

# Chemistry

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## Courses

Visit online course listings to view semester offerings for L07 Chem.

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### L07 Chem 500 Independent Work

Independent mentored work in Chemistry, such as (but not limited to) a detailed literature search and report on a topic of current interest. Prerequisite: Permission of the faculty mentor. Credit variable, maximum 6 units.

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### L07 Chem 5001 Physical Science in 12 Problems

Exercises related to general chemistry, classical mechanics, quantum mechanics, statistical mechanics, thermodynamics, and kinetics, will be solved with numerical software. Each exercise will be accompanied by a lecture, a software template solving a problem and presenting a related take-home problem. The software will allow us to focus on, and treat in a transparent fashion, physical problems without the unwieldy idealizations and contrivances found in textbooks. Prerequisites: Chem 106/112A and/or Physics 192/194, and prior or concurrent enrollment in either Chem 401 or Phys 217. The lectures will be in-person however a complete set of taped lectures will also be available. A remote help session will be scheduled at a mutually agreed to time. There are no quizzes, exams or a final. Same as L07 Chem 400. Credit 1 unit. A&S IQ: NSM Arch: NSM Art: NSM

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### L07 Chem 5010 Physical Chemistry I

Introduction to quantum chemistry with applications to electronic structure and elementary spectroscopy. Prerequisites: Chem 106/112A and Math 233; prior completion of Physics 191 and 192 is strongly encouraged (but concurrent enrollment in Physics I will be accepted); or permission of instructor. Required course for all Chemistry majors. Same as L07 Chem 401. Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: SCI

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### L07 Chem 5020 Physical Chemistry II

This course presents an introduction to chemical thermodynamics, statistical mechanics, and transport phenomena, and it is a required course for all Chemistry majors. Prerequisites: Chem 401, and Math 233; or permission of instructor. Prior completion of Physics 192/194 is strongly encouraged, but prior completion of Physics 191/193 and concurrent enrollment in Physics 192/194 will be accepted. Same as L07 Chem 402. Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: SCI

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### L07 Chem 5030 Chemical Kinetics

This lecture course will provide an introduction to the kinetics of chemical reactions for graduate and upper-level undergraduate science and engineering students. Bulk and molecular-level considerations will be discussed and provide a foundation for the understanding of chemical reaction mechanisms and the techniques used for their study. Students will gain an understanding of the importance and significance of the rate laws of reactions and in particular the reaction rate constant. Details of how the environment in which reactions occur

(i.e., gas phase, solution phase, and surface reactions) and molecular structure are reflected in the rate constant will be discussed. Examples such as catalytic loss cycles in the atmosphere, enzyme catalysis, combustion systems, chain reactions, and explosions are presented in detail to illustrate how the fundamental principles of chemical kinetics can be applied to predict reaction rates, chemical reactivity, and the outcomes of particular processes. Prerequisites: Chem 106/112A and/or permission of instructor. Same as L07 Chem 403. Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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### L07 Chem 5035 Nuclear and Radiochemistry Lab

Application of radiochemistry to problems in chemistry, physics, and nuclear medicine, with emphasis on particle detectors and experimental techniques. Prerequisites: 3 units of physical chemistry or quantum mechanics, or permission of instructor. Five hours of laboratory a week. Same as L07 Chem 435. Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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### L07 Chem 5036 Introduction to the Atomic Nucleus

Introduction to the interaction of radiation with matter, the production and decay of radioactive nuclides, the structure and properties of nuclei, and various applications of nuclear science (including nuclear power) are all presented. Prerequisites: General Chemistry and/or Physics, and prior or concurrent enrollment in either Chemistry 401 or Physics 217. Lectures will be in-person but a complete set of taped lectures will also be available. A weekly, in-person or remote, help session will be scheduled at a mutually agreed to time. There will be about 6 timed quizzes, one midterm and one final, all of which must be taken in-person on mutually agreed dates. Same as L07 Chem 436. Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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### L07 Chem 5050 Computational Problem Solving in the Chemical Sciences

