Chemistry (CHEM)

CHEM 1012 Chemistry in Everyday Life 3 Credits
Course Description: If it is possible to appreciate art without being an artist, shouldn't it also be possible for a non-scientist to appreciate chemistry? Yes! The omnipresence of chemistry in our everyday lives will be explored in this course for nonscience majors. The fundamentals of chemistry will be covered primarily through lectures, text readings, journal articles, problem-solving, and group projects. We will investigate the origin of the elements, spectroscopy, synthesis of new substances, how we interact with molecules through our senses, metabolism, health, and environmental chemistry involving the air we breathe, the water we drink, the weather we enjoy or endure, as well as special topics like nanotechnology, genetics, forensics, and art conservation. A major goal of this course is to help students understand how science works and what it means for something to be "scientifically proven". We repeatedly ask the question: "How do we know?" because it is not what we know that is so important, it is how we know it and how certain we are that it is correct that matters.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1014 Chemistry of Climate Change 1.5 Credits
This course is an introduction to the chemistry involved in climate change. No background in chemistry is assumed, the relevant concepts will be developed as needed. The course will discuss energy transformations, sources and sinks of carbon dioxide. Using chemical principles, the course will explain the greenhouse effect and why carbon dioxide is the primary focus for climate change. The evidence for climate change as well as the science behind the consequences will be examined.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1020 Environmental Chemistry 3 Credits
Introduction to the chemistry of the environment. Topics will include acid rain, global warming, greenhouse effect, ozone layer, photochemical smog, pesticides, eutrophication, and nuclear power. Related ground, air, and water pollution issues as well as pollution abatement measures will also be discussed. No background in chemistry is assumed; the relevant concepts will be developed as needed. Spring.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1023 Molecular Gastronomy 3 Credits
This course will examine the interconnected relationship between food and chemistry. Ever wonder why an egg solidifies when you cook it? Or why fruit turns brown when it's cut? Or why certain dishes are prepared in certain ways? Or why recipies have the ingredient list they do? These questions are all rooted in the science of the food components and their treatment. Relevant concepts and language surrounding the chemistry behind proteins, fats, carbohydrates, beverages and other food products will be developed during the semester. No science background is assumed. This course counts toward completion of the College's math/science requirement.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1024 Chemistry of Human Body 3 Credits
This course focuses on how chemistry controls the biological systems of the human body. Topics covered will include how the body gets energy, how memories are made, and what happens to the biology when the chemistry goes wrong. This is meant to be an interdisciplinary course that will cover introduction to biological systems and more in-depth chemical principles associated with those systems. Students do not need to have a strong background in chemistry or biology and all topics and background material will be introduced as needed. This course fulfills the requirement of Science for All.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1025 Intro to Forensic Chemistry 3 Credits
This course is designed for the non-science major students to stimulate their interest in the forensic chemistry and help them appreciate and understand the basic fundamental concepts of chemistry. In each chapter, chemical concepts related to a forensic topic are introduced in addition to a brief description of an analytical instrumentation or methodology used in crime investigation lab and a case study. The main purpose of this course is to deliver the chemistry concepts to students without going into great details.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1026 Science in the News 3 Credits
This course has been designed to provide non-science majors with the skills to critically read and understand science (specifically chemistry) as it is presented in the news. Everyone can benefit from being able to read a news article and evaluate the science presented as reliable or not. Students are not expected to have strong background in chemistry and introductory material necessary for the lecture will be presented. The course material will consist of news articles as well as scientific papers.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1028 Climate Change 1.5 Credits
This course will focus on climate change and its impact on society. Is the global climate changing? How do we know if the climate is changing? Are we to blame? We will explore the science of climate investigating the causes of change from the greenhouse effect to future climates and consider which changes are natural, and which are anthropogenic. For example, fossil fuels provide most of our energy and their extraction creates an environmental impact, particularly during combustion. There is solid evidence that Earth's climate is changing and computer models in conjunction with other techniques are used to project the future climate. We will delve into the challenge of climate change in a series of presentations and debates, mostly setting aside the complicated mathematical calculations related to the subject.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1030 Climate Change in the News 3 Credits
This course is a credit course that has been designed to provide non-science majors with the skills to critically read and understand the chemistry of climate change as it is presented in the news. Everyone can benefit from being able to read a news article and evaluate the science presented as reliable or not. Students are not expected to have a strong background in chemistry and introductory material necessary for the lecture will be presented. The course material will consist of news articles as well as scientific papers.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1040 Kitchen Chemistry 3 Credits
This course has been designed to provide non-science majors with a understanding of the chemistry reactions that can be found within cooking. Students are not expected to have a strong background in chemistry and introductory material necessary for the lecture will be presented.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1080 Science and Energy Security 3 Credits
Access to affordable energy has become paramount to the national and economic security of every nation. From wood to coal, oil to natural gas, nuclear to wind, global primary energy sources continue to evolve. Shifts in energy usage track with advancements in energy, natural resource, environment, and health science. In this course, we will examine the fundamental concepts in chemistry, physics, geology, and biology that underpin energy. Drawing from an interdisciplinary set of scientific concepts, we will discuss how those concepts have led to advancements in science that have changed our primary global energy supply over time. We will highlight the links among international policy, scientific policy, the scientific enterprise, and how scientific understanding is ultimately developed, tested, and revised. Some seats in this class are reserved.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 1100 General Chemistry I 3 Credits
This course conveys a cohesive narrative starting with electrons, atoms and the periodic table and progresses to molecules, gases, and condensed phases of matter. The emphasis in the first semester is to lay a strong, albeit introductory, foundation in quantum mechanics and the laws of thermodynamics. Topics include: electronic structure of atoms, periodic trends, chemical bonding, molecular geometry, molecular orbital theory, gases, intermolecular forces, liquids, solid state materials, enthalpy, entropy, Gibbs free energy, physical equilibria and phase diagrams.
Level: Undergraduate
Corequisites: CHEM 1105
Grading: Main Campus (UGrad, Grad)

