Chemistry

The Chemistry PhD program is designed towards developing within each student the ability to do creative scientific research. Accordingly, the single most important facet of the curriculum for an individual is his or her own research project. In keeping with the goal of fostering an atmosphere of scholarly, independent study, formal course requirements are minimal and vary among disciplines; advisor's tailor course requirements to best prepare the student for the chosen research field.

The Doctoral program includes the following concentrations, each of which has specific degree requirements:

1. **Physical Chemistry:** In general, the Physical Chemistry Graduate Program encompasses analytical, nuclear, biophysical, and theoretical chemistry.
2. **Synthetic Chemistry:** The Synthetic Chemistry Graduate Program includes emphases in either organic or inorganic chemistry
3. **Chemical Biology:** The Chemical Biology Graduate Program covers a range of research areas at the interface of Chemistry and Biology.

Admission to the University

Uniform minimum requirements for admission

The following minimum requirements apply to all programs and will be verified by the Graduate Division:

1. A bachelor's degree or recognized equivalent from an accredited institution;
2. A minimum grade-point average of B or better (3.0);
3. If the applicant comes from a country or political entity (e.g. Quebec) where English is not the official language, adequate proficiency in English to do graduate work, as evidenced by a TOEFL score of at least 570 on the paper-and-pencil test, 230 on the computer-based test, 90 on the iBT test, or an IELTS Band score of at least 7 (note that individual programs may set higher levels for any of these); and
4. Enough undergraduate training to do graduate work in the given field.

Applicants who already hold a graduate degree

The Graduate Council views academic degrees as evidence of broad research training, not as vocational training certificates; therefore, applicants who already have academic graduate degrees should be able to take up new subject matter on a serious level without undertaking a graduate program, unless the fields are completely dissimilar.

Programs may consider students for an additional academic master's or professional master's degree if the additional degree is in a distinctly different field.

Applicants admitted to a doctoral program that requires a master's degree to be earned at Berkeley as a prerequisite (even though the applicant already has a master's degree from another institution in the same or a closely allied field of study) will be permitted to undertake the second master's degree, despite the overlap in field.

The Graduate Division will admit students for a second doctoral degree only if they meet the following guidelines:

1. Applicants with doctoral degrees may be admitted for an additional doctoral degree only if that degree program is in a general area of knowledge distinctly different from the field in which they earned their original degree. For example, a physics PhD could be admitted to a doctoral degree program in music or history; however, a student with a doctoral degree in mathematics would not be permitted to add a PhD in statistics.
2. Applicants who hold the PhD degree may be admitted to a professional doctorate or professional master's degree program if there is no duplication of training involved.

Applicants may only apply to one single degree program or one concurrent degree program per admission cycle.

Any applicant who was previously registered at Berkeley as a graduate student, no matter how briefly, must apply for readmission, not admission, even if the new application is to a different program.

Required documents for admissions applications

1. **Transcripts:** Upload unofficial transcripts with the application for the departmental initial review. Official transcripts of all college-level work will be required **if admitted**. Official transcripts must be in sealed envelopes as issued by the school(s) you have attended. Request a current transcript from every post-secondary school that you have attended, including community colleges, summer sessions, and extension programs.
   If you have attended Berkeley, upload unofficial transcript with the application for the departmental initial review. Official transcript with evidence of degree conferral ***will not*** be required if admitted.
2. **Letters of recommendation:** Applicants can request online letters of recommendation through the online application system. Hard copies of recommendation letters must be sent directly to the program, not the Graduate Division.
3. **Evidence of English language proficiency:** All applicants from countries in which the official language is not English are required to submit official evidence of English language proficiency. This requirement applies to applicants from Bangladesh, Burma, Nepal, India, Pakistan, Latin America, the Middle East, the People's Republic of China, Taiwan, Japan, Korea, Southeast Asia, and most European countries. However, applicants who, at the time of application, have already completed at least one year of full-time academic course work with grades of B or better at a U.S. university may submit an official transcript from the U.S. university to fulfill this requirement. The following courses will not fulfill this requirement: 1) courses in English as a Second Language, 2) courses conducted in a language other than English, 3) courses that will be completed after the application is submitted, and 4) courses of a non-academic nature. If applicants have previously been denied admission to Berkeley on the basis of their English language proficiency, they must submit new test scores that meet the current minimum from one of the standardized tests.