Have you ever wondered how molecular interactions shape the world around us? Why do certain materials exhibit unique properties? How can we predict and manipulate chemical reactions at the atomic level? These are the mysteries at the heart of chemistry, where understanding the unseen world of atoms and molecules can unlock groundbreaking advances in science and technology. However, one needs specialized numerical methods and computational chemistry skills to explore these questions. This course is designed to bridge this gap. It provides a comprehensive introduction to the mathematical and computational skills necessary to model chemical phenomena at the atomic level. We start by building a strong foundation in mathematical representations of chemical problems, utilizing open-source software tools for problem-solving, data interpretation, and visualization of materials and molecular structures. In the second part of the course, we delve into the fascinating world of atomic-level computer modeling. You'll learn various methodologies, such as Monte Carlo and molecular dynamics. We'll analyze static (thermodynamic and structural) and dynamic properties and their statistical errors. Don't worry if you're new to coding - we'll cover the basics of Python programming in the first few lectures, setting you up for success. By the end of this course, you will be proficient in using computational tools, understanding atomic interactions, and approaching chemical problems with a structured and strategic thought process. Join us to unlock the secrets of the molecular world and transform the way you see chemistry! Prerequisites: Chem 106/112A, Math 132, Physics 191, Chem 261. Same as L07 Chem 4050. Credit 3 units. A&S IQ: NSM

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#### **L07 Chem 5051 Methods of Biophysical Chemistry**

The course provides an overview of key methodologies of contemporary biophysics and biophysical chemistry, covering: 1) Spectroscopic methods routinely used in biochemistry, including absorption, fluorescence, and circular dichroism; 2) Biophysical methods to study intra- and intermolecular protein interactions including solution-state NMR, FCS, and FRET; 3) Cutting-edge biophysical techniques to study transient protein-protein/ protein-nucleic acids interactions. A significant emphasis is placed on the principles of quantum mechanics, which underpin all the techniques discussed. The course begins with an introduction to the basics of quantum mechanics, laying a foundation for understanding the core physical principles that govern each method. Throughout the course, we will derive and analyze key formulae essential for comprehending and applying these advanced biophysical techniques effectively. Credit 3 units.

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#### **L07 Chem 5064 NMR for Biological Solids**

The course will cover theoretical and practical aspects of nuclear magnetic resonance (NMR) spectroscopy. Specific focus will be given to solid-state NMR and its application for studying amorphous biological solids. Prerequisites: undergraduate-level course in quantum mechanics. Credit 3 units.

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#### **L07 Chem 5070 Instrumental Methods: Physical Chemistry**

A course providing direct hands-on experience with the principles of physical chemistry (thermodynamics, quantum, kinetics) and associated experimental methods and instrumentation, including optical, infrared, and nuclear and electron spin resonance, electrochemistry, calorimetry, laser kinetics, and basic electronics. Prerequisite: Chem 401 or concurrent enrollment in Chem 402. Same as L07 Chem 445. Credit 3 units. A&S IQ: NSM, WI Arch: NSM Art: NSM

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#### **L07 Chem 510 Chemical Dynamics of Biological Pathways**

This course will provide a highly advanced evaluation of cellular metabolism. The course will interrogate metabolic pathways and associated enzymatic mechanisms by tracking stable isotope labeling patterns as measured by liquid chromatography/mass spectrometry. The course will not contain any background treatment of mass spectrometry or basic metabolism. To be enrolled, students must already have an in-depth understanding of these topics. Major objectives of the course are: (1) to learn how to use labeling patterns qualitatively to understand chemical mechanisms at the arrow-pushing level as well as metabolic regulation, (2) to learn metabolic flux analysis, (3) to understand the complex metabolic interactions between cells and organs, and (4) to understand how metabolic reprogramming of specific cell types supports physiologic coordination at the organismal level. Pre-reqs: Chem 482/Chem 5820/Biol 4820 AND permission of instructor. Credit 3 units.

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#### **L07 Chem 5147 Contrast Agents for Biological Imaging**

Contrast Agents in Biological Imaging will build the chemistry foundations for the design and use of contrast agents in imaging applications such as nuclear medicine, magnetic resonance imaging (MRI) and optical imaging. The course will include lectures on the design of radiopharmaceuticals for gamma scintigraphy and positron emission tomography, MRI contrast agents and agents for optical imaging, including bioluminescence and fluorescence microscopy. Prereqs: one year of general chemistry, one semester of organic chemistry. Same as L41 Biol 5147. Credit 3 units.