CHEM 1105 General Chemistry Lab 2 Credits
General Chemistry Lab is designed to introduce students to the knowledge and skills necessary to become an experimental scientist. The hands-on lab sessions are designed to teach students necessary techniques including safe handling of materials and effective use of instrumentation. A range of skills are developed: proper methods for mass and volume measurement, reagent transfer, careful observations, collecting and recording data, graphing and analyzing data. Special attention is given to laying a strong foundation in evaluating accuracy and precision of collected data, applying the stoichiometric calculations, and utilizing UV-Vis spectroscopy. Some labs involve guided inquiry/discovery-based protocols. Students discover the gas laws, measure reaction enthalpies and enthalpy of vaporization, and use different model kits to build and predict molecular and solid-state structures. Students are introduced to writing formal lab reports. Recitation is a critical part of the course experience. During recitations students have the opportunity to engage with lecture material in small class setting, ask questions and learn about the experiment of the week. There are weekly quizzes and assignments submitted during recitation. Two hours of recitation and one three-hour laboratory per week. Concurrent: -CHEM 1100. Fall.
Level: Undergraduate
Corequisites: CHEM 1100
Grading: Main Campus (UGrad, Grad)
Mutual exclusion: CHEM 057, CHEM 1305

CHEM 1200 General Chemistry II 3 Credits
The focus of the second course of the two-semester sequence is on chemical reactions and their significance in environmental and biochemical contexts. Concepts covered in the first semester are applied to explain and predict chemical change both qualitatively and quantitatively. Topics include: chemical equilibria, acid base reactions, oxidation-reduction chemistry, kinetics, coordination chemistry, nuclear decay processes and nuclear energy.
Level: Undergraduate
Prerequisites: (CHEM 001 or CHEM 1100) and (CHEM 009 or CHEM 1105)
Corequisites: CHEM 1205
Grading: Main Campus (UGrad, Grad)

CHEM 1205 Intermediate Chemistry Lab 2 Credits
Chem 1205 is designed to build upon prior lab experience in Chem 1105. In this Intermediate Chemistry Lab course, students hone and refine their lab skills and technique. Higher standards are set as students are expected to be more independent in the lab and utilize previously learned concepts and techniques. This course delves into important topics such as chemical equilibria and reaction properties. Experiments in this course include colligative properties, electrochemistry, kinetics, and coordination chemistry. Students build upon their scientific writing skills from CHEM 1105 and complete formal reports. Recitation is a critical part of the course experience. During recitations students have the opportunity to engage with lecture material in a small class setting, ask questions and learn about the experiment of the week. There are weekly quizzes and assignments submitted during recitation. Two hours of recitation and one three-hour laboratory per week. Concurrent: -CHEM 1200. Spring. Pre-requisites: Chem 1105 and Chem 1100
Level: Undergraduate
Prerequisites: (CHEM 009 or CHEM 1105) or (CHEM 057 or CHEM 1305) or (CHEM 064 or CHEM 1909)
Corequisites: CHEM 1200
Grading: Main Campus (UGrad, Grad)

CHEM 1300 Majors General Chemistry I 3 Credits
CHEM -055 is the first semester of two-semester General Chemistry Lecture sequence intended for chemistry and biochemistry majors with an emphasis on developing analytical problem solving skills and reasoning skills. This course covers fundamental principles and laws in chemistry. Topics include matter and measurements, atoms, molecules and ions, stoichiometry, reactions in solutions, thermochemistry, electronic structure of atoms, periodic properties of elements, chemical bonding, molecular geometry, and gases. Concurrent: -057. Fall.
Level: Undergraduate
Corequisites:
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to students with a major in Biochemistry, Biochemistry, Biochemistry, Biochemistry, Chemistry, Chemistry, Chemistry or Chemistry.

Enrollment is limited to Undergraduate level students.

CHEM 1305 Majors General Chemistry Lab 2 Credits
Majors General Chemistry Lab is designed to introduce students majoring in chemistry and biochemistry to the knowledge and skills necessary to become an experimental scientist. The hands-on lab sessions are designed to teach students necessary techniques including safe handling of materials and effective use of instrumentation. A range of skills are developed: proper methods for mass and volume measurement, reagent transfer, careful observations, collecting and recording data, graphing and analyzing data. Special attention is given to laying a strong foundation in evaluating accuracy and precision of collected data, applying the stoichiometric calculations, and utilizing UV-Vis spectroscopy. Some labs involve guided inquiry/discovery-based protocols. Students discover the gas laws, measure reaction enthalpies and enthalpy of vaporization, and use different model kits to build and predict molecular and solid-state structures. Students are introduced to writing formal lab reports. Recitation is a critical part of the course experience. During recitations students have the opportunity to engage with lecture material in small class setting, ask questions and learn about the experiment of the week. There are weekly quizzes and assignments submitted during recitation. Two hours of recitation and one three-hour laboratory per week. Concurrent: -CHEM 1300. Fall.
Level: Undergraduate
Corequisites: CHEM 1300
Grading: Main Campus (UGrad, Grad)
Mutual exclusion: CHEM 009, CHEM 1105
Course registration restrictions:
Enrollment is limited to students with a major in Biochemistry, Biochemistry, Biochemistry, Biochemistry, Chemistry, Chemistry, Chemistry or Chemistry.

CHEM 1400 Majors General Chemistry II 3 Credits
Continues and presupposes -055. Concurrent: -058. Spring.
Level: Undergraduate
Prerequisites: (CHEM 001 or CHEM 1100) or (CHEM 055 or CHEM 1300)
Grading: Main Campus (UGrad, Grad)

CHEM 1405 Majors Intermediate Chem Lab 2 Credits
Chem 1405 is designed to build upon prior lab experience in Chem 1305. In this Intermediate Chemistry Lab course, students majoring in chemistry and biochemistry hone and refine their lab skills and technique. Higher standards are set as students are expected to be more independent in the lab and utilize previously learned concepts and techniques. This course delves into important topics such as chemical equilibria and reaction properties. Experiments in this course include colligative properties, electrochemistry, kinetics, and coordination chemistry. Students build upon their scientific writing skills from CHEM 1305 and complete formal reports. Recitation is a critical part of the course experience. During recitations students have the opportunity to engage with lecture material in a small class setting, ask questions and learn about the experiment of the week. There are weekly quizzes and assignments submitted during recitation. Two hours of recitation and one three-hour laboratory per week. Concurrent: -CHEM 1400. Spring. Pre-requisites: Chem 1305 and Chem 1300.
Level: Undergraduate
Prerequisites: CHEM 1300 and CHEM 1305
Corequisites: CHEM 1400
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to students with a major in Biochemistry, Biochemistry, Biochemistry, Biochemistry, Chemistry, Chemistry, Chemistry or Chemistry.

