

CHEMISTRY (CHEM-GA)

CHEM-GA 1113 Chemistry of the Transition Metals (4 Credits)

Typically offered Fall

Bonding and electronic structure of transition metal complexes; basic transformations of organometallic chemistry; catalytic reaction, including cross-coupling, olefin metathesis, asymmetric hydrogenation, olefin polymerization.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1200 Chemical Applications of Group Theory (4 Credits)

Study applications of a branch of abstract algebra to problems of symmetry in chemistry, electronic structure theory, spectroscopy, and crystallography. Symmetries of molecules and crystals, construction of symmetry adapted linear combinations of atomic orbitals, prediction of normal modes and allowed spectroscopic transitions of molecules.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1300 Colloid Science (4 Credits)

Introduction to the major concepts in Colloid Science, including synthesis and stabilization of colloidal suspensions, particle characterization and self-assembly principles. Study of scientific principles underlying the behavior of colloidal suspension. Overview of most important types of particle interactions and how these interactions can be used to guide colloidal self-assembly. Study classic synthetic strategies to fabricate stable and monodisperse particles as well as advanced methodologies to shape and functionalize colloidal matter. Familiarization with standard particle characterization methods.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1311 Adv Organic Chem: React of Organic Compound (4 Credits)

Typically offered Spring

Survey of the major classes of organic reactions, reagents, mechanisms, stereochemistry, and protecting groups. Discusses the origins of chemoselectivity, regioselectivity, and stereoselectivity and the planning of organic synthesis.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1313 Physical Organic Chemistry (4 Credits)

Typically offered Fall

Structure and bonding in organic molecules, including MO calculations, perturbation methods, and aromaticity; stereochemistry and conformational analysis; pericyclic reactions; thermochemistry and kinetics; transition state theory and activation parameters; acids and bases; and methods for the determination of mechanisms.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1315 Supramolecular Chemistry (4 Credits)

Typically offered Spring

Molecular recognition in the context of organic and biological molecules. Emphasis will be on the understanding of weak forces that dictate self-assembly, and intra- and intermolecular interactions. Physical organic and biophysical methods are introduced as necessary.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1400 Spectroscopic Analysis in Organic and Inorganic Chemistry (4 Credits)

Introduction to modern spectroscopic techniques for structural determination of organic and inorganic molecules. Topics include NMR spectroscopic methods, EPR spectroscopy, mass spectrometric methods, vibrational spectroscopy techniques, electronic (UV-visible) spectroscopic techniques, and cyclic voltammetry

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1500 Machine Learning in Molecular Science (4 Credits)

Introduction to machine learning and its applications to problems in chemistry. Study of practical understanding of machine learning, concepts, methods, intuitions, algorithms, strengths, limitations, applicability and application of these concepts.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1815 Macromolecular Chemistry (4 Credits)

Typically offered Fall

Structural chemistry of macromolecules, including vector analysis, symmetry, crystallography, DNA, RNA, and virus structure.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1818 Adv Biophysical Chem (4 Credits)

Typically offered Fall

Three advanced topics in biophysical chemistry are discussed: electron transfer theory and its application to electron transfer in biology; statistical mechanics of biopolymers; and protein-DNA interactions with emphasis on DNA repair enzymes.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 1883 Molecular Biochemistry (4 Credits)

Typically offered Fall

Mechanisms and interactions of biomolecules found in nature, including noncovalent interactions; DNA, RNA and protein synthesis and structure; protein modifications and turnover; biomolecular catalysis, allostery and cooperativity; lipids and carbohydrates of the cell; biosynthesis of natural products; modern techniques in biochemistry.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 2262 Special Topics: (2-4 Credits)

Typically offered occasionally

This course will provide an introduction to spectroscopy. The course will discuss molecular motion and symmetry in the context of spectroscopic analysis as well as a general description of two-level systems, transition probabilities, line shapes and coherences. In addition the instrumentation, measurement and analysis tools will be described.

