Chemistry

Overview

The Chemistry Department at UC Berkeley provides the opportunity for an undergraduate student to obtain thorough and fundamental knowledge of all fields of chemistry. There are lecture courses in the general areas of inorganic, organic, and physical chemistry. The department offers many more specialized courses, including analytical, nuclear, and biophysical chemistry, and chemical biology. Laboratory experience is provided in inorganic and organic synthesis, analytical methods, physical-chemical measurements, spectroscopy, biochemical engineering, and chemical methods in nuclear technology. Independent and original work is stressed in the laboratories and modern equipment is available to carry out the work. The equipment and techniques available to the undergraduate students include nuclear magnetic resonance; electron paramagnetic resonance; visible, ultraviolet, and infrared spectrometers; X-ray diffraction; mass spectrometry; high-vacuum, high-pressure, and low-temperature equipment; gas chromatography; and others. Many of these instruments are interfaced directly to computers. In other cases, data analysis and graphics displays are accomplished using the College of Chemistry Computer Facility. In addition, arrangements can be made to use many specialized research techniques available on the campus.

More important than the formal lecture and laboratory courses is the intellectual environment provided by the department. There is a student commons room that makes it convenient for students to learn from one another. The Chemistry Library has an excellent collection of books, journals, and reference materials. Graduate student instructors, who are themselves graduate students working toward PhD degrees, are further sources of scientific information and help. Faculty members are available as academic advisors and hold office hours for consultation about their courses. They are also willing to discuss chemistry, science, career opportunities, and even philosophy. The best way to take full advantage of the scientific opportunities available in the department is to join a research group. This can be done through courses for advanced undergraduates or simply as an employee.

Graduate study at Berkeley is mainly individual learning in a research field chosen by the student. New students begin research shortly after arriving in Berkeley and usually complete their thesis work in about five years or less. Courses are normally taken only during the first two years, but seminars are a rich source of new knowledge throughout the entire graduate career. All graduate students are required to be graduate student instructors for a minimum of three semesters. Teaching is not only an essential service; it is an excellent method for learning. Financial support for graduate students is provided by graduate student instructor positions, research assistantships, and fellowships.

There is currently an active graduate student organization whose membership includes all graduate students in the college. The overall goal of this organization is to involve graduate students in the department and to provide a sense of community among the various separate sub-disciplines in the college as well as to increase communication among faculty, administration, and students.

Undergraduate Programs

Chemistry (https://guide.berkeley.edu/archive/2024-25/undergraduate/degree-programs/chemistry/): BA (offered through the College of Letters and Science), BS (offered through the College of Chemistry), Minor

Chemical Biology (https://guide.berkeley.edu/archive/2024-25/undergraduate/degree-programs/chemical-biology/): BS

Chemical Engineering: (http://guide.berkeley.edu/undergraduate/degree-programs/chemical-engineering/) BS, Minor

Graduate Program

Chemistry (https://guide.berkeley.edu/archive/2024-25/graduate/degree-programs/chemistry/): PhD

Chemistry

CHEM 1A General Chemistry 3 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Stoichiometry of chemical reactions, quantum mechanical description of atoms, the elements and periodic table, chemical bonding, real and ideal gases, thermochemistry, introduction to thermodynamics and equilibrium, acid-base and solubility equilibria, introduction to oxidation-reduction reactions, introduction to chemical kinetics.

Rules & Requirements

Prerequisites: High school chemistry recommended

Credit Restrictions: Students will receive no credit for CHEM 1A after completing CHEM 1AD or CHEM 4A. A deficient grade in CHEM 1A may be removed by taking CHEM 1AD.

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture, 1-1 hours of discussion, and 0-2 hours of voluntary per week

Summer: 8 weeks - 6-6 hours of lecture, 2-2 hours of discussion, and 0-2 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 1AD General Chemistry (Digital) 3 Units

Terms offered: Spring 2016
An interactive general chemistry course that uses modern digital technology, offered in a smaller classroom setting to facilitate student participation and foster an engaging learning environment. Topics cover the Chemistry 1A curriculum, ranging from quantum mechanics and interactions of atoms and molecules to properties and equilibria of bulk materials. The course involves a blend of classroom lectures and peer learning with substantial web-based assignments and resources including web access to lecture videos. Lecture time is also devoted to ChemQuiz peer discussions and live demos of chemical properties and processes, which students generally find to be illuminating and valuable learning experiences.