CHEM 1500 First-Year Seminar 1 Credit
The first-year seminar provides opportunities for new chemistry and biochemistry majors to meet the scientists in the Chemistry Department, learn about the wide array of cutting-edge research led by the faculty as well as the variety of options for undergraduate participation. How research is conducted, its impacts, challenges and unique outcomes will be explored. Additionally, there will be an emphasis on community building among students as well as an exploration of career opportunities. The course will meet once weekly. Assessment will be based on participation and engagement. This course is graded on a pass/fail basis.
Level: Undergraduate
Grading: Pass/Fail Default

CHEM 1909 Intro Research Experimentation 3 Credits
Special topics course which introduces methods of chemical research. Exploratory projects, both at the computer and in the laboratory, will be supervised by the instructor. Students may opt to work in research laboratories for part of the semester. For Chemistry and Biochemistry majors only.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 2100 Organic Chemistry I 1-3 Credits
Principles and theories of organic chemistry, including structural changes as studied by spectroscopy (IR, NMR, and mass spectra). Preparations, reactions, mechanisms, stereochemistry, and properties of alkanes, alkenes, alkyl halides, alcohols, ethers, aldehydes, ketones, and organometallic compounds are studied in detail. Prerequisites: -CHEM 1200, -CHEM 1205. Three lectures plus evening sessions for exams. Fall
Level: Undergraduate
Prerequisites: (CHEM 002 or CHEM 1200) or (CHEM 056 or CHEM 1400)
Course attribute:
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Students cannot enroll who have a major in Post Baccalaureate Pre-Medical, Post Baccalaureate Pre-Medical, Post Baccalaureate Pre-Medical or Post Baccalaureate Pre-Medical.

CHEM 2105 Organic Chemistry I Lab 0-2 Credits
Introduction to experimental organic chemistry. Fundamental techniques of organic synthesis, including separation, purification, and characterization of organic compounds. Introduction to spectroscopic and chromatographic methods. Prerequisites: CHEM 1200, CHEM 1205. Concurrent: CHEM 2100. One four-hour laboratory and one one-hour recitation. Fall.
Level: Undergraduate
Prerequisites: (CHEM 002 or CHEM 1200) and (CHEM 010 or CHEM 1205)(CHEM 056 or CHEM 1400) and (CHEM 058 or CHEM 1405)
Grading: Main Campus (UGrad, Grad)

CHEM 2200 Organic Chemistry II 3 Credits
Continues and presupposes -CHEM 2100. Compounds studied include aromatic compounds, amines, carbonyl-containing compounds, conjugated and difunctional compounds, heterocyclics, and the biologically important amino acids, peptides, and carbohydrates. Prerequisite: -CHEM 2100. Three lectures plus evening sessions for exams. Spring.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 2205 Organic Chemistry II Lab 0-2 Credits
Continues and presupposes -CHEM 2105. More complex synthetic reactions, including cycloadditions, carbonyl additions and condensations, isolation of natural products; qualitative organic analysis. Prerequisites: CHEM 2100 and -CHEM 2105. Concurrent: -CHEM 2200. One four-hour laboratory and one one-hour recitation. Spring.
Level: Undergraduate
Prerequisites: (CHEM 115 or CHEM 2100) or (CHEM 119 or CHEM 2300) and (CHEM 117 or CHEM 2105)
Grading: Main Campus (UGrad, Grad)

CHEM 2300 Majors Organic Chemistry I 3 Credits
This course is for Chemistry / Biochemistry Majors. Principles and theories of organic chemistry, including structural changes as studied by spectroscopy (IR, NMR, and mass spectra). Preparations, reactions, mechanisms, stereochemistry, and properties of alkanes, alkenes, alkyl halides, alcohols, ethers, aldehydes, ketones, and organometallic compounds are studied in detail. Prerequisites: -CHEM 1400, -CHEM 1405. Fall.
Level: Undergraduate
Prerequisites: (CHEM 002 or CHEM 1200) or (CHEM 056 or CHEM 1400)
Grading: Main Campus (UGrad, Grad)

CHEM 2400 Majors Organic Chemistry II 3 Credits
Continues and presupposes -CHEM 2300. Compounds studied include aromatic compounds, amines, carbonyl-containing compounds, conjugated and difunctional compounds, heterocyclics, and the biologically important amino acids, peptides, and carbohydrates. Prerequisite: -CHEM 2300. Three lectures plus evening sessions for exams. Spring.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 2500 Earth Systems Science 3 Credits
The United Nations has developed 17 goals in achieving sustainable development, many of them aiming to mitigate anthropogenic pollution to air, water, climate, and other Earth systems. This course guides students to understand the underlying science principles, often integrating basic chemistry, physics, and biology, for interrelated Earth systems, and how Earth systems science informs environmental policymaking. Topics include stratospheric ozone depletion and Montreal Protocol, climate change science, and Paris Agreement, air/water pollution and EPA regulations (including the first-ever National Drinking Water Standard for PFAS), chemical contamination and Stockholm/Basel Conventions, as well as biogeochemical cycles. For each topic, the transdisciplinary science is demonstrated by combining key concepts, data analysis, and case studies, followed by discussions on formulating science-based policies. In addition, knowledge gaps and future developments in Earth systems science are discussed.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 3100 Analytical Methods 3 Credits
First course in modern analytical chemistry. Topics covered: Statistical analysis of experimental data, acid-base equilibria and titrimetric analysis, extraction chemistry, and basic gas and liquid chromatography. UV-visible absorption spectroscopy, fluorescence spectroscopy, nuclear magnetic resonance, and mass spectrometry. Fall.
Level: Undergraduate
Prerequisites: (CHEM 002 or CHEM 1200) or (CHEM 056 or CHEM 1400) and (CHEM 010 or CHEM 1205) or (CHEM 058 or CHEM 1405) and (CHEM 213 (may be taken concurrently) or CHEM 3105 (may be taken concurrently))
Grading: Main Campus (UGrad, Grad)