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#### **L07 Chem 515 Biological Chemistry Seminar**

This course is required for all graduate students following the biological chemistry track. The course will consist of tutorials for first year graduate students and research presentations by second year students. Prerequisites: enrollment in the biological chemistry track or permission of the instructor. Credit 1 unit.

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#### **L07 Chem 533 Time-Dependent Quantum Mechanics & Spectroscopy**

This graduate-level course lays the foundations of time-dependent quantum mechanics and applications to contemporary optical spectroscopies, particularly ultrafast techniques. Formal theoretical descriptions for nonlinear spectroscopic techniques including transient absorption, photon echo, and two-dimensional spectroscopies will be developed. Practical aspects of these experiments including modern laser systems, instrument design, data collection, data processing, and data analysis will also be discussed. Discussion of current literature in the field will be an important component of the course. Prerequisite courses: Chem 401 or permission from the instructor. Credit 3 units.

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#### **L07 Chem 536 Radiochemistry for the Life Sciences**

This course will provide an introduction to nuclear science (e.g. radioactive decay, nuclear stability, interactions of radiation with matter) and followed by an overview of how radiochemistry is used in the life sciences. Lectures on radiolabeling chemistry with radionuclides used in medical imaging (single photon emission computed tomography (SPECT) and positron emission tomography (PET) and their applications will be presented. In addition, lectures on radiochemistry with tritium (H-3) and C-14 will also be included. Additional applications include environmental radiochemistry as applied to nuclear waste disposal and biofuels. Credit 2 units.

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#### **L07 Chem 540 Inorganic/Organometallic Chemistry Seminar**

Students present informal seminars on topics of current interest from the chemical literature or from their own dissertation research. Credit 1 unit.

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#### **L07 Chem 541 Advanced Inorganic Chemistry**

Study of physical inorganic concepts with an emphasis on modern experimental methods applied to inorganic and bioinorganic systems. The spectral and magnetic properties of inorganic and bioinorganic compounds will be discussed. Topics in group theory will be covered, including symmetry of molecules and ions, the application of group theory in molecular structure determination, chemical bond theory and spectroscopy for inorganic materials as molecular species and in crystal lattices. Prerequisite: Chem 461, or consent of instructor. Credit 3 units.

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#### **L07 Chem 542 Special Topics in Inorganic Chemistry**

This course focuses on an important current topic in inorganic chemistry. Open to undergraduates with permission of the instructor. Chemistry 461 recommended. Credit 3 units.

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#### **L07 Chem 543 Physical Properties of Quantum Nanostructures**

This course will explore the physical properties of semiconductor nanomaterials with dimensions that are small enough to give rise to quantum-confinement effects. These effects strongly influence the electronic structures, absorption/emission behavior, and charge-carrier dynamics within quantum wells, rods, wires, dots, and nanotubes.

The course begins with an overview of the electronic structure of bulk semiconductors. The theoretical and experimental bases for quantum-confinement effects, which are of considerable fundamental and applied interest, will then be developed. A significant emphasis will be placed on the optical absorption and photoluminescence properties of semiconductor quantum nanostructures. Recent advances and observations as reported in the literature will be emphasized throughout the semester. Prerequisites: Chem 461/Chem 5610 and Chem 465/Chem 5620, or permission of the instructor. While the course is steered to graduate students in the Chemistry Department, Chemistry undergraduate students, graduate or undergraduate students in Physics, Electrical & Systems Engineering, Energy, Environmental & Chemical Engineering, Mechanical Engineering & Materials Science may also find this course valuable.  
Credit 3 units.

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#### L07 Chem 550 Mass Spectrometry

The first focus of the course is an overview of the subject and its history. The second covers the fundamentals of ionization to produce molecular ions. Ionization methods include electron ionization, chemical ionization, electrospray, and matrix-assisted laser desorption. Thermodynamic principles of ionization including ionization energies, proton affinities, and gas-phase acidities provide a fundamental basis for ionization. The third major focus is interpretation of EI and product-ion spectra from MS/MS. Mechanisms of gas-phase ion decomposition reactions, rates and thermodynamics of gas-phase ion processes, and ion-molecule reactions are discussed in terms of interpreting spectra. A major emphasis is the spectra of peptides and proteins, providing a basis for the field of proteomics and related "omics" areas. The fourth focus is the fundamentals of instrumentation design and implementation: quadrupole, time-of-flight, ion trap, orbitraps, and Fourier transform instruments. Combined or hyphenated GC/MS, LC/MS, and tandem mass spectrometry are also discussed. Applications in a variety of areas are worked in as the course progresses: structure determination of synthetic, natural products, metabolites, and biomolecules, exact mass measurements (high resolution MS), peptide and protein and other biomolecule sequencing, sensitive detection, trace analysis, and mixture analysis. Prerequisite: Chem 262 or permission of instructor.  
Credit 3 units.

