not required.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **CHEM596**
Prereq: **MB&B208 OR BIOL265 OR CHEM381 OR CHEM325 OR MB&B335 OR CHEM338 OR CHEM383 OR PHYS316 OR PHYS340 OR BIOL266**

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**
Grading: **OPT**

CHEM491 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: **Host**
Grading: **OPT**

CHEM492 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: **Host**
Grading: **OPT**

CHEM495 Research Apprentice, Undergraduate
Project to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **Cr/U**

CHEM496 Research Apprentice, Undergraduate
Project to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **Cr/U**

CHEM500 Graduate Pedagogy
The elements of good teaching will be discussed and demonstrated through lectures, practice teaching sessions, and discussions of problems encountered in the actual teaching environment. The staff consists of faculty and experienced graduate students. An integral part of the course is a required one-day workshop BEFORE the first day of formal classes.

Training in pedagogy in the first semester of attendance is required for all incoming Wesleyan MA and PhD students who have not already fulfilled this requirement at Wesleyan. BA/MA students are not required to get training in pedagogy but may choose to do so.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **None**
Identical With: **E&ES500, BIOL500, ASTR500, MB&B500, MUSC500, PHYS500, PSYC500, MATH500**
Prereq: **None**

CHEM501 Individual Tutorial for Graduates
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

CHEM502 Individual Tutorial for Graduates
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

CHEM504 Selected Topics, Graduate Science
Topic to be arranged in consultation with the tutor. A seminar primarily concerned with papers taken from current research publications designed for, and required of, graduate students.
Offering: **Host**
Grading: **OPT**

CHEM507 Molecular Biophysics Journal Club I
This course includes presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from journals including but not limited to the Biophysical Journal, Biopolymers, Current Opinion iIn Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B507, MB&B307, CHEM307, PHYS317, PHYS517**
Prereq: **None**

CHEM508 Molecular Biophysics Journal Club II
Presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from the Biophysical Journal, Biopolymers, Current Opinion in Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B508, MB&B308, PHYS318, PHYS518, CHEM308**
Prereq: **None**

CHEM509 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 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: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **CHEM309, MB&B309, MB&B509, PHYS339, PHYS539**
Prereq: **(CHEM251 AND CHEM252)**

CHEM511 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

CHEM512 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

CHEM519 Structural Mechanisms of Protein-Nucleic Acid Interactions
This course focuses on recent advances in the understanding of the structural basis of the recognition of nucleic acids by proteins. Macromolecular systems to be discussed include site-specific DNA endonucleases, topoisomerases, the histone fold, helicases, site-specific recombinases, nuclear RNA-protein complexes, tRNA-binding proteins, and the ribosome.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **None**
Identical With: **MB&B519**
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**

CHEM535 Protein Folding: From Misfolding to Disease
Amyloidogenesis, the process by which proteins and peptides misfold to form amyloid fibers, is at the root of several different diseases, including Parkinson's disease, Alzheimer's disease, mad cow disease, and type II diabetes to name a few. This course will focus on current research in the field that seeks to understand why a functional, well-folded protein adopts the misfolded amyloid form. In the course of discussing the misfolded nature of these proteins, we will review central elements of protein structure and stability to better understand the protein-folding landscape and the process of misfolding. We will also discuss how the process of misfolding leads to the different diseases and disease pathologies. We will read current literature that studies the molecular nature of these diseases and discuss the strategies used to detect, identify and study these misfolded proteins in the body and in the test-tube.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B535, MB&B335, CHEM335**
Prereq: **MB&B208 OR MB&B325**

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: **1.00**
Gen Ed Area: **NSM-CHEM**
Prereq: **None**

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 and Design
This course will introduce students to the practical and theoretical aspects of computationally modeling and designing biological macromolecules, with a particular emphasis on protein structures. Students will run molecular dynamics simulations with Gromacs (http://www.gromacs.org) and do protein structure predication/design with Rosetta (https://www.rosettacommons.org). Over the course of the semester students will embark on a group research project, likely related to redesigning proteins that show potential for use as drugs. Both Gromacs and Rosetta use the Mac/Linux command-line, so having some familiarity with that prior to the course would be helpful but not required.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **CHEM396**
Prereq: **MB&B208 OR BIOL265 OR CHEM381 OR CHEM325 OR MB&B335 OR CHEM338 OR CHEM383 OR PHYS316 OR PHYS340 OR BIOL266**