CHEM 3105 Analytical Methods Lab 0 or 2 Credits
Laboratory techniques of classical chemical quantitative analysis, including volumetric analysis as well as practical exercises in potentiometric, chromatographic and spectroscopic analysis. Two three-hour laboratories. Prerequisite or concurrent: CHEM 3100. Fall.
Level: Undergraduate
Prerequisites: (CHEM 002 or CHEM 1200) or (CHEM 056 or CHEM 1400)(CHEM 010 or CHEM 1205) or (CHEM 058 or CHEM 1405) and CHEM 3100 (may be taken concurrently)
Grading: Main Campus (UGrad, Grad)

CHEM 3300 Physical Chemistry I 3 Credits
Introduction to atomic and molecular energy levels, molecular structure, introduction to statistical mechanics, quantum mechanics and atomic structure, molecular symmetry and group theory, theory of chemical bonding, barriers in chemical reactions, spectroscopy, X-ray diffraction, electrical properties of molecules. Prerequisites: Two semesters of general chemistry with lab (CHEM 55-56-57-58 or CHEM 001/009 and 002/010); PHYS 101-102, or PHYS 151-152; MATH 035-036. Prerequisite or concurrent: MATH-137
Level: Undergraduate
Prerequisites: (PHYS 101 or PHYS 2051) or (PHYS 151 or PHYS 2101)(PHYS 102 or PHYS 2052) and (PHYS 152 or PHYS 2102)(CHEM 002 or CHEM 1200) or (CHEM 056 or CHEM 1400) and (MATH 036 or MATH 1360)
Grading: Main Campus (UGrad, Grad)

CHEM 3350 Physical Chemistry for Biochem 3 Credits
This course covers principles and biological applications of thermodynamics, kinetics, quantum mechanics and molecular spectroscopy.
Level: Undergraduate
Prerequisites: (CHEM 002 or CHEM 1200) or (CHEM 056 or CHEM 1400) and (CHEM 116 or CHEM 2200)(CHEM 120 or CHEM 2400) and (MATH 035 or MATH 1350) and (MATH 036 or MATH 1360)
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to students with a major in Biochemistry, Biochemistry, Biochemistry or Biochemistry.

CHEM 3400 Physical Chemistry II 3 Credits
Properties of gases, kinetic theory, laws of thermodynamics, statistical thermodynamics, liquids, phase equilibria, colligative properties, non-ideal systems, theory of reactions, surface phenomena. Prerequisites: -219, MATH-137. Lecture. Spring.
Level: Undergraduate
Prerequisites: CHEM 002 or (CHEM 1200 or CHEM 056 or CHEM 1400) and (MATH 036 or MATH 1360)(PHYS 101 or PHYS 2051 or PHYS 151 or PHYS 2101) and (PHYS 102 or PHYS 2052 or PHYS 152 or PHYS 2102)
Grading: Main Campus (UGrad, Grad)

CHEM 3500 CHEM Transform Environment 3 Credits
This course investigates mechanisms underlying chemical transformation in the environment. Reactions and processes such as hydrolysis, catalysis, redox, acid-base, and phase partitioning are discussed in Earth's spheres including the atmosphere, hydrosphere, lithosphere and biosphere. Natural (e.g., unaltered air and rain water) and perturbed (e.g., photochemical smog and acid rain) systems are compared. Both qualitative (product identification and reaction pathways) and quantitative (reaction kinetics and equilibrium) aspects of environmental chemistry are considered. Green chemistry principles and applications are examined using case studies. These topics are discussed in the context of distinct and often interlinking global environmental issues such as stratospheric ozone loss, air quality degradation, climate change, and plastics pollution.
Level: Undergraduate
Prerequisites: (CHEM 002 or CHEM 1200) and (CHEM 056 or CHEM 1400) or (CHEM 002 or CHEM 1200) or (CHEM 056 or CHEM 1400)
Grading: Main Campus (UGrad, Grad)

CHEM 3600 Inorganic Chemistry 3 Credits
An intermediate-level lecture course providing an introduction to modern theories of inorganic reactions, bonding, and structure, in addition to emphasis on properties of the main categories of inorganic substances. Prerequisites: -116, -211. Prerequisite or concurrent: -220. Lecture. Spring.
Level: Graduate, Undergraduate
Prerequisites: (CHEM 002 or CHEM 1200 or CHEM 056 or CHEM 1400) and (MATH 036 or MATH 1360)(PHYS 101 or PHYS 2051 or PHYS 151 or PHYS 2101) and (PHYS 102 or PHYS 2052 or PHYS 152 or PHYS 2102)
Grading: Main Campus (UGrad, Grad)