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#### L07 Chem 5510 Organic Chemistry III

A lecture course that builds on the material in Chem 261/262, covering in more detail certain topics in those courses while also introducing new topics. A transition to graduate-level study in organic chemistry; recommended for chemistry, biochemistry, and biology majors. Prerequisite: Chem 262.  
Same as L07 Chem 451  
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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#### L07 Chem 5511 Synthetic Polymer Chemistry

This course that describes various methods for the synthesis and characterization of polymers. Copolymers, control of architecture, polymer reactivity, polymer properties, structure/property relationships, and applications of polymers will be discussed. Current topics of interest from the recent literature will also be covered. Prerequisite: Chem 262 or permission of instructor.  
Same as L07 Chem 452  
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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#### L07 Chem 5521 Physical Organic Chemistry

The goal of physical organic chemistry (formerly called mechanistic organic chemistry) is to understand the details of reaction mechanisms, and gain insight into structures and reactivity common to organic chemicals and of high-energy chemical intermediates. This course focuses on the structure of any intermediates, the extent of a reaction

from the perspective of the transition state, and identifying the relative energies of reactants, products, intermediates, and transition states. Students will learn concepts needed to solve mechanistic organic problems encountered in research, covering common organic reaction mechanisms, experimental techniques, and theoretical approaches. After the course, students will be able to design experiments to probe mechanistic questions and propose reasonable mechanisms and intermediates to explain experimental observations. Prerequisite CHEM 262 or permission of the instructor.  
Same as L07 Chem 450  
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: SCI

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#### L07 Chem 5522 Synthetic Methods

A lecture course presenting a detailed survey of synthetically useful reactions of carbonyl compounds and their derivatives, with particular attention to their stereoselectivity aspects and asymmetric methodology. The course is intended to provide the necessary background for more advanced work in organic synthesis.  
Credit 3 units.

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#### L07 Chem 554 Molecular Orbital Theory

Lectures will cover the background, practice and applications of computational chemistry to the modeling of the structures and chemical reactions of organic molecules. Different levels of calculation will be presented, from molecular mechanics calculations and Hückel molecular orbital theory, through semi-empirical and ab initio self-consistent field calculations with correlation energy corrections, and density functional theory. Hands-on experience performing calculations is an important element in this course.  
Credit 3 units.

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#### L07 Chem 555 Special Topics in Organic Chemistry

This course focuses on an important current topic in organic chemistry. Open to undergraduates with the permission of the instructor.  
Credit 3 units.

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#### L07 Chem 557 Advanced Organic Synthesis

The objective of this course is to teach students the art of planning a total synthesis. Key synthetic concepts, strategies and tactics, as well as a variety of reactions and synthetic methods, will be illustrated using examples from total syntheses of the main groups of natural products - terpenes, steroids, and alkaloids. Prerequisite: Chem 451/Chem 5510 or permission of instructor.  
Credit 3 units.

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#### L07 Chem 5570 Synthetic Polymer Chemistry Laboratory

Chem 462 is an upper-level undergraduate laboratory course that complements Chem 452 Synthetic Polymer Chemistry. This twice-a-week lab provides hands-on training in the design, synthesis, and characterization of polymers and polymeric materials through four standard experiments (each one week) and one independent project (over five to six weeks). The independent project involves using an article from the literature as the basis for developing a short proposal. At the end of the course, students give oral presentations of their proposals, which are reviewed by their classmates. Prerequisite or Concurrent: Chem 452 or permission from instructor.  
Same as L07 Chem 462  
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: SCI

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**L07 Chem 558 Spectral Methods in Organic Chemistry**

A detailed treatment of the structure and stereochemistry of organic compounds with particular emphasis on ultraviolet, visible, infrared, nuclear magnetic resonance, and mass spectroscopic techniques for structure determination. Prerequisite: Chem 262 or permission of instructor.

