Graduate courses in Chemistry

Course number	*Title, units*	*Description*
CHEM 200	Advanced Organic Synthesis [3]	Logical approaches to designing syntheses of target organic compounds. Introduction to retrosynthetic analyses and background on the reactions needed to achieve common syntheses; protecting groups and stereoselective methodologies. Classic syntheses are discussed in the context of modern methods. Introduction to literature search tools, a practical estimate of the reliability of published protocols, and references on chemical purification.
CHEM 201	Organic and Organometallic Reaction Mechanisms [3]	Thermodynamics, statistical mechanics, and molecular orbital theory are used to explain reactivity, product distributions, the stability of intermediates, and transition state structure. Elements of computational chemistry, kinetic methods of interrogation, linear free energy relationships, kinetic isotope effects, and other methods for empirically constructing plausible reaction mechanisms
CHEM 202	Bioorganic Chemistry [3]	The molecular basis of biological processes. Methods by which enzymes catalyze organic reactions; experimental methods by which the mechanisms of enzyme-catalyzed reactions are elucidated; chemistry of disease states and drug action.
CHEM 212	Molecular and Solid State Quantum Chemistry [3]	Theory and practical application of molecular quantum mechanics. Schrödinger equation and matrix representations of quantum mechanics; simple exactly solvable model problems; calculation of observable properties; vibrational and electronic wave functions; approximation methods; quantum mechanics of spectroscopy.
CHEM 214	Statistical Thermodynamics [3]	Includes a treatment of statistical mechanical ensembles, applications of equilibrium statistical mechanics to interacting and noninteracting systems and the connection to classical thermodynamics, numerical simulation techniques, and an introduction to topics in nonequilibrium statistical mechanics.
CHEM 215	Chemical Kinetics [3]	The rates and mechanisms of elementary reactions, unimolecular reactions, reactions in the gas phase, in solutions and on surfaces. Energy and charge transfer phenomena. Kinetics of surface and enzyme catalysis. Kinetic modeling of multistep reactions.
CHEM 225	Molecular Electronic Structure [3]	Modern theoretical methods, algorithms, and computational tools for understanding the energetics and properties of molecules. This includes molecular mechanics, semi-empirical methods, but with a focus on ab initio based approaches. Electronic structure methods such as Hartree-Fock, density functional theory, couples-cluster, and configuration interaction will be introduced.

CHEM 231	Molecular Spectroscopy [3]	Time-dependent quantum mechanics; interaction of radiation with matter; electronic spectra of atoms and molecules; vibrational, rotational, and Raman spectra; magnetic resonance spectroscopy; X-ray, neutron, and electron diffraction. Modern experimental and theoretical methods in spectroscopy.
CHEM 260	Introduction to Scientific Computing [3]	Teaches the tools and principles of scientific computing, covering the Linux operating system, programming tools and editors, shell scripting, data analysis using R, and scientific programming using interpreted and compiled languages. Course involves interactive lecture/laboratory sessions where students will gain experience doing scientific computing on both local and remote computers.
CHEM 270	Academic Writing in Graduate Studies [2]	Designed to increase the writing proficiency of graduate students, with a focus on strategies for reading critically, organizing and developing thoughts, choosing appropriate vocabulary, and generating and revising writing in a given scientific field. Topics address scientific disciplines. Projects may include writing abstracts, research reports, literature reviews, posters, and grant proposals.
CHEM 281	Molecular Dynamics and Biomolecular Simulation [4]	Uses lectures and laboratory exercises to teach the practice of biomolecular modeling. Topics include classical molecular dynamics, molecular mechanics and visualization. The laboratories involve simulations of systems including water, DNA and proteins. The course includes two projects for the students to apply molecular simulation to their graduate research.
CHEM 290	Current Topics in Physics and Chemistry [3]	Exploration of current research directions, problems, and techniques in molecular and materials chemistry, physics, and engineering. Course format emphasizes student-led presentation, analysis, and discussion of reading assignments from the current and recent scientific literature. Topics are determined by the instructor and change each semester.
CHEM 291	Physics and Chemistry Seminar [1]	Graduate seminar in physics and chemistry. *S/U grading only.*
CHEM 295	Graduate Research [1 - 15]	Supervised research. *Permission of instructor required. S/U grading only.*
CHEM 298	Directed Group Study [1 - 6]	Group project under faculty supervision. *Permission of instructor required. S/U grading only.*
CHEM 299	Directed Independent Study [1 - 6]	Independent project under faculty supervision. *Permission of instructor required. S/U grading only.*

Graduate courses in other disciplines

PHYS 210	Electrodynamics and Optics I [4]	Introduction to electrodynamics. Electrostatics including Poisson and Laplace equations, Green's theorem and different boundary value problems, polarizability, susceptibility and dielectric media. Magnetostatics, Maxwell's equations, plane electromagnetic waves, polarization of light, electromagnetic radiation in different media.
PHYS 241	Condensed Matter Physics [4]	An introduction to the physics of materials designed for graduate students in physics or chemistry. The course will cover traditional solid state physics and include topics in soft matter. This class will examine the relationship between microscopic structure and bulk properties.
QSB 202	Graduate Level Biochemistry [3]	The overall objective of QSB 202 is to teach students fundamental principles and concepts of biochemistry as a scientific discipline at the graduate level. The emphasis will be on the relationship between macromolecular structure and function.
QSB 207	Physical Biochemistry [3]	Physical Biochemistry is the study of properties such as macromolecular folding, multimerization, structure, and ligand binding. This course will instruct students on these, and on the experimental techniques that can quantitatively probe these properties, including hands-on work with multidimensional NMR data. Also included is in-depth discussion of recent biophysical literature.
QSB 294	Responsible Conduct of Research [1]	Seminar covering responsibilities and expectations for researchers as well as advice for success in graduate school and science careers, required for NIH-funded graduate students. *S/U grading only*.