

CHEMISTRY

The Department of Chemistry is internationally recognized for its research and education. As part of a commitment to continuing this tradition of excellence, the department provides a graduate program that integrates opportunities for cutting-edge creative research and study across a wide range of areas including analytical, atmospheric, biochemistry, biophysical, chemical physics, environmental, organic, materials and nanoscience, and physical chemistry.

Graduate students enjoy extensive scientific collaboration with chemistry and biochemistry faculty, with other departments such as Molecular, Cellular and Developmental Biology, and Physics, and with research institutes and agencies such as the Cooperative Institute for Research in Environmental Sciences (CIRES), Joint Institutes of Laboratory Astrophysics (JILA) and the National Oceanic and Atmospheric Administration (NOAA).

Course code for this program is CHEM.

Master's Degree

- Chemistry - Master of Science (MS) (<https://catalog.colorado.edu/graduate/colleges-schools/arts-sciences/programs-study/chemistry/chemistry-master-science-ms/>)

Doctoral Degrees

- Chemistry - Doctor of Philosophy (PhD) (<https://catalog.colorado.edu/graduate/colleges-schools/arts-sciences/programs-study/chemistry/chemistry-doctor-philosophy-phd/>)
- Chemical Physics - Doctor of Philosophy (PhD) (<https://catalog.colorado.edu/graduate/colleges-schools/arts-sciences/programs-study/chemistry/chemical-physics-doctor-philosophy-phd/>)

Faculty

While many faculty teach both undergraduate and graduate students, some instruct students at the undergraduate level only. For more information, contact the faculty member's home department.

Asirvatham, Margaret (https://experts.colorado.edu/display/fisid_103670/)
Senior Instructor Emerita; PhD, Kansas State University

Bierbaum, Veronica (https://experts.colorado.edu/display/fisid_101124/)
Professor Emerita; PhD, University of Pittsburgh

Birks, John
Professor Emeritus

Bouwman, Jordy (https://experts.colorado.edu/display/fisid_167913/)
Assistant Professor; PhD, Leiden University (Netherlands)

Broering, Ellen (https://experts.colorado.edu/individual/fisid_167610/)
Instructor; PhD, University of Georgia

Brown, Steven S. (https://experts.colorado.edu/display/fisid_119987/)
Professor Adjunct; PhD, University of Wisconsin–Madison

Browne, Eleanor Carol (https://experts.colorado.edu/display/fisid_156464/)
Assistant Professor; PhD, University of California, Berkeley

Cuk, Tanja (https://experts.colorado.edu/display/fisid_159751/)
Associate Professor; PhD, Stanford University

Damrauer, Niels Harley (https://experts.colorado.edu/display/fisid_129797/)
Professor; PhD, University of California, Berkeley

de Gouw, Joost (https://experts.colorado.edu/display/fisid_105125/)
Professor, Associate Chair; PhD, University of Utrecht (Netherlands)

Dukovic, Gordana (https://experts.colorado.edu/display/fisid_147414/)
Professor; PhD, Columbia University

Eaves, Joel David (https://experts.colorado.edu/display/fisid_147419/)
Professor; PhD, Massachusetts Institute of Technology

George, Steven (https://experts.colorado.edu/display/fisid_103289/)
Professor; PhD, University of California, Berkeley

Gin, Douglas L. (https://experts.colorado.edu/display/fisid_122861/)
Professor; PhD, California Institute of Technology

Gough, Raina V. (https://experts.colorado.edu/display/fisid_149207/)
Instructor; PhD, University of Colorado

Hendrickson, Susan Marie (https://experts.colorado.edu/display/fisid_145101/)
Senior Instructor; PhD, Colorado State University

Hynes, James T.
Distinguished Professor Emeritus; PhD, Princeton University

Jimenez, Ralph (https://experts.colorado.edu/display/fisid_132670/)
Professor Adjunct; PhD, University of Chicago

Jimenez-Palacios, Jose Luis (https://experts.colorado.edu/display/fisid_125580/)
Distinguished Professor; PhD, Massachusetts Institute of Technology

Jonas, David (https://experts.colorado.edu/display/fisid_107145/)
Professor; PhD, Massachusetts Institute of Technology