Credit 3 units.

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**L07 Chem 559 Organic Chemistry Seminar**

The organic chemistry graduate students enrolled will each present one seminar on a topic of current interest in the literature.

Credit 1 unit.

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**L07 Chem 5610 Inorganic Chemistry**

Inorganic chemistry encompasses the structure, properties, and reactivity of inorganic molecules and solids and it is a required course for all Chemistry majors. This course will focus on the symmetry, bonding, electronic structure, spectroscopy, and reactivity of inorganic coordination complexes in which ligands are bound to one or more metal centers. The course will start with using group theory to classify molecules based on the symmetry elements they possess. A series of different bonding models including VSEPR, valence bond theory, molecular orbital theory, crystal field theory, and ligand field theory will be used to describe the structure and bonding of inorganic molecules, coordination complexes, and organometallic compounds. These models will serve as a basis for interpreting and predicting the electronic and vibrational spectra of inorganic compounds.

Prerequisites: Chem 106 or 112, and Chem 152.

Same as L07 Chem 461

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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**L07 Chem 562 Statistical Thermodynamics**

Statistical mechanical methods will be used to characterize equilibrium and non-equilibrium thermodynamic systems. Computer programming assignments are given. An initial familiarity with ideal equilibrium systems will be assumed. Prerequisite Chem 401 or its equivalent or permission of the instructor.

Credit 3 units.

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**L07 Chem 5620 Solid-State and Materials Chemistry**

A description of how the structures of crystalline solids at different length scales control their chemical and physical properties is critical for understanding how these materials are applied in a variety of technologies ranging from solar cells to lithium batteries. This course begins with basic crystallography and introduces common inorganic structure types as well as common defects in crystalline solids. With the aid of computer models, students will learn to analyze and index x-ray powder-diffraction patterns that provide a fingerprint to identify a crystal. The relation between the crystal structure of a solid and its resulting electronic structure, chemical reactivity, and physical properties (e.g., optical, electrical, and mechanical) will be discussed throughout the semester with an emphasis on how crystal defects alter these properties. The course will conclude with the use of phase diagrams to assess the composition and microstructure of metals and ceramics. Prerequisite: Chem 105/111A or permission of instructor

Same as L07 Chem 465

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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**L07 Chem 5630 Inorganic Electrochemistry and Photochemistry**

An understanding of electrochemical processes is critical in describing the behavior of batteries, fuel cells, and other important devices used in energy conversion and environmental remediation. This course will cover modern inorganic electrochemistry, photochemistry, and photoelectrochemistry from a microscopic perspective of solid-electrolyte interfaces. The course material will start with the

thermodynamics of solid-electrolyte interfaces and the kinetics of electron transfer across these interfaces. Electroanalytical techniques, including cyclic voltammetry and potential-step experiments, will be described to understand the mechanism of electrochemical and photochemical reactions. Lectures will include applications of electrochemical cells in catalysis, materials synthesis, and solar-fuel generation. Prerequisites: Chem 461, or Chem 465, or consent of instructor.

Same as L07 Chem 426

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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**L07 Chem 5670 Inorganic Chemistry Laboratory**

A laboratory course emphasizing both the synthesis of inorganic compounds and the study of their physical properties. Laboratory exercises will introduce novel synthetic techniques including high-temperature synthesis and vacuum-line manipulations. Compounds will be spectroscopically characterized by UV-visible absorption, gas-phase infrared, and multinuclear and dynamic NMR spectroscopies. Measurements of electrochemical behavior, magnetic susceptibility, and electrical conductivity will be performed. Prereq: Chem 461 or consent of the instructor. A Writing Intensive option is available with the permission of the instructor.

Same as L07 Chem 470

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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**L07 Chem 571 Quantum Chemistry and Spectra**

This course covers the development and application of quantum mechanics as applied to molecular structure and properties. Material to be discussed will include the fundamentals of quantum mechanics; representations; matrix formalisms; applications to model systems; perturbation theory; variational methods; many-electron wavefunctions; Hartree-Fock theory and post-Hartree Fock methods; density functional theory; additional topics and applications. Prereq: Chem 401.

Credit 3 units.