CHEM 3605 Synthetic Methods Lab 3 Credits
Advanced synthetic techniques applied to the preparation, purification and characterization of organic and organometallic compounds. Topics covered include inert atmosphere handling of reactions, chromatographic separation, catalysis, asymmetric synthesis, biotechnology, microwave chemistry, green chemistry, and product analysis using NMR, MS, crystallography, chiral chromatography and other techniques. Prerequisite: 118. Spring.
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 3709 Chemistry Research I 1-5 Credits
Each student carries out, and submits a written report on, an original research project. Previous mutual agreement is required between each student and a faculty member who will direct the research. Students should consult various faculty members of their choice, at least one semester in advance, to ascertain projects and faculty members' individual policies. Students should register for the section of their faculty research mentor. The course may be repeated. One to four credits Fall
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 3805 Exp. Methods in Biochemistry 3 Credits
Lecture and laboratory. Biochemical assays, enzyme kinetics, fluorescence spectroscopy, liquid column chromatography, radioactivity measurements, DNA sequence analysis, ultracentrifugation, gel electrophoresis, gel filtration and HPLC, characterization of biomolecules including enzymes. Prerequisite: -419. Spring.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 3809 Chemistry Research II 1-4 Credits
Each student carries out, and submits a written report on, an original research project. Previous mutual agreement is required between each student and a faculty member who will direct the research. Students should consult various faculty members of their choice at least one semester in advance, to ascertain projects and faculty members' individual policies. Students should register for the section of their faculty research mentor. The course may be repeated. One to four credits Spring
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 4000 Chem Transform Environment 3 Credits
This course investigates mechanisms underlying chemical transformation in the environment. Reactions and processes such as hydrolysis, catalysis, redox, acid-base, and phase partitioning are discussed in Earth’s spheres including the atmosphere, hydrosphere, lithosphere and biosphere. Natural (e.g., unaltered air and rain water) and perturbed (e.g., photochemical smog and acid rain) systems are compared. Both qualitative (product identification and reaction pathways) and quantitative (reaction kinetics and equilibrium) aspects of environmental chemistry are considered. Green chemistry principles and applications are examined using case studies. These topics are discussed in the context of distinct and often interlinking global environmental issues such as stratospheric ozone loss, air quality degradation, climate change, and plastics pollution.
Level: Graduate, Undergraduate
Prerequisites: CHEM 2100 or CHEM 2300
Grading: Main Campus (UGrad, Grad)

CHEM 4100 Biochemistry I 3 Credits
An overview of biochemistry; structure and function of major biomolecules; proteins; enzymes and catalysis; catabolism and biochemical reaction pathways; biochemical regulatory mechanisms; enzyme reaction mechanisms; physical and chemical methods in biochemistry; genes and transfer of genetic information; biosyntheses of DNA, RNA and proteins. Prerequisites or concurrent: Organic and Physical Chemistry or permission of instructor. Fall.
Level: Graduate, Undergraduate
Prerequisites: (CHEM 118 or CHEM 2205) or (CHEM 120 or CHEM 2400) and (CHEM 219 (may be taken concurrently) or CHEM 3300 (may be taken concurrently))
Grading: Main Campus (UGrad, Grad)

CHEM 4305 Phys-Chem Measurements 3 Credits
CHEM-323 introduces students to modern laboratory instrumentation and experimental techniques in physical chemistry. It consists of a number of experiments that use different techniques to explore fundamental concepts in chemical thermodynamics, spectroscopy, quantum mechanics, chemical equilibrium, and kinetics. Scientific methods of careful experimentation, development and testing of quantitative predictive theory in chemistry and physical sciences and effective written communication of results are developed through lectures and writing of detailed scientific reports analyzing data obtained from various laboratory experiments and the final independent project.Prerequisite or concurrent: -219. Lecture and laboratory. Fall.
Level: Graduate, Undergraduate
Prerequisites: (CHEM 211 (may be taken concurrently) or CHEM 3100 (may be taken concurrently)) and (CHEM 213 (may be taken concurrently) or CHEM 3105 (may be taken concurrently)) and (CHEM 219 (may be taken concurrently) or CHEM 3300 (may be taken concurrently))
Grading: Main Campus (UGrad, Grad)

CHEM 4405 Instrumental Analysis 3 Credits
The primary objective of this course is to learn the principles of diverse modern analytical instruments in the qualitative and quantitative characterizations of chemical systems in a research-oriented environment. This course is designed to give you practical experience in using modern analytical instrumentation and to provide you with the background theory and principles of operation. As such, it has both a laboratory and lecture component. In the lectures you will learn about the chemical or physical principles used during the measurement, how the instrument actually takes the measurement and some of the techniques used to increase accuracy, precision and sensitivity. Topics to be covered in lecture include: spectroscopy, electrochemistry, NMR spectroscopy, mass spectrometry, chromatography, and electro-separations. In the laboratory, you will put this knowledge into practice by performing various experiments designed to provide examples of the usefulness of the particular instrument or technique. As in many chemistry classes, you must develop good physical manipulation skills. However, it is important to remember that many different types of a particular instrument exist. We don't want you to be an "expert" on one instrument but learn the operating principles of the technique so that you will be able to understand and operate a wide range of instruments based on this knowledge. Most people who follow a scientific career will use instruments at some time to take measurements of various chemical or physical properties. Even people who follow a non-scientific career will often need to interpret data and assess its quality (accuracy and reliability) and determine if the data was recorded in a sensible way using an appropriate instrument. .
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 4505 ExpMethods in Biophysical Chem 3 Credits
The goal of this course is to provide rigorous, quantitative theory and hands-on laboratory experience on the physical principles governing the structure-function relationship of biological macromolecules. The course has three modules. The first two modules are experimental, and are focused on two distinct but complementary sets of biophysical experiments that integrate calorimetric and spectroscopic approaches to study protein stability, folding and ligand binding. The third module involves computational modeling, statistical analysis of data using non-linear curve fitting models, and error analysis.
Level: Graduate, Undergraduate
Prerequisites: (CHEM 419 or CHEM 4100) and (CHEM 408 or CHEM 3805)
Grading: Main Campus (UGrad, Grad)

CHEM 4809 Honors Research I 3 Credits
Starting in the junior year, each honors program student undertakes and completes an original research project which becomes the basis of the senior honors thesis. Students should consult faculty members of their choice at least one semester in advance, to ascertain projects and faculty members' individual policies. Students should register for the section of their research faculty mentor. Spring.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 4909 Honors Research II 2 Credits
Starting in the junior year, each honors program student undertakes and completes an original research project which becomes the basis of the senior honors thesis. Students should consult faculty members of their choice at least one semester in advance, to ascertain projects and faculty members' individual policies. Students should register for the section of their research faculty mentor. Fall
Level: Graduate, Undergraduate
Prerequisites: (CHEM 364 or CHEM 4809)
Grading: Main Campus (UGrad, Grad)