Kelly, Christine
Instructor Emeritus

Koch, Tad H.
Professor Emeritus; PhD, Iowa State University

Koval, Carl A.
Professor Emeritus; PhD, California Institute of Technology

Kroll, Jay (https://experts.colorado.edu/display/fisid_156135/)
Instructor; PhD, University of Colorado Boulder

Lineberger, William Carl
Distinguished Professor Emeritus; PhD, Georgia Institute of Technology

Luca, Oana (https://experts.colorado.edu/display/fisid_157952/)
Assistant Professor; PhD, Yale University

Marder Seth (https://experts.colorado.edu/display/fisid_167617/)
Professor; PhD, University of Wisconsin-Madison

Marshak, Michael Pesek (https://experts.colorado.edu/display/fisid_156422/)
Assistant Professor; PhD, Massachusetts Institute of Technology

Michl, Josef (https://experts.colorado.edu/display/fisid_102977/)
Professor, Endowed Chair; PhD, Czech Academy of Sciences (Czech Republic)

Minton, Timothy K. (https://experts.colorado.edu/display/fisid_167230/)
Professor; PhD, University of California Berkeley

Montoya Castillo, Andres (https://experts.colorado.edu/display/fisid_167156/)
Assistant Professor; PhD, Columbia University In the City of New York

Nesbitt, David J. (https://experts.colorado.edu/display/fisid_100333/)
Professor Adjunct; PhD, University of Colorado

Noble D., Richard
Research Professor; PhD, University of California–Davis

Nozik, Arthur (https://experts.colorado.edu/display/fisid_113395/)
Professor Emeritus; PhD, Yale University

Parson, Robert (https://experts.colorado.edu/display/fisid_101032/)
Professor, Associate Chair; PhD, University of Michigan Ann Arbor

Peters, Kevin
Professor Emeritus; PhD, Yale University

Pierpont, Cortlandt G.
Professor Emeritus; PhD, Brown University

Rumbles, Garry (https://experts.colorado.edu/display/fisid_147479/)
Professor Adjunct; PhD, University of London (England)

Sammakia, Tarek (https://experts.colorado.edu/display/fisid_101597/)
Professor Emeritus, Chair; PhD, Yale University

Sharma, Sandeep (https://experts.colorado.edu/display/fisid_158286/)
Associate Professor; PhD, Massachusetts Institute of Technology

Sievers, Robert E. (https://experts.colorado.edu/display/fisid_102866/)
Professor Emeritus; PhD, University of Illinois at Urbana–Champaign

Skodje, Rex T. (https://experts.colorado.edu/display/fisid_103448/)
Professor Emeritus; PhD, University of Minnesota Twin Cities

Tolbert, Margaret A. (https://experts.colorado.edu/display/fisid_104976/)
Distinguished Professor; PhD, California Institute of Technology

Vaida, Veronica (https://experts.colorado.edu/display/fisid_100313/)
Professor; PhD, Yale University

Volkamer, Rainer (https://experts.colorado.edu/display/fisid_144988/)
Professor; PhD, University of Heidelberg (Germany)

Walba, David M. (https://experts.colorado.edu/display/fisid_105830/)
Professor; PhD, California Institute of Technology

Walczak, Maciej Andrzej (https://experts.colorado.edu/display/fisid_153323/)
Associate Professor; PhD, University of Pittsburgh

Wang, Xiang (https://experts.colorado.edu/display/fisid_145812/)
Associate Professor; PhD, Boston University

Weber, Jorg Mathias (https://experts.colorado.edu/display/fisid_142930/)
Professor; PhD, University of Kaiserslautern (Germany)

Wise, Matthew Eric (https://experts.colorado.edu/display/fisid_143977/)
Senior Instructor, Faculty Director, Associate Chair; PhD, University of Colorado Boulder

Zhang, Wei (https://experts.colorado.edu/display/fisid_146429/)
Professor, Chair; PhD, University of Illinois at Urbana–Champaign

Ziemann, Paul Jeffrey (https://experts.colorado.edu/display/fisid_153281/)
Professor; PhD, Pennsylvania State University

Courses

CHEM 5011 (3) Advanced Inorganic Chemistry 1

Inorganic chemistry based on principles of bonding, structure, reaction mechanisms, and modern synthetic methods. Chemistry and general properties of representative and transition elements and their compounds.