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**L07 Chem 5721 Quantum Chemistry in Practice**

A spectrum of modern computational tools -- from semiempirical, self-consistent field theory, and density functional theory one-electron pictures to perturbative and simulation many-electron pictures -- will be used to determine potential energy surfaces, spectroscopic cross-sections, and oxidation-reduction energetics.

Credit 3 units.

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**L07 Chem 576 Magnetic Resonance**

Quantum mechanical and classical aspects of paramagnetism and of nuclear and electronic magnetic resonance. Phenomenological equations of motion, spin interactions, spin temperature, thermal relaxation, dynamic polarization, multiple resonance phenomena.

Credit 3 units.

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**L07 Chem 5762 Electron Spin Resonance**

Principles of magnetic resonance of paramagnetic species, structure and dynamics of organic free radicals and transition metal ions in the condensed phase. Detection of transient paramagnetic species generated in photochemical reactions and photo physical processes.

Prereq, Chem 401.

Credit 3 units.

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**L07 Chem 578 Nuclear Magnetic Resonance Spectroscopy**

A course dealing with the quantum and classical description of the nuclear magnetic resonance of an isolated system of two spin-1/2 nuclei. The design of pulsed NMR spectrometers and the Fourier analysis of time-dependent observable magnetization in 1 and 2 dimensions are treated in detail, NMR relaxation in liquids and solids is included phenomenologically. Prerequisite: Physical Chemistry or permission of the instructor.  
Credit 3 units.

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**L07 Chem 580 Special Topics in Physical Chemistry: Methods of Biophysical Chemistry**

The course provides an overview of key methodologies of contemporary biophysics and biophysical chemistry, covering: 1) Spectroscopic methods routinely used in biochemistry, including absorption, fluorescence, and circular dichroism; 2) Biophysical methods to study intra- and intermolecular protein interactions including solution-state NMR, FCS, and FRET; 3) Cutting-edge biophysical techniques to study transient protein-protein/ protein-nucleic acids interactions. Prerequisites: undergraduate-level course in quantum mechanics (Chem 401)  
Credit 3 units.

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**L07 Chem 581 Advanced Quantum Chemistry**

A study of the theory and methods of quantum mechanics, with applications to problems of chemical interest. Prerequisite, Chem 571 or permission of the instructor.  
Credit 3 units.

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**L07 Chem 5810 General Biochemistry I**

Topics include the properties and structures of biomolecules, including amino acids, nucleotides, lipids, carbohydrates, proteins and nucleic acids. Additional topics include enzyme kinetics and mechanisms, membrane structure and properties, protein folding, an introduction to metabolism, oxidative phosphorylation and photosynthesis. This course is the first semester of an integrated two-semester sequence. The second course is Chem 482. Prerequisites: Biol 2970, Chem 262.  
Same as L07 Chem 481  
Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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**L07 Chem 5811 Introduction to Biomolecules**

The goal of this course is to introduce students to the preparation, characterization, structure-function relationship, and chemistry of proteins, polysaccharides, and nucleic acids. The course emphasizes understanding the chemical and physical properties of the respective building blocks and their noncovalent interactions as the foundation for macromolecular properties and function. Students will apply fundamental energetic and mechanistic principles (from general and organic chemistry) and develop chemical reasoning skills that enable scientific problem-solving towards the understanding of chemical phenomena in biological systems.  
Credit 3 units.

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**L07 Chem 5820 General Biochemistry II**

Biochemistry explores the chemistry of life processes at the molecular level. This course is the second semester of a two-semester General Biochemistry sequence (Chem481/482 or Bio4810/4820). Prerequisites include Chem481/Bio4810 and Chem262 or instructor permission. The first semester of the Biochemistry sequence covered the basics of the topic with an emphasis on the structures, functions, and interactions of biomolecules including proteins, nucleic acids, carbohydrates, and lipids. This second semester course will emphasize metabolism, the biosynthetic (anabolism) and degradation (catabolism) pathways that provide the energy of life and define the molecules associated with healthy and disease states.

Same as L07 Chem 482

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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**L07 Chem 5821 Chemical Biology**

This course is a survey of modern chemical biology focusing on the application of a broad array of chemical tools to biological problems. The course is roughly divided into four sections; biopolymers, computational methods and bioinformatics, tools for chemical biology, and applications of chemical biology. A mandatory discussion section accompanies the course and is used to review current and classical literature in the field. Prereqs: Chem 262 and Biol 2970, or permission of the instructor.