Curriculum

Physical Chemistry Concentration

CHEM 300	Professional Preparation: Supervised Teaching of Chemistry	2
Electives, as per approved individualized study list		

Synthetic Chemistry, Organic Concentration

CHEM 200	Chemistry Fundamentals	1
CHEM 261A	Organic Reactions I	1
CHEM 261B	Organic Reaction II	1
CHEM 261C	Organic Reactions III	1
CHEM 260	Reaction Mechanisms	2
CHEM 300	Professional Preparation: Supervised Teaching of Chemistry	2
Electives, as per approved individualized study list		

Synthetic Chemistry, Inorganic Concentration

CHEM 201	Fundamentals of Inorganic Chemistry	1
CHEM 250A	Introduction to Bonding Theory	1
CHEM 251A	Coordination Chemistry I	1
CHEM 300	Professional Preparation: Supervised Teaching of Chemistry	2
Electives, as per approved individualized study list		

Chemical Biology Concentration

CHEM 200	Chemistry Fundamentals	1
CHEM C271A	Chemical Biology I - Structure, Synthesis and Function of Biomolecules	1
CHEM C271B	Chemical Biology II - Enzyme Reaction Mechanisms	1
CHEM C271C	Chemical Biology III - Contemporary Topics in Chemical Biology	1
CHEM 300	Professional Preparation: Supervised Teaching of Chemistry	2
Electives, as per approved individualized study list		

Chemistry

CHEM 200 Chemistry Fundamentals 1 Unit
Review of bonding, structure, stereochemistry, conformation, thermodynamics and kinetics, and arrow-pushing formalisms.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 201 Fundamentals of Inorganic Chemistry 1 Unit
Review of bonding, structure, MO theory, thermodynamics, and kinetics.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 208 Structure Analysis by X-Ray Diffraction 4 Units
The theory and practice of modern, single-crystal X-ray diffraction. Groups of four students determine the crystal and molecular structure of newly synthesized materials from the College of Chemistry. The laboratory work involves the mounting of crystals and initial evaluation by X-ray diffraction film techniques, the collection of intensity data by automated diffractometer procedures, and structure analysis and refinement.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 8 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 214 Heterocyclic Chemistry 3 Units
Advanced topics in organic chemistry with a focus on the reactivity and synthesis of aromatic heterocycles. Classic and modern methods for the synthesis of indoles, pyridines, furans, pyrroles, and quinolines will be covered, as well as complex, multi-heteroatom ring systems. Applications to medicinal and bioorganic chemistry will be included where appropriate.
Rules & Requirements

Prerequisites: Graduate student standing or consent of instructor. A year of organic chemistry with a grade of B- or better is required for undergraduate enrollment

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Instructor: Maimone

CHEM 220A Thermodynamics and Statistical Mechanics 3 Units
A rigorous presentation of classical thermodynamics followed by an introduction to statistical mechanics with the application to real systems.
Rules & Requirements

Prerequisites: 120B

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 220B Statistical Mechanics 3 Units
Principles of statistical mechanics and applications to complex systems.
Rules & Requirements

Prerequisites: 220A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 221A Advanced Quantum Mechanics 3 Units
Introduction, one dimensional problems, matrix mechanics, approximation methods.
Rules & Requirements

Prerequisites: 120B and 122 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 221B Advanced Quantum Mechanics 3 Units
Time dependence, interaction of matter with radiation, scattering theory. Molecular and many-body quantum mechanics.
Rules & Requirements

Prerequisites: 221A

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 222 Spectroscopy 3 Units
This course presents a survey of experimental and theoretical methods of spectroscopy, and group theory as used in modern chemical research. The course topics include experimental methods, classical and quantum descriptions of the interaction of radiation and matter. Qualitative and quantitative aspects of the subject are illustrated with examples including application of linear and nonlinear spectroscopies to the study of molecular structure and dynamics and to quantitative analysis. This course is offered jointly with 122.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 223A Chemical Kinetics 3 Units
Deduction of mechanisms of complex reactions. Collision and transition state theory. Potential energy surfaces. Unimolecular reaction rate theory. Molecular beam scattering studies.
Rules & Requirements

Prerequisites: 220A (may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM C230 Protein Chemistry, Enzymology, and Bio-organic Chemistry 2 Units
The topics covered will be chosen from the following: protein structure; protein-protein interactions; enzyme kinetics and mechanism; enzyme design. Intended for graduate students in chemistry, biochemistry, and molecular and cell biology.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Hours & Format