CHEM 4949 Tutorial: Chemistry 3 Credits
Level: Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 4999 Honors Thesis 2 Credits
During their last semester, students in the honors program bring their research projects to conclusion, make an oral presentation of the results to a seminar group of faculty and students, and prepare and submit a written thesis on the basis of their research results. Students should register for the section of their research faculty mentor. Spring.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5030 Advanced Analytical Chemistry 3 Credits
In-depth course in modern analytical chemistry. Topics covered include: Statistical analysis of experimental data, multiple equilibria, chromatography, electroseparations, spectroscopy, and electrochemistry. Extensive use will be made of the current literature to illustrate applications in students' areas of study.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5040 Advanced Biochemistry 3 Credits
The goal of this course is to gain an understanding of fundamental aspects of biochemical structure and function from a chemistry viewpoint. Students will learn how biomolecules (proteins, nucleic acids) interact with each other, and how researchers can quantitatively assess these interactions. Students will learn the fundamental chemical reactions that govern key biochemical processes. Students will learn concepts of fluorescent molecules and fluorescence measurements in biochemistry. Intended for beginning graduate students.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5050 Advanced Inorganic Chemistry 3 Credits
Bonding theories, electronic structure, spectroscopy, and reaction pathways of inorganic compounds will be discussed. Tools will be developed to comprehensively understand the structure and reactivity of compounds containing elements which span the periodic table. Numerous classical and contemporary examples of synthetic and mechanistic inorganic chemistry will fortify core principles. Focused coverage on one or more frontier topics of critical importance to other areas of science including advanced materials, catalysis, medicine and biotechnology will be included.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5060 Synthesis 3 Credits
Mechanistic and synthetic aspects as well as applications of important organic reactions and methodologies will be discussed. This knowledge will be utilized to develop strategies towards the synthesis of multifunctional organic compounds including natural products. Through structural analysis of various target compounds using the disconnecting approach students will learn to convert a complex structure into synthons (chemical building blocks) and to plan a rational synthesis (retrosynthesis).
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5070 Physical Organic Chemistry 3 Credits
The course will involve free-energy relationships, structure-reactivity relationships, coordinates for concerted reactions based on orbital symmetry rules, assessments of molecular properties (such as dipoles and conformations) from basic electronic principles, assessment of thermodynamic and kinetic control of reactions, and other aspects of modern physical organic chemistry.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5080 Advanced Physical Chemistry 3 Credits
Overview of both quantum mechanical and statistical mechanical computational methods in chemistry and biochemistry. The course includes hands-on computational projects, as well as brief introductions to the theoretical bases of the methods. The course includes hands-on computational projects.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5115 X-Ray Crystallography Mol St 3 Credits
Determination of molecular structure by diffraction methods, including pertinent theory; particular emphasis on X-ray diffraction; includes "hands-on" experience. Prerequisite: Physical Chemistry. Spring.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5125 Computational Methods 3 Credits
The aim of the course to introduce the student to computational chemistry as a practical tool to solve chemical problems. As background we will cover the basic principles and applications of modern theory of bonding. The three main themes are: potential energy surfaces, force field methods and quantum methods. Practical and computational aspects will be emphasized. After a review of some basics of molecular structure and modeling and the basic concepts of quantum mechanics, the course outlines in detail the various approximate methods of quantum chemistry avoiding purely mathematical derivations as much as possible. Qualitative aspects of bonding will be emphasized based on molecular orbital theory.Hybridization, aromaticity, ligand field theory and group theory will be discussed. Skills to analyze specific calculations will be developed. Spring.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5130 Spectrometric Applications 3 Credits
Classical theory, correlations and interpretations of the 1D and 2D NMR, IR, UV-vis, ORD-CD, fluorescence and mass spectra of organic and inorganic compounds. Elucidation of structure of synthetic compounds and selected natural products. Prerequisites: Organic or Inorganic and Physical Chemistry. Fall.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5200 Biochemistry II 3 Credits
Extension of concepts developed in Biochemistry I to illustrate biochemical pathways including DNA replication, transcription, microtubule assembly/function, muscle excitation-contraction, G protein signaling, neuronal signaling, and others. Part I (nucleic acid biochemistry), Part II (cellular biochemistry) and Part III (signal transduction) are integrated in order to emphasize concepts in macromolecular assembly, regulation of enzymes, the dynamic nature of gene structure/expression, and the relationship between dysfunctional biochemical pathways and disease state. Prerequisite: -419. Spring.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate or Undergraduate level students.