Equivalent - Duplicate Degree Credit Not Granted: CHEM 4011

Requisites: Requires prerequisite courses of CHEM 4011 and CHEM 4531 (all minimum grade B-) or graduate standing.

CHEM 5061 (3) Advanced Inorganic Chemistry 2

Lectures in physical inorganic chemistry with an emphasis on topics for understanding modern solar energy conversion to electricity and fuels. Includes a description of bonding and properties of coordination compounds in terms of the ligand field and molecular orbital theories. The primary research literature will be used to motivate exploration of relevant themes including spectroscopy, electron transfer, energy transfer, bioenergetic conversion, and small-molecule activation.

Requisites: Requires prerequisite course of CHEM 4011 (minimum grade C-) or graduate standing.

CHEM 5121 (2) Practical Laboratory Skills for Analytical Chemistry

Practical laboratory skills for research in experimental analytical and atmospheric chemistry (and related fields such as physical chemistry). Short lectures followed by hands-on laboratory practice and discussion. Topics covered include gases and flows; electricity and signals; key environmental measurements; data acquisition and other advanced topics.

Requisites: Restricted to graduate students only.

Grading Basis: Letter Grade

CHEM 5131 (3) Computer Programming and Data Analysis for Chemists

Provides an introduction to computer programming and data analysis skills that are a fundamental part of graduate research. The programming section of the course introduces the coding skills necessary for simulating, analyzing and visualizing data using IGOR Pro and for acquiring data and analyzing data using LabVIEW. Basic concepts in statistics and error analysis are also covered.

Requisites: Restricted to graduate students only.

Recommended: Prerequisites CHEM 4511 or CHEM 4171.

Grading Basis: Letter Grade

CHEM 5141 (3) Environmental Water and Soil Chemistry

Application of basic chemical principles to understanding the processes that determine the chemical composition of oceans, lakes, rivers, soils and sediments. Topics include air-water exchange; acid-base, redox, coordination, precipitation and dissolution, ion exchange and sorption reactions; nutrient chemistry; and the use of simple equilibrium and kinetic models for describing the chemistry of inorganic and organic species in air-water-soil systems.

Equivalent - Duplicate Degree Credit Not Granted: CHEM 4141

Requisites: Restricted to graduate students only.

CHEM 5151 (3) Atmospheric Chemistry

Lect. Basic kinetics and photochemistry of atmospheric species. Stratospheric chemistry with emphasis on processes controlling ozone abundance. Tropospheric chemistry focusing on photochemical smog, acid deposition, oxidative capacity of the atmosphere and global climate change.

Equivalent - Duplicate Degree Credit Not Granted: ATOC 5151

Requisites: Restricted to graduate students only.

Recommended: Prerequisite one semester of college-level chemistry.

CHEM 5152 (3) Advanced Atmospheric Chemistry

Follows Graduate Atmospheric Chemistry (CHEM 5151) and explores advanced topics in atmospheric chemistry, such as secondary aerosol formation, oxidant formation, the chemistry of global climate change and/or design of advanced laboratory experiments.

Equivalent - Duplicate Degree Credit Not Granted: ATOC 5152

Recommended: Prerequisite CHEM 5151 or ATOC 5151.

CHEM 5161 (3) Analytical Atmospheric Spectroscopy

Optical spectrochemical analysis, atmospheric transmittance, including atomic and molecular spectroscopy, line-by-line spectral databases such as HITRAN, absorption, emission, fluorescence, scattering processes of gases, surface enhancements, aerosols, optical spectroscopic instrument components, and techniques, and their applications to atmospheric, and environmental problems. Department enforced prereq., undergraduate physical chemistry or instructor consent.

Requisites: Restricted to graduate students only.

CHEM 5171 (3) Electroanalytical Chemistry

Lect. Establishes a background for understanding electrochemical systems through a review of the relevant thermodynamic, kinetic and electronic principles. Compares classical and modern electrochemical methods of analysis. Several special topics are discussed in depth. Department enforced prerequisite: undergraduate physical chemistry or instructor consent.