Fall and/or spring:
10 weeks - 3 hours of lecture per week
15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Also listed as: MCELLBI C214

CHEM C234 Green Chemistry: An Interdisciplonary Approach to Sustainability 3 Units
Meeting the challenge of global sustainability will require interdisciplinary approaches to research and education, as well as the integration of this new knowledge into society, policymaking, and business. Green Chemistry is an intellectual framework created to meet these challenges and guide technological development. It encourages the design and production of safer and more sustainable chemicals and products.
Rules & Requirements

Prerequisites: One year of chemistry, including a semester of organic chemistry, or consent of instructors based on previous experience

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Summer: 6 weeks - 20 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Instructors: Arnold, Bergman, Guth, Iles, Kokai, Mulvihill, Schwarzman, Wilson

Also listed as: ESPM C234/PB HLTH C234

CHEM C236 Energy Solutions: Carbon Capture and Sequestration 3 Units
After a brief overview of the chemistry of carbon dioxide in the land, ocean, and atmosphere, the course will survey the capture and sequestration of CO2 from anthropogenic sources. Emphasis will be placed on the integration of materials synthesis and unit operation design, including the chemistry and engineering aspects of sequestration. The course primarily addresses scientific and engineering challenges and aims to engage students in state-of-the-art research in global energy challenges.
Rules & Requirements

Prerequisites: Chemistry 4B or 1B, Mathematics 1B, and PHYSICS 7B, or equivalents

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Instructors: Bourg, DePaolo, Long, Reimer, Smit

Also listed as: CHM ENG C295Z/EPS C295Z

CHEM C238 The Berkeley Lectures on Energy: Energy from Biomass 3 Units
After an introduction to the different aspects of our global energy consumption, the course will focus on the role of biomass. The course will illustrate how the global scale of energy guides the biomass research. Emphasis will be places on the integration of the biological aspects (crop selection, harvesting, storage, and distribution, and chemical composition of biomass) with the chemical aspects to convert biomass to energy. The course aims to engage students in state-of-art research.
Rules & Requirements

Prerequisites: BIOLOGY 1A; Chemistry 1B or 4B, Mathematics 1B

Repeat rules: Repeatable when topic changes with consent of instructor.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Instructors: Bell, Blanch, Clark, Smit, C. Somerville

Also listed as: BIO ENG C281/CHM ENG C295A/PLANTBI C224

CHEM 243 Advanced Nuclear Structure and Reactions 3 Units
Selected topics on nuclear structure and nuclear reactions.
Rules & Requirements

Prerequisites: 143 or equivalent and introductory quantum mechanics

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 250A Introduction to Bonding Theory 1 Unit
An introduction to group theory, symmetry, and representations as applied to chemical bonding.
Rules & Requirements

Prerequisites: 200 or 201 or consent of instructor and background in the use of matrices and linear algebra

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 250B Inorganic Spectroscopy 1 Unit
The theory of vibrational analysis and spectroscopy as applied to inorganic compounds.
Rules & Requirements

Prerequisites: 250A or consent of instructor

Hours & Format

Fall and/or spring:
6 weeks - 3 hours of lecture per week
15 weeks - 0 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 251A Coordination Chemistry I 1 Unit
Structure and bonding, synthesis, and reactions of the d-transition metals and their compounds.
Rules & Requirements

Prerequisites: 250A or consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 251B Coordination Chemistry II 1 Unit
Synthesis, structure analysis, and reactivity patterns in terms of symmetry orbitals.
Rules & Requirements

Prerequisites: 251A or consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 252A Organometallic Chemistry I 1 Unit
An introduction to organometallics, focusing on structure, bonding, and reactivity.
Rules & Requirements

Prerequisites: 200 or 201 or consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 252B Organometallic Chemistry II 1 Unit
Applications of organometallic compounds in synthesis with an emphasis on catalysis.
Rules & Requirements

Prerequisites: 252A or consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 253A Materials Chemistry I 1 Unit
Introduction to the descriptive crystal chemistry and electronic band structures of extended solids.
Rules & Requirements