CHEM 5310 Special Topics - Analytical 3 Credits
The course is structured in two parts: In the first part, we will review the chemical and instrumental aspects of modern mass and ion-mobility spectrometries, highlighting the strengths and weaknesses of each method. In the second part, applications of modern techniques will be discussed. Both inorganic and organic applications will be covered. The second part will include a presentation and a paper by each student on the applications of gas-phase ion measurements in their research topic of choice (preferably their PhD research).
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5320 Surface Chemistry 3 Credits
This course will introduce basic principles of widely used surface and structural characterization techniques to advanced undergraduate and graduate students. Useful experimental methods to discern and identify both macro- and nano-scale properties will be discussed in depth, while focusing on the surface and interfacial analysis of various materials such as metals, semiconductors, polymers, and biological materials. During the course, students will apply basic knowledge of chemistry, physics, and biology to understand scientific fundamentals, operating principles, and instrumental designs of many spectroscopy- or microscopy-based methods. The course teaches a range of these experimental methods for determining surface topology, metrology, elemental composition, chemical states, and other crucial material properties. Some examples of these techniques include secondary-ion mass spectrometry, scanning probe microscopy, electron microscopy, optical microscopy, electron spectroscopy, Raman spectroscopy, scanning confocal florescent microscopy, diffraction techniques, X-ray photoelectron spectroscopy, and ellipsometry. When appropriate, the course will cover pertinent derivations and formulations to explain suitable applications, technical requirements, capabilities and limitations of each characterization technique. Students will learn how the principles of such surface and structural characterization techniques are used for controlling and improving desired properties of materials during their synthesis from real-life examples taken in the active research area of Surface Science.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5330 Nanobiochemistry 3 Credits
This course provides fundamental understanding of technologically important nanomaterials by specifically focusing on their synthesis, properties, and applications in nanobiotechnology. The course is aimed to provide fundamental backgrounds in order to promote better understanding of nanotechnology and nanobiotechnology. This course is suitable for graduate students in chemistry as well as physics and biology. Although no prerequisite is required, students should be familiar with basic concepts covered in the areas of general chemistry, physical chemistry, and general physics. The course contents include, but not limited to key concepts in solid state physics, nanomaterial synthesis, nanomaterials' properties, and nanomaterials' applications. Specifically, this course will focus on technologically important materials such as quantum dots, carbon nanotubes, semiconductor nanowires, conductive nanorods, nanoscale polymers, and nanosized biomaterials. Fundamental properties of these nanomaterials will be emphasized. The course will also cover the details of key measurement techniques that are commonly used to characterize these 0D and 1D materials. This course will also look into current and future applications of these materials in biology and medicine by covering the operating principles of these promising techniques in nanobiotechnology.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5410 Chemical Biology 3 Credits
Chemical biology applies the principles and techniques of organic chemistry to understand or solve problems relevant to biology and to manipulate biosystems via synthetic molecules or chemical modifications. The goal of this course is for you to: understand this approach to biochemical systems; know what concepts are typically applied in generating and understanding these systems with a quantitative focus on the energy involved and the balance of entropy and enthalpy in the system with major contributions from solvation; and be able to read, interpret and present data from chemical biology papers.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5420 Biomolecular Thermodynamics 3 Credits
This course will cover topics in protein structure, protein folding and the linkage between protein stability and ligand binding. The course has two parts. In the first part we will review basic concepts in protein thermodynamics, and the application of bulk calorimetric and spectroscopic methods for the analysis of protein stability and ligand binding. You will also learn how to use the software Mathematica to simulate protein unfolding processes, how to fit experimental data, and how to analyze the linkage between ligand binding and protein stability. In the second part of the course we will discuss more recent single-molecule biophysical methods to study the stability and dynamics of folding processes in individual protein molecules. Requisites: Basic concepts in thermodynamics, ligand binding and protein structure. Textbook: Will provide access to several textbooks in protein thermodynamics, protein stability and linkage theory. Spring.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5430 Special Topics - Biochemistry 3 Credits
Amino acids, nucleic acids, carbohydrates, lipids, and biomembranes. Emphasis on rational drug design and biomolecular engineering. Topics will include incorporation of synthetic amino acids, catalytic antibodies, catalytic properties of rRNA, biosynthesis and mechanisms of action of selected natural products, functional models of biopolymers, drug delivery. Prerequisites: Organic Chemistry or equivalent and Biochemistry or permission of instructor. Spring.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5435 Experimental Meth in Biochem 3 Credits
Students will work on a project that entails application of 5 to 8 modern techniques in biochemistry, including recombinant DNA methods, targeted gene expression in yeast or bacteria, subcellular fractionation/ organelle purification, protein purification, gel electrophoresis and fluorescence spectroscopy. Combination of these techniques to perform an actual scientific project that would be typical for a modern biochemistry laboratory (e.g., expression, purification and structural analysis of a site-directed mutant protein). Prerequisite or concurrent: CHEM-419 or equivalent.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5440 Medicinal Biochemistry 3 Credits
This course will expose students to the rapidly evolving ways in which molecular biochemistry intersects with medicinal chemistry, with a focus on the ongoing biopharmaceutical revolution. How Chemistry and Biochemistry intersect in modern Pharmacology will be studied. More specifically, our goal will be to better understand the development, production, and clinical application of such biopharmaceuticals as monoclonal antibodies ("mAbs"), DNA or RNA – based vaccines, cytokines, growth factors, and other major biopharmaceutical classes, using the language and concepts of classical medicinal chemistry. How these differ from "biologics" used in the clinic will be discussed. Long-standing theories and concepts will be explored and challenged, for example, why the rules of Lipinski do not necessarily apply to biopharmaceuticals and why this is important, whereas they still apply for small molecules such as Imatinib that are among the most exciting new pharmaceuticals produced to date based on a detailed understanding of target molecular biochemistry.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5510 Inorganic Materials 3 Credits
Aspects of the structure, synthesis, and chemical and physical properties of inorganic compounds and related materials. Techniques, methods, and theories related to inorganic chemistry. Currently open problems and recent developments of broad importance are presented. Specific topics covered will vary from year to year. Prerequisites: Physical Chemistry and CHEM-366 or equivalent.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5520 f-Elements Chemistry 3 Credits
This course will provide an introduction to the f-block, including the rare earth and actinide elements. Topics will include coordination chemistry, trends in periodicity, bonding, speciation and reactivity, electronic structure, spectroscopy, and magnetism. Special topics will highlight areas of current interest such as critical materials needs (e.g. separations) and nuclear energy production and waste management.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5530 Energy and the Environment 3 Credits
This course explores the chemical principles that underlie energy production, storage, and environmental impact across all major energy sources. Topics will include fossil fuels such as coal-fired power plants, nuclear energy, and renewable technologies including wind and solar.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5610 Stereochemistry 3 Credits
Principles of chirality and dynamic stereochemistry; analytical methods for determination of enantiomer composition; principles of asymmetric synthesis;enantioselective and diastereoselective synthesis
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5620 Solid State Organic 3 Credits
Organic solid state materials have numerous practical applications in a broad range of areas e.g. structure determination, pharmaceuticals, energetic materials, agrochemicals and electronics. This class will introduce some of the historically important concepts from which much of the current field is derived and attempt to show how ideas develop to the current state of the art. Topics covered include fundamentals of crystalline materials, nucleation & growth, solid state reactivity & phase changes, and structure-property relationships and their applications. Other topics may be included depending on collective interest.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5630 AdvTop:MacromoleculePoly Chem 3 Credits
Polymer synthesis, structure, and characterization. Mechanisms of step-growth and chain-growth polymerizations (radical, ionic, group transfer, metathesis, copolymerization, suspension, and emulsion). Introduction to polymers of different composition, topology and functionality, and their characterization. Survey of "modern" polymer chemistry (dendrimers, supramolecular, conducting, self-healing, depolymerizable, and bio-polymers, etc.). Rheological and viscoelastic behavior: relaxations and transitions, rubber elasticity. Applications of polymers and colloidal particles in diverse fields.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5640 Solution Kinetics 3 Credits
Currently interesting aspects of kinetics and mechanisms of chemical reactions in liquid solutions. Techniques, methods, and theories that concern those reactions. The course will cover organic, inorganic, and biochemical reactions. Specific topics covered will vary from year to year. Prerequisite: Physical Chemistry. Spring.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5650 Special Topics Organic 3 Credits
Different Topics in organic chemistry will be discussed.
Level: Graduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5660 Supramolecular Chemistry 3 Credits
This course will explore the realms of so-called supramolecular chemistry, host-guest chemistry, and self-assembly. Over the past 50+ years, chemists have developed an ability to exploit non-covalent (or reversible covalent) intermolecular interactions, occasionally inspired by molecular biology, in order to realize the potential of being able to design organized, informed, and functional molecular architectures to various productive ends. For three pioneers of the field, research efforts culminated in the Nobel Prize in Chemistry in 1987, but more important is the recognition that aspects of intermolecular organization and “chemistry beyond the molecule” permeate all aspects of the chemical sciences, from nanochemistry, to materials science, to chemical synthesis, to molecular biology. This special-topics course will begin with a textbook discussion of intermolecular interactions, but will eventually attempt to focus on the lessons that can be gleaned from landmark experiments and papers in what is now an expansive and diverse field of contemporary chemistry. Some topics that will be covered include: Introduction (perusal of the field, definitions, etc.) Classical Theory of Intermolecular Interactions (ion-ion, ion-dipole, dipole-dipole, polar-nonpolar, dispersion, van der Waals interactions, semi-empirical atom-atom potentials, hydrogen bonding, solvation, hydrophobic effect, - interactions, cation- interactions, weak hydrogen bonds, charge transfer, halogen bonding, “unconventional interactions” etc.) Synthetic Hosts for Molecular Recognition (cation recognition, crown ethers, cryptands, cavitands, anion binding/recognition, catenanes, rotaxanes, knots, dendrimers, container molecules, macocycles, kinetic and thermodynamic templation) Lessons in Supramolecular Chemistry (basic thermodynamics, basic equilibrium, kinetics, measurement of association constants, thermodynamic cycles, physical/experimental techniques, databases, enthalpy-entropy compensation, enantioselectivity) Functional Molecular Matter (encarceration, constrictive binding, gating, supramolecular isomerism, self-assembly, chemistry within molecules, biological self-assembly and conservation of information, self-sorting, issues of length scale, sensing, supramolecular synthesis/catalysis, enzyme mimics, molecular machines, self-replication/autocatalysis, dynamic combinatorial libraries, amplification, dynamic covalent chemistry, mesoscale assembly, crystal engioneering, gels, etc.)
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5810 Molecular Spectroscopy 3 Credits
In-depth study of linear spectroscopy, including electronic, vibrational, and rotational responses, which manifest as ultraviolet and infrared absorption, emission, and scattering. Symmetry and group theory as useful predictors of the radiation-molecule response based on chemical structure. Topics in nonlinear optical spectroscopy; advanced molecular studies in gases, liquids, and solids. Prerequisite: Physical Chemistry.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)