Requisites: Restricted to graduate students only.

CHEM 5181 (3) Mass Spectrometry, Chromatography, and Computer Programming

Covers mass spectrometry, including instrumentation, ionization techniques, and interpretation of spectra. Analytical separation methods such as gas and liquid chromatography, ion mobility, and capillary electrophoresis. Introduction to atmospheric chemistry applications. Computer programming (Igor and LabVIEW) and simulation of instrumentation and processes. Department prerequisite: basic computer programming (or willingness to work hard on it), and undergraduate physics, statistics, and physical chemistry.

Requisites: Restricted to graduate students only.

CHEM 5251 (3) Materials Chemistry and Properties

Lec. Understanding of materials from chemistry perspective including metals, oxides, semiconductors and polymers. Basic description of chemical preparation of materials. Overview of fundamental properties of materials including structural, chemical, mechanical, thermal, electrical, and optical properties. Description of behavior of materials and various applications in modern technology. Discussion of materials characterization methods.

Equivalent - Duplicate Degree Credit Not Granted: CHEM 4251

Requisites: Requires prerequisite course of CHEM 4431 or CHEM 4531 (all minimum grade C-) or graduate standing.

CHEM 5261 (3) Organic Materials: Structures and Functions

Overview of the preparation and functioning mechanism of novel organic materials that have recently been developed, including conductive polymers, 2-D macrocyclic structures, 3-D molecular cages, molecular machines/muscles/switches, fullerene derivatives and carbon nanotube composites. Emphasizes the use of organic and physical chemistry as tools to develop novel materials and probe their structure-property relationship.

Equivalent - Duplicate Degree Credit Not Granted: CHEM 4261

Requisites: Requires prerequisite course of CHEM 4431 or CHEM 4531 (all minimum grade C-) or graduate standing.

CHEM 5271 (3) Chemistry of Solar Energy

Chemical principles of conversion of solar energy into electricity and fuels in molecular and semiconductor-based systems. Overview of solid-state electronic structure of materials and interfaces, light-matter interactions, principles of harvesting photoexcited currents and useful chemical species. Description of processes utilized in established and emerging solar energy technologies.

Equivalent - Duplicate Degree Credit Not Granted: CHEM 4271

Requisites: Requires prerequisite course of CHEM 4431 or CHEM 4531 (all minimum grade C-) or graduate standing.

CHEM 5281 (3) Semiconductor Processing and Device Fabrication

Understanding of semiconductor processing and device fabrication from chemistry perspective. Overview of processing steps used to fabricate inorganic semiconductor devices including deposition, patterning and etching techniques. Description of process integration during device fabrication. Discussion of key issues facing advanced semiconductor fabrication.

Requisites: Restricted to graduate students only.

Grading Basis: Letter Grade

CHEM 5311 (3) Advanced Synthetic Organic Chemistry

Lect. Surveys synthetic transformations emphasizing important functional group transformations and carbon-carbon, bond-forming reactions. Required of all organic chemistry graduate students. Department enforced prerequisite: one year of organic chemistry or graduate standing.

CHEM 5321 (3) Advanced Physical Organic Chemistry

Lect. Modern concepts of physical organic chemistry and their use in interpreting data in terms of mechanisms of organic reactions and reactivities of organic compounds. Required of all organic chemistry graduate students. Department enforced prerequisites: one year of organic chemistry and one year of physical chemistry or graduate standing.

CHEM 5331 (3) Advanced Spectroscopic Techniques in Organic Chemistry

Lect. Advanced spectroscopic techniques for structure and determination in organic chemistry. Emphasizes proton and carbon-13 NMR spectroscopy. Department enforced prerequisites: one year of organic chemistry and one year of physical chemistry or graduate standing.

CHEM 5501 (3) Advanced Topics in Physical Chemistry

Covers various topics in physical chemistry focusing on their mathematical and physical background. Topics include the application of classical mechanics and electrodynamics in chemistry, the classical mechanics background for the description of atoms and molecules, the use of vector spaces in wave mechanics and quantum mechanics and the classical description of spectroscopy in terms of interaction of light and matter. Department enforced prerequisites: undergraduate physical chemistry, graduate standing or instructor consent.