Same as L07 Chem 475

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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**L07 Chem 583 Time-Dependent Quantum Mechanics & Spectroscopy**

This graduate-level course lays the foundations of time-dependent quantum mechanics and applications to contemporary optical spectroscopies, particularly ultrafast techniques. Formal theoretical descriptions for nonlinear spectroscopic techniques including transient absorption, photon echo, and two-dimensional spectroscopies will be developed. Practical aspects of these experiments including modern laser systems, instrument design, data collection, data processing, and data analysis will also be discussed. Discussion of current literature in the field will be an important component of the course. Prerequisite courses: Chem 401 or permission from the instructor.  
Credit 3 units.

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**L07 Chem 5830 Bioorganic Chemistry**

This course presents a molecule-centered perspective on the current state of the art in antibiotic drug discovery and natural products chemistry. The molecular mechanisms of antibiotic drug action and pathogen resistance will be covered along with the biosynthetic origins of antibiotics from plants and microbes. The course is taught from the perspective of understanding how organic chemistry plays out in biological systems, with an emphasis on small organic molecules and enzymes. Curved arrow mechanisms will be used frequently in learning activities and assignments. Thus, Chem 262 (Organic Chemistry 2) is a mandatory prerequisite for this course. A working knowledge of protein structure and function is helpful. Students are encouraged (but not required) to take Chem 481 (General Biochemistry 1) and/or Chem 482 (General Biochemistry 2) in preparation for this course. Students will be responsible for writing a review article on an assigned antibiotic molecule and presenting their paper to the class.  
Same as L07 Chem 453

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM

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**L07 Chem 5833 Protein Biochemistry**

The focus of this course is protein biochemistry, and is intended to build upon General Biochemistry (Chem 481). In this course we will focus on protein structure, folding, and techniques to purify and characterize protein activity. We will progress from initial studies to first understand protein fold and function to current efforts to better characterize protein structure-function relationships. We will also highlight human diseases that are underpinned by protein misfolding. This course will focus on reading and understanding primary literature, including landmark papers along with more recent work. During the second half of the semester, each student will select a paper and prepare a written analysis of that paper. The student will then present the paper and lead a journal club style discussion of the paper. Prerequisites: Chem 481 or instructor's permission  
Same as L07 Chem 483

Credit 3 units. A&S IQ: NSM Arch: NSM Art: NSM BU: SCI

**L07 Chem 584 Molecular Spectroscopy**

Cursory overview of electromagnetic radiation and its interaction with atoms and molecules. The course will assume a general knowledge of quantum chemistry, (i.e., Chem 401), although a quick review of eigenfunctions and states will be given. We will cover Rotational Spectroscopy, Vibrational Spectroscopy, Electronic Spectroscopy, and Time-resolved Spectroscopy. In so doing, attention will be focused on diatomic molecules, although some examples of polyatomics will be given with emphasis placed on how structure contributes to spectra. Emphasis is placed on creating intuition into spectroscopy, not necessarily the quantum-mechanical rigor or detailed calculations of molecular spectroscopy. Prerequisite, Chem 401 or permission of the instructor.

Credit 3 units.

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**L07 Chem 585 Molecular Reaction Dynamics**

This course addresses the question, "what happens in a chemical reaction?" at the atomic/molecular level. Topics: Non-reactive and reactive molecular collisions, scattering and resonances, unimolecular and bimolecular reactions, potential energy surfaces, reaction rate calculations and models, state to state experiments and stereodynamics, energy transfer mechanisms, time resolved and frequency resolved dynamics, condensed phase dynamics, control of chemical reactions. Requirements: Chem 401 is a pre-requisite and prior completion or current registration in Chem 402 is required. However, equivalent courses will be considered at the discretion of the instructor.

Credit 3 units.

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**L07 Chem 599 Chemical Laboratory Safety**

An overview of current laboratory safety, regulatory, and compliance practices. Safety and compliance issues that impact chemical, biological, and materials research will be covered. Required for entering chemistry graduate students.

Credit 0.5 units.

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**L07 Chem 883 Master's Continuing Student Status**

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**L07 Chem 885 Master's Nonresident**

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**L07 Chem 886 Doctoral Nonresident**

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**L07 Chem 887 Master's Resident**

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**L07 Chem 888 Doctoral Resident**

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