CHEM 5820 NMR Spectroscopy 3 Credits
Practical and theoretical aspects of NMR spectroscopy. Instrumental and experimental aspects of Fourier NMR including multipulse sequences, theories underlying the experiments, techniques, and hardware. Prerequisite: Physical Chemistry.
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 5830 Computation for Large Systems 3 Credits
Computer simulation methods for small molecules to proteins in solution, as well as molecular liquids. After an introduction to the fundamental principles of these methods, i.e., statistical thermodynamics, the course will cover practical aspects of performing molecular dynamics simulations, such as set-ups for complex molecules including force fields, best-practices based on the fundamental principles, and ways to analyze simulations. Prerequisites: physical chemistry or permission of instructor
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 7100 Seminar 0-2 Credits
Students will be required to conduct intensive literature investigations on approved topics. Presentation of these topics in a formal manner to the seminar group. Lectures by faculty and visiting authorities.
Level: Graduate, Undergraduate
Grading: Pass/Fail Default
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 7200 Literature Seminar 0-2 Credits
Students will be required to conduct intensive literature investigations on approved topics. Presentation of these topics in a formal manner to the seminar group. Lectures by faculty and visiting authorities.
Level: Graduate, Undergraduate
Grading: Pass/Fail Default
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 7949 Tutorial: Chemistry 3-6 Credits
Level: Graduate, Undergraduate
Grading: Main Campus (UGrad, Grad)
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 8000 Chemistry Research 1-12 Credits
Graduate research. Choose the section taught by the faculty supervising the research.
Level: Graduate, Undergraduate
Grading: Pass/Fail Default
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 8100 Grad Research Teaching I 1 Credit
An introduction to graduate research and teaching for new graduate students. This course is designed to: gain awareness about the range of research opportunities in the department, provide support and training for teaching assistantships, learn about university support services, and provide a forum for discussion of topics relevant to their development as scholars and teachers.
Level: Graduate, Undergraduate
Grading: Pass/Fail Default
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 8200 Grad Research Teaching II 1 Credit
An introduction to graduate research and teaching for new graduate students. This course is designed to: gain awareness about the range of research opportunities in the department, provide support and training for teaching assistantships, learn about university support services, and provide a forum for discussion of topics relevant to their development as scholars and teachers.
Level: Graduate
Grading: Pass/Fail Default
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 9991 Continuous Registration
Level: Graduate, Undergraduate
Grading: No Grade
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 9992 Continuous Registration
Level: Graduate, Undergraduate
Grading: No Grade
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 9993 Continuous Registration
Level: Graduate, Undergraduate
Grading: No Grade
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 9994 Continuous Registration
Level: Graduate, Undergraduate
Grading: No Grade
Course registration restrictions:
Enrollment is limited to Graduate level students.

CHEM 9999 Thesis Research
Thesis research in chemistry.
Level: Graduate, Undergraduate
Grading: No Grade
Course registration restrictions:
Enrollment is limited to Graduate level students.