Requisites: Restricted to graduate students only.

CHEM 5531 (3) Statistical Mechanics

Lect. Fundamental concepts of quantum and classical statistical mechanics. Applications to properties of gases, liquids, solids, spin and polymer systems. Reaction, fluctuation, nucleation and relaxation phenomena. Department enforced prerequisite: undergraduate physical chemistry.

Requisites: Restricted to graduate students only.

CHEM 5541 (3) Chemical Dynamics

Lect. Discussion of mechanism and rate of chemical reactions from a fundamental point of view. Discusses nature of collision and develops concepts of cross section and rate constant. Theories of elementary bimolecular and decay processes are critically examined. Department enforced prerequisite: undergraduate physical chemistry.

Requisites: Restricted to graduate students only.

CHEM 5555 (4) Theoretical and Computational Chemistry

Explores computational methods to understand chemical systems. Topics include: atomic and molecular electronic structure calculations, Monte Carlo and molecular dynamics simulations and thermodynamic calculations.

Equivalent - Duplicate Degree Credit Not Granted: CHEM 4555

Requisites: Restricted to graduate students only.

Grading Basis: Letter Grade

CHEM 5571 (3) Surface Science

Lect. Principles of surface science with emphasis on fundamental surface phenomena, surface techniques and surface chemistry. Basic description of surfaces, adsorbate-surface interactions, surface kinetics and methods of surface analysis. Surface science of heterogeneous catalysis, semiconductor processing, and environmental interfaces. Department enforced prerequisites: undergraduate physical chemistry and graduate standing or instructor consent.

Requisites: Restricted to graduate students only.

CHEM 5581 (3) Introductory Quantum Chemistry

Lect. Basic principles and techniques of quantum mechanics with applications to questions of chemical interest. Quantum dynamics of atoms, molecules and spin; electronic structure of atoms and molecules. Department enforced prerequisite: two semesters of physical chemistry and graduate standing or instructor consent.

Requisites: Restricted to graduate students only.

CHEM 5591 (3) Advanced Molecular Spectroscopy

Lect. Rotational, vibrational and electronic spectra of molecules, and their interpretation in terms of the quantum theory of molecular structure. Department enforced prerequisites: two semesters of physical chemistry and graduate standing or instructor consent.

Requisites: Restricted to graduate students only.

CHEM 6001 (1) Seminar: Inorganic Chemistry

Student, faculty, and guest presentations and discussions of current research in inorganic chemistry and related topics (transition element and main group element compound properties, inorganic compound in biological, industrial, and materials applications). Required of all inorganic chemistry graduate students. Credit deferred until presentation of satisfactory seminar.

Repeatable: Repeatable for up to 3.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 6021 (1-3) Special Topics in Inorganic Chemistry

Lect. Subjects of current interest in inorganic chemistry. Primarily used for graduate-level presentations of special topics by visiting and resident faculty. Variable class schedule.

Repeatable: Repeatable for up to 7.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 6031 (3) Special Topics in Nanoscience

Introduces the synthesis, physical properties, and applications of nanometer-scale materials and devices. Includes synthesis of metal and semiconductor nanoparticles and nanowires, optical and electronic properties of nanoscale systems, and applications in biotechnology and energy.

Requisites: Requires prerequisite course of CHEM 4431 or CHEM 4511 (all minimum grade B-) or graduate standing.

CHEM 6101 (1) Seminar: Analytical Chemistry

Student, faculty, and guest presentations and discussions of current research in analytical chemistry. Required of all analytical chemistry graduate students. Credit deferred until presentation of satisfactory seminar.

Repeatable: Repeatable for up to 3.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 6111 (1-3) Special Topics in Analytical Chemistry

Lect. Subjects of current interest in analytical chemistry. Used for graduate-level presentations of special topics by visiting and resident faculty. Variable class schedule.

Repeatable: Repeatable for up to 7.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 6301 (1-3) Seminar in Organic Chemistry

Discussions principally concerned with recent literature in organic chemistry. Required of all organic chemistry graduate students.