Grading: GSAS Graded

Repeatable for additional credit: Yes

CHEM-GA 2400 The Science of Materials (4 Credits)

Typically offered Fall

A comprehensive foundation course that addresses basic concepts of materials science. Topics include bonding forces, crystal structures, defects, x-ray diffraction, solid-state phase diagrams, crystallization mechanisms, diffusion in solids, and mechanical, electrical, optical, and magnetic properties. Classes of materials include metals, ceramics, polymers, liquid crystals, organic crystals.

Grading: GSAS Graded

Repeatable for additional credit: No

CHEM-GA 2420 Polymer Chemistry (4 Credits)*Typically offered Spring*

This course is intended to introduce the student to the major concepts in polymer chemistry such as polymerizations and reactions of polymers and to prepare the student for research in polymer science.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 2600 Statistical Mechanics (4 Credits)***Typically offered Fall and Spring*

Introduction to the fundamentals of statistical mechanics. Topics include classical mechanics in the Lagrangian and Hamiltonian formulations and its relation to classical statistical mechanics, phase space and partition functions, and the development of thermodynamics. Methods of molecular dynamics and Monte Carlo simulations are also discussed.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 2627 Computational Chemistry (4 Credits)***Typically offered not typically offered*

An introduction to molecular modeling and simulation with the goal of assisting students to develop a practical understanding of computational methods.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 2665 Quantum Mechanics (4 Credits)***Typically offered Fall*

Quantum mechanics of elementary systems; includes perturbation theory, particle in a box, the one-electron atom, harmonic oscillators, and the elements of atomic and molecular structure.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 2666 Quantum Chemistry and Advanced Statistical Mechanics (4 Credits)***Typically offered Spring*

Representation theory, time-dependent and time-independent perturbation theory, rotational and vibrational levels in molecules, many-electron systems, interaction of electric and magnetic fields with atoms and molecules, quantum treatment of many-electron systems, and techniques of quantum chemistry.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 2671 Special Topics Physical Chemistry: (0-4 Credits)***Typically offered occasionally*

Special Topics is an umbrella course and is used to introduce many new courses or run infrequently held courses

Grading: GSAS Graded**Repeatable for additional credit:** Yes**CHEM-GA 2672 Special Topics: (4 Credits)***Typically offered occasionally*

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Grading: GSAS Graded**Repeatable for additional credit:** Yes**CHEM-GA 2673 Professional Development (0 Credits)***Typically offered Fall*

This class centers prepares students to be successful at NYU, in their field and in their future employment. In detail, students enrolled in this class are a) being introduced to the workings of NYU, 2) learn about the ethics of carrying out research, 3) learn how to publish scientific results, 4) are being introduced to effective teaching techniques, 5) learn how to apply for funding and fellowships, 6) are being familiarized with the safety procedures in chemical lab settings, and 7) are being introduced to career paths past their degree.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**CHEM-GA 2674 Chemical Biology Lab (4 Credits)**

This is a one-semester laboratory class aimed at emphasizing key techniques in chemical biology. The laboratory modules will emphasize techniques in (a) protein expression and analysis such as chromatography, gel electrophoresis, and pull-down assays, (b) biophysical chemistry such as spectroscopy, surface plasmon resonance, nuclear magnetic resonance and (c) nucleic acid molecular biology such as DNA purification, mutagenesis, and transformation of plasmids to bacterial cells.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 2680 Nmr Spectroscopy: Theory and Practice (4 Credits)***Typically offered Fall and Spring*

This course discusses modern NMR techniques in theory and practice. Both liquid- and solid-state NMR techniques will be introduced and demonstrated. Connections to Magnetic Resonance Imaging will be discussed. Applications to structure determination of biomolecules and materials will be discussed. Hands-on experience and computer simulations using MATLAB and Mathematica will be offered during class.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 2718 Dive Into Computational Physical chemistry (4 Credits)**

The goal of this class is to prepare you to use computational tools for chemistry research. It will also lay a foundation for data science and scientific computing more generally. A short lecture portion will introduce concepts behind what we are doing, but the primary emphasis of the class will be on doing. The goal by the end of the class is that you can jump into using new tools with ease and confidence.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 2884 Bio-Organic Chemistry (4 Credits)***Typically offered Spring*