Prerequisites: 200 or 201, and 250A, or consent of instructor

Hours & Format

Fall and/or spring:
6 weeks - 3 hours of lecture per week
15 weeks - 0 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 253B Materials Chemistry II 1 Unit
General solid state synthesis and characterization techniques as well as a survey of important physical phenomena including optical, electrical, and magnetic properties.
Rules & Requirements

Prerequisites: 253A or consent of instructor

Hours & Format

Fall and/or spring:
6 weeks - 3 hours of lecture per week
15 weeks - 0 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 253C Materials Chemistry III 1 Unit
Introduction to surface catalysis, organic solids, and nanoscience. Thermodynamics and kinetics of solid state diffusion and reaction will be covered.
Rules & Requirements

Prerequisites: 253A or consent of instructor

Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Instructors: Somorjai, Yang

CHEM 254 Bioinorganic Chemistry 1 Unit
A survey of the roles of metals in biology, taught as a tutorial involving class presentations.
Hours & Format

Fall and/or spring:
6 weeks - 3 hours of lecture per week
15 weeks - 0 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 260 Reaction Mechanisms 2 Units
Advanced methods for studying organic reaction mechanisms. Topics include kinetic isotope effects, behavior of reactive intermediates, chain reactions, concerted reactions, molecular orbital theory and aromaticity, solvent and substituent effects, linear free energy relationships, photochemistry.
Rules & Requirements

Prerequisites: 200 or consent of instructor

Hours & Format

Fall and/or spring: 10 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Formerly known as: 260A-260B

CHEM 261A Organic Reactions I 1 Unit
Features of the reactions that comprise the vocabulary of synthetic organic chemistry.
Rules & Requirements

Prerequisites: 200 or 201 or consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 261B Organic Reaction II 1 Unit
More reactions that are useful to the practice of synthetic organic chemistry.
Rules & Requirements

Prerequisites: 261A or consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 261C Organic Reactions III 1 Unit
This course will consider further reactions with an emphasis on pericyclic reactions such as cycloadditions, electrocyclizations, and sigmatropic rearrangements.
Rules & Requirements

Prerequisites: 261B or consent of instructor

Hours & Format

Fall and/or spring: 6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 262 Metals in Organic Synthesis 1 Unit
Transition metal-mediated reactions occupy a central role in asymmetric catalysis and the synthesis of complex molecules. This course will describe the general principles of transition metal reactivity, coordination chemistry, and stereoselection. This module will also emphasize useful methods for the analysis of these reactions.
Rules & Requirements

Prerequisites: 261B or consent of instructor

Hours & Format

Fall and/or spring:
6 weeks - 3 hours of lecture per week
15 weeks - 0 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 263A Synthetic Design I 1 Unit
This course will describe the application of modern reactions to the total synthesis of complex target molecules. Natural products, such as alkaloids, terpenes, or polypropionates, as well as theoretically interesting "non-natural" molecules will be covered.
Rules & Requirements

Prerequisites: 262 or consent of instructor

Hours & Format

Fall and/or spring:
6 weeks - 3 hours of lecture per week
15 weeks - 0 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 263B Synthetic Design II 1 Unit
The principles of retrosynthetic analysis will be laid down and the chemistry of protecting groups will be discussed. Special attention will be given to the automated synthesis of biopolymers such as carbohydrates, peptides, and proteins, as well as nucleic acids.
Rules & Requirements

Prerequisites: 263A or consent of instructor

Hours & Format

Fall and/or spring:
6 weeks - 3 hours of lecture per week
15 weeks - 0 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 265 Nuclear Magnetic Resonance Theory and Application 1 Unit
The theory behind practical nuclear magnetic resonance spectroscopy and a survey of its applications to chemical research.
Rules & Requirements

Prerequisites: 200 or 201 or consent of instructor

Hours & Format

Fall and/or spring:
6 weeks - 3 hours of lecture per week
15 weeks - 0 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 268 Mass Spectrometry 2 Units
Principles, instrumentation, and application in mass spectrometry, including ionization methods, mass analyzers, spectral interpretation, multidimensional methods (GC/MS, HPLC/MS, MS/MS), with emphasis on small organic molcules and bioanalytical applications (proteins, peptides, nucleic acids, carbohydrates, noncovalent complexes); this will include the opportunity to be trained and checked out on several open-access mass spectrometers.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Credit Restrictions: Students will receive 1 unit of credit for 268 after taking 266.