Repeatable: Repeatable for up to 3.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 6311 (1-3) Special Topics in Synthetic Organic Chemistry

Lect. Selected topics in synthetic organic chemistry, encompassing both methods and/or total synthesis of complex molecules.

Requisites: Requires prerequisite course of CHEM 5311 (minimum grade B-). Restricted to graduate students only.

CHEM 6321 (1-3) Special Topics in Physical Organic Chemistry

Lect. Selected topics in physical organic chemistry, which may include photochemistry, carbene chemistry, free radical chemistry, molecular orbital methods, organic materials, or gas phase ion chemistry.

Requisites: Requires prerequisite course of CHEM 5321 (minimum grade B-). Restricted to graduate students only.

CHEM 6401 (1-3) Seminar: Physical Chemistry

Student, faculty, and guest presentations of current research in physical chemistry. Discussion of research topics related to the subject of weekly physical chemistry/chemical physics seminar and appropriate journal articles.

Repeatable: Repeatable for up to 3.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 6411 (1-3) Chemistry in the Contemporary and Ancient Earth

Lect.

Requisites: Restricted to graduate students only.

CHEM 6801 (0) Departmental Research Seminar

Lectures by visiting scientists and occasionally by staff members and graduate students on topics of current research. Meets once a week. Required for all graduate students in chemistry.

Repeatable: Repeatable for up to 3.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 6901 (1-6) Research in Chemistry

Repeatable: Repeatable for up to 15.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 6941 (1) Master's Candidate for Degree

Registration intended for students preparing for a thesis defense, final examination, culminating activity, or completion of degree.

Requisites: Restricted to graduate students only.

CHEM 6951 (1-6) Master's Thesis

Requisites: Restricted to graduate students only.

CHEM 7021 (2) Seminar: Structural Inorganic Chemistry

Current research in the area of structural inorganic chemistry. Concerns topics related to electronic and molecular structure of transition metal complexes. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7101 (2) Seminar: Chromatography and Trace Analysis

Student and faculty discussions and reports on research advances in chromatography, trace analysis and environmental chemistry. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7111 (2) Seminar: Electrochemistry

Student and faculty discussions and reports on research advances in electrochemistry. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7131 (1) Seminar in Atmospheric Aerosol Chemistry

Discusses advances in atmospheric aerosol chemistry, with emphasis on new methods for analysis and their application to laboratory and field studies.

Repeatable: Repeatable for up to 2.00 total credit hours.

Requisites: Restricted to graduate students only.

Recommended: Prerequisites CHEM 5151 and CHEM 5181.

CHEM 7161 (1) Seminar: Heterogeneous Atmospheric Chemistry

Topics in atmospheric chemistry emphasizing the structure and reactivity of atmospheric particulates. Presentations on current research and critical evaluations of recent literature. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7211 (1) Seminar: Topics in Synthetic Methodology and Natural Product Synthesis

Discussion of contemporary synthetic organic chemistry with a focus on new methodology and total synthesis of natural products.

Requisites: Restricted to graduate students only.

CHEM 7221 (1) Seminar: Photochemistry and Free Radical Chemistry

Current research in areas of organic free radical chemistry, photochemistry, and related topics are presented and discussed. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7231 (1) Seminar: Reactive Intermediates

Application of contemporary ideas of chemical physics to organic molecules. Special attention to structures and bonding in organic ions and radicals. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7241 (1) Seminar: Synthetic Organic Chemistry

Series of seminars on directed total synthesis. Emphasizes modern synthetic methodology and applications to total synthesis of natural products. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7251 (1) Selected Topics in Chemical Genetics

Discusses the brief history of the emerging field of chemical genetics, and focuses on the recent development of concepts, techniques, applications, and its impact on both science and human health.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7271 (1) Seminar: Picosecond Dynamics of Reactions

Includes development and application of picosecond laser spectroscopy to organic and organometallic reactions. Emphasizes relationship between current theoretical developments and experiments. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7281 (1) Seminar: Molecular Self-Assembly

Discusses current topics and recent advances in molecular self-assembly, with emphasis on new liquid crystal designs and applications.