Covers a broad range of topics at the interface between organic chemistry and biology, based on the most recent advances in bioorganic chemistry, chemical biology functional genomics, and molecular evolution.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 2931 Research (1-12 Credits)***Typically offered Fall*

Engage in a process of systematic inquiry that entails collection of data; documentation of critical information; and analysis and interpretation of that data/information, in accordance with suitable methodologies set by specific fields of chemistry and conducted as part of a research group under the supervision of a principal investigator.

Grading: GSAS Graded**Repeatable for additional credit:** Yes

CHEM-GA 2932 Research (1-12 Credits)*Typically offered Spring*

Engage in a process of systematic inquiry that entails collection of data; documentation of critical information; and analysis and interpretation of that data/information, in accordance with suitable methodologies set by specific fields of chemistry and conducted as part of a research group under the supervision of a principal investigator.

Grading: GSAS Graded**Repeatable for additional credit:** Yes**CHEM-GA 3010 Graduate Seminar (2 Credits)***Typically offered Fall*

Students enrolled in this course (1) learn how to give a presentation understandable to an audience of their peers, many of whom work in a different area of specialization; (2) learn how to evaluate presentations given by their peers both within and outside their area of specialization; (3) gain exposure to a broad range of scientific topics and presentation styles; and (4) have the opportunity to attend presentations by external speakers to broaden exposure to various topics and professional presentation styles.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 3020 Master's Thesis in Chemistry (2 Credits)**

A two-credit, one-semester capstone course for second-year students pursuing a thesis-based Master's degree, research track, in the Department of Chemistry. The course is designed as a workshop that covers all stages of the thesis writing process, providing students with the tools to perfect both the thesis content and format. The course concludes with a presentation of the completed thesis work to an audience of peers and graduate advisors.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** No**CHEM-GA 3200 Original Research Proposal (1 Credit)**

This course is a required one-credit one-semester course for third-year graduate students pursuing a Ph.D. degree in the Department of Chemistry. The course covers topics related to research proposals in all fields of chemistry, including the conception and writing of innovative proposals as well as the associated review process. Each student will be tasked with creating an original research proposal that will be aided, and then reviewed, by peer teams that emulate NSF review panels or NIH study sections. As such, the course will provide guidance for the written and oral component for the 3rd year Original Research Proposal (ORP) exam early in the spring semester, as well as for proposals intended to secure resources in future careers.

Grading: GSAS Pass/Fail**Repeatable for additional credit:** Yes**CHEM-GA 9627 Computational Chemistry (4 Credits)***Typically offered not typically offered*

Fulfillment: Chemistry elective.

Grading: GSAS Graded**Repeatable for additional credit:** No

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CHEM-GA 9666 Quantum Chemistry and Advanced Statistical Mechanics (4 Credits)

Representation theory, time-dependent and time-independent perturbation theory, rotational and vibrational levels in molecules, many-electron systems, interaction of electric and magnetic fields with atoms and molecules, quantum treatment of many-electron systems, and techniques of quantum chemistry.

Grading: GSAS Graded**Repeatable for additional credit:** No**CHEM-GA 9668 Chemical Dynamics (4 Credits)**

Chemical dynamics provides a theoretical description of reactions, relaxation, and transfer events in molecular and condensed-phase systems. The motion of molecules at finite temperature is important to understand chemical reactions in complex systems, especially when Born-Oppenheimer approximation breaks down. In this course, students will be introduced to theoretical and computational approaches of dynamics including classical molecular dynamics, quantum dynamics, rate theories, electronic and energy transfer theories, mixed quantum-classical dynamics, as well as semiclassical dynamics. The environment effects on chemical dynamics are discussed. Path-integral-based formalisms are introduced for treating nuclear quantum effects and theoretical frameworks of ultrafast spectroscopy are also included.

Grading: GSAS Graded**Repeatable for additional credit:** No