Hours & Format

Fall and/or spring: 10 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 270A Advanced Biophysical Chemistry I 1 Unit
Underlying principles and applications of methods for biophysical analysis of biological macromolecules.
Rules & Requirements

Prerequisites: 200 or consent of instructor

Hours & Format

Fall and/or spring: 7.5 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 270B Advanced Biophysical Chemistry II 1 Unit
More applications of methods for biophysical analysis of biological macromolecules.
Rules & Requirements

Prerequisites: 270A or consent of instructor

Hours & Format

Fall and/or spring: 7.5 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM C271A Chemical Biology I - Structure, Synthesis and Function of Biomolecules 1 Unit
This course will present the structure of proteins, nucleic acids, and oligosaccharides from the perspective of organic chemistry. Modern methods for the synthesis and purification of these molecules will also be presented.
Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Also listed as: MCELLBI C212A

CHEM C271B Chemical Biology II - Enzyme Reaction Mechanisms 1 Unit
This course will focus on the principles of enzyme catalysis. The course will begin with an introduction of the general concepts of enzyme catalysis which will be followed by detailed examples that will examine the chemistry behind the reactions and the three-dimensional structures that carry out the transformations.
Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Also listed as: MCELLBI C212B

CHEM C271C Chemical Biology III - Contemporary Topics in Chemical Biology 1 Unit
This course will build on the principles discussed in Chemical Biology I and II. The focus will consist of case studies where rigorous chemical approaches have been brought to bear on biological questions. Potential subject areas will include signal transduction, photosynthesis, immunology, virology, and cancer. For each topic, the appropriate bioanalytical techniques will be emphasized.
Hours & Format

Fall and/or spring: 5 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Also listed as: MCELLBI C212C

CHEM 272A Bio X-Ray I 1 Unit
Theory and application of X-ray crystallography to biomacromolecules.
Rules & Requirements

Prerequisites: 270A-270B or consent of instructor

Hours & Format

Fall and/or spring:
5 weeks - 3 hours of lecture per week
6 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 273A Bio NMR I 1 Unit
Fundamentals of multidimensional NMR spectroscopy (including use of the density matrix for analysis of spin response to pulse sequences) and applications of multidimensional NMR in probing structure, interactions, and dynamics of biological molecules will be described.
Rules & Requirements

Prerequisites: 270A-270B or consent of instructor

Hours & Format

Fall and/or spring: 7.5 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 273B Bio NMR II 1 Unit
Triple resonance methods for determination of protein and nucleic acid resonance assignments, and for generation of structural restraints (distances, angles, H-bonds, etc.). Methods for calculating biomolecular structures from NMR data and the quality of such structures will be discussed.
Rules & Requirements

Prerequisites: 273A

Hours & Format

Fall and/or spring: 7.5 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 295 Special Topics 1 - 3 Units
Lecture series on topics of current interest. Recently offered topics: Natural products synthesis, molecular dynamics, statistical mechanics, molecular spectroscopy, structural biophysics, organic polymers, electronic structure of molecules and bio-organic chemistry.
Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

CHEM 298 Seminars for Graduate Students 1 - 3 Units
In addition to the weekly Graduate Research Conference and weekly seminars on topics of interest in biophysical, organic, physical, nuclear, and inorganic chemistry, there are group seminars on specific fields of research. Seminars will be announced at the beginning of each semester.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-3 hours of seminar per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

CHEM 299 Research for Graduate Students 1 - 9 Units
The facilities of the laboratory are available at all times to graduate students pursuing original investigations toward an advanced degree at this University. Such work is ordinarily in collaboration with a member of the staff.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 300 Professional Preparation: Supervised Teaching of Chemistry 2 Units
Discussion, curriculum development, class observation, and practice teaching in chemistry.
Rules & Requirements

Prerequisites: Graduate standing and appointment as a graduate student instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Chemistry/Professional course for teachers or prospective teachers

Grading: Letter grade.