Repeatable: Repeatable for up to 2.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7291 (1) Seminar: Physical Organic Chemistry

Modern experimental techniques and theoretical models in physical organic chemistry are discussed in relation to the development of new materials, such as molecular size tinkertoys to the development of novel photochemical systems and their spectroscopies. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7301 (1) Seminar: Synthetic and Mechanistic Chemistry

Discusses particularly the synthesis of complex organic molecules and the mechanism of reagents used in organic synthesis. Includes a study of transition metal mediated organic reactions. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7311 (1) Selected Topics in Organic Materials

Current research in the area of organic/materials chemistry. Concerns topics related to organic materials synthesis, carbon nanotube functionalization, artificial photosynthesis, gas storage and catalysis.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7401 (1) Seminar in Photochemical Reaction Control

Discusses progress towards control of molecular reactivity using light, including synthetic methods for creating control subjects. Emphasizes new methods to achieve coherent control.

Repeatable: Repeatable for up to 2.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7421 (2) Seminar: Negative Ion Chemistry

Chemistry of negative ions; experimental methods and designs; laser spectroscopy of ions; theoretical methods; reactive dynamics of ions in the gas phase. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7431 (1) Seminar: Topics in Theoretical Chemical Physics

Seminars presented on a variety of topics in theoretical chemical physics. Molecular collisions and unimolecular dynamics predominantly featured. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7441 (2) Research Seminar: Theoretical Chemistry

Studies theoretical description of molecular dynamics as related to rate processes. Focuses on chemical reactions in liquids, absorption-desorption on surfaces, nucleation reactions, and energy flow in molecules. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7461 (1) Seminar: Gas Phase Ion Chemistry

Studies gas phase ion chemistry relevant to thermochemical measurements and atmospheric, interstellar, and biomedical applications.

Requisites: Restricted to graduate students only.

CHEM 7471 (1) Seminar in Ultrafast Spectroscopy of Proteins

Discusses advances and developments in biomolecular dynamics, and considers the connection of protein dynamics with function. Emphasizes experimental studies via ultrafast laser spectroscopy.

Repeatable: Repeatable for up to 2.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7481 (2) Seminar: Molecular Spectroscopy and Photochemistry

Discussion and presentation of current research in spectroscopy and photochemistry of organic as well as organometallic systems. Reviews state of the art techniques available for the theoretical and experimental characterization of excited states. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7491 (1) Seminar: Molecular Vibrational Dynamics

Topics pertaining to vibrational dynamics of small molecules are discussed, with particular emphasis upon IR laser spectroscopy, van der Waals' clusters, vibrationally induced dipole moments, and predissociation. Discussion of current research and recently published literature. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7501 (1) Seminar: Theoretical Molecular Dynamics

Variety of topics in theoretical chemical physics, emphasizing dynamics of molecules in dissipative environments or in radiation fields. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7511 (1) Seminar: Reaction Dynamics in Condensed Phases

Studies elementary steps in chemical reactions and their observation by ultrafast spectroscopy. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7521 (1) Seminar: Atmospheric Kinetics and Photochemistry

Discusses laboratory studies of degradation mechanisms. Applies these studies to atmospheric phenomena such as global warming and stratospheric ozone loss. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7531 (1) Seminar: Surface Chemistry and Thin Film Growth

Topics in surface chemistry and thin film growth with focus on atomic layer deposition (ALD) and molecular layer deposition (MLD). Properties of thin films grown using ALD and MLD. Applications of thin films in areas including flexible displays, energy storage and catalysis. Department consent required.

Repeatable: Repeatable for up to 6.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 7551 (1) Selected Topics in Ion Spectroscopy

Treats current topics in the spectroscopy of ions. Seminar lectures are given by graduate students on their research and on literature topics, and the results of both in-house and external research groups are studied. Additionally, ideas for interesting directions of research and new experiments are proposed and discussed.

Repeatable: Repeatable for up to 2.00 total credit hours.

Requisites: Restricted to graduate students only.

CHEM 8991 (1-10) Doctoral Dissertation

All doctoral students must register for 30 hours of dissertation credit as part of the requirements for the degree. For a detailed discussion of doctoral dissertation credit, refer to the Graduate School section.

Repeatable: Repeatable for up to 30.00 total credit hours.

Requisites: Restricted to graduate students only.