CHEM 301 Pre-High School Chemistry Classroom Immersion 1 Unit
Provides training and opportunity for graduate students to make presentations in local public schools. Training ensures that presenters are aware of scientific information mandated by the State of California for particular grade levels, and that presentations are intellectually stimulating, relevant to the classroom students' interests, and age-appropriate. Time commitment an average of two to three hours/week, but actual time spent is concentrated during preparation and classroom delivery of presentations, which are coordinated between teachers' needs and volunteers' availability.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Chemistry/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructor: Bergman

CHEM 301A Undergraduate Lab Instruction 2 Units
Tutoring of students in 1AL and 1B laboratory. Students attend one hour of the regular GSI preparatory meeting and hold one office hour per week to answer questions about laboratory assignments.
Rules & Requirements

Prerequisites: Junior standing or consent of instructor; 1A, 1AL, and 1B with grades of B- or higher

Repeat rules: Course may be repeated once for credit.Course may be repeated for a maximum of 4 units.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 4 hours of tutorial per week

Additional Details

Subject/Course Level: Chemistry/Professional course for teachers or prospective teachers

Grading: Offered for pass/not pass grade only.

CHEM 301B Undergraduate Chemistry Instruction 2 Units
Tutoring of students in 1A-1B. Students attend a weekly meeting on tutoring methods at the Student Learning Center and attend 1A-1B lectures.
Rules & Requirements

Prerequisites: Sophomore standing; 1A, 1AL, and 1B with grades of B- or higher

Repeat rules: Course may be repeated once for credit.Course may be repeated for a maximum of 4 units.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 5 hours of tutorial per week

Additional Details

Subject/Course Level: Chemistry/Professional course for teachers or prospective teachers

Grading: Offered for pass/not pass grade only.

Formerly known as: 301

CHEM 301C Chemistry 3 Lab Assistant 2 Units
Undergraduate organic lab assistants help in the teaching of the 3AL and 3BL. Each week students attend a laboratory preparation meeting for one hour, assist in the laboratory section for four hours, and help in the development of experiments for one hour.
Rules & Requirements

Prerequisites: Sophomore standing and consent of instructor; 3B and 3BL with grades of B or higher

Repeat rules: Course may be repeated once for credit.Course may be repeated for a maximum of 4 units.

Hours & Format

Fall and/or spring: 15 weeks - 5 hours of laboratory and 1 hour of discussion per week

Additional Details

Subject/Course Level: Chemistry/Professional course for teachers or prospective teachers

Grading: Offered for pass/not pass grade only.

CHEM 301D Undergraduate Chemistry Course Instruction 1 - 2 Units
Tutoring of students enrolled in an undergraduate chemistry course.
Rules & Requirements

Prerequisites: Junior standing or consent of instructor; completion of tutored course with a grade of B- or better

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2-4 hours of tutorial per week

Additional Details

Subject/Course Level: Chemistry/Professional course for teachers or prospective teachers

Grading: Offered for pass/not pass grade only.

CHEM 301T Undergraduate Preparation for Teaching or Instruction in Teaching 2 Units
Rules & Requirements

Prerequisites: Junior standing, overall GPA 3.1, and consent of instructor

Repeat rules: Course may be repeated for a maximum of 8 units.Course may be repeated for a maximum of 8 units.

Hours & Format

Fall and/or spring: 15 weeks - 2-3 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Professional course for teachers or prospective teachers

Grading: Letter grade.

CHEM 301W Supervised Instruction of Chemistry Scholars 2 Units
Tutoring of students in the College of Chemistry Scholars Program who are enrolled in general or organic chemistry. Students attend a weekly meeting with instructors.
Rules & Requirements

Prerequisites: Sophomore standing and consent of instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of independent study and 4-5 hours of tutorial per week

Additional Details

Subject/Course Level: Chemistry/Professional course for teachers or prospective teachers

Grading: Offered for pass/not pass grade only.

CHEM 375 Professional Preparation: Supervised Teaching of Chemistry 2 Units
Discussion, curriculum development, class observation, and practice teaching in chemistry.
Rules & Requirements

Prerequisites: Graduate standing and appointment as a graduate student instructor

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of seminar per week

Additional Details

Subject/Course Level: Chemistry/Professional course for teachers or prospective teachers

Grading: Letter grade.

CHEM 602 Individual Study for Doctoral Students 1 - 8 Units
Individual study in consultation with the major field adviser, intended to provide an opportunity for qualified students to prepare themselves for the various examinations required of candidates for the Ph.D. degree. May not be used for unit or residence requirements for the doctoral degree.
Rules & Requirements

Repeat rules: Course may be repeated for credit. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 1-8 hours of independent study per week

Summer: 8 weeks - 1.5-15 hours of independent study per week

Additional Details

Subject/Course Level: Chemistry/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.