Rules & Requirements

Prerequisites: High school chemistry recommended

Credit Restrictions: Students will receive no credit for Chemistry 1AD after completing Chemistry 1A or 4A. A deficient grade in Chemistry 1A may be removed by taking Chemistry 1AD.

Hours & Format

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

Summer: 8 weeks - 6 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Pines, Slack

CHEM 1AL General Chemistry Laboratory 2 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
An experimental approach to chemical sciences with emphasis on developing fundamental, reproducible laboratory technique and a goal of understanding and achieving precision and accuracy in laboratory experiments. Proper use of laboratory equipment and standard wet chemical methods are practiced. Areas of investigations include chemical equilibria, spectroscopy, nanotechnology, green chemistry, and thermochemistry. Completion of, or concurrent enrollment in 1A is required.

Rules & Requirements

Prerequisites: CHEM 1A, with min grade of C-; or co-enrollment in CHEM 1A; or AP CHEM with min score of 4; or CHEM HL IB with min score of 5; or GCE A-Level CHEM with min grade of C

Credit Restrictions: Students will receive no credit for 1AL after taking 4A.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture, 3 hours of laboratory, and 0 hours of voluntary per week

Summer: 8 weeks - 2 hours of lecture, 6 hours of laboratory, and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

CHEM 1B General Chemistry 4 Units

Terms offered: Spring 2025, Spring 2023, Spring 2022
Introduction to chemical kinetics, electrochemistry, properties of the states of matter, binary mixtures, thermodynamic efficiency and the direction of chemical change, quantum mechanical description of bonding introduction to spectroscopy. Special topics: Research topics in modern chemistry and biochemistry, chemical engineering.

Rules & Requirements

Prerequisites: CHEM 1A and CHEM 1AL with min grades of C-; or CHEM 4A with min grade of C-; or AP CHEM with min score of 4; or CHEM HL IB with min score of 5; or GCE A-Level CHEM with min grade of C

Credit Restrictions: Students will receive no credit for Chemistry 1B after completing Chemistry 4B.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture, 4 hours of laboratory, and 0 hours of voluntary per week

Summer: 8 weeks - 6 hours of lecture, 8 hours of laboratory, and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM W1A General Chemistry 3 Units

Terms offered: Summer 2013 10 Week Session, Summer 2013 8 Week Session, Summer 2012 8 Week Session
Stoichiometry of chemical reactions, quantum mechanical description of atoms, the elements and periodic table, chemical bonding, real and ideal gases, thermochemistry, introduction to thermodynamics and equilibrium, acid-base and solubility equilibria, introduction to oxidation-reduction reactions, introduction to chemical kinetics. This course is web-based.
Rules & Requirements

Prerequisites: High school chemistry is recommended

Credit Restrictions: Students will receive no credit for CHEM W1A after passing CHEM 1A or CHEM 4A. A deficiency in CHEM 1A may be removed by taking CHEM W1A.

Hours & Format

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

Summer: 8 weeks - 6 hours of web-based lecture and 2 hours of web-based discussion per week

Online: This is an online course.

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 3A Chemical Structure and Reactivity 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Introduction to organic chemical structures, bonding, and chemical reactivity. The organic chemistry of alkanes, alkyl halides, alcohols, alkenes, alkynes, and organometallics.
Rules & Requirements

Prerequisites: CHEM 1A with min grade of C-; or AP Chem with min score of 4; or Chem HL IB with min score of 5; or GCE A-Level Chem with min grade of C

Credit Restrictions: Students will receive no credit for CHEM 3A after completing CHEM 12A; a deficient grade in CHEM 12A may be removed by taking CHEM 3A- will restrict credit if completed before Chemistry 3A.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 0 hours of voluntary per week

Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 3AL Organic Chemistry Laboratory 2 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Introduction to the theory and practice of methods used in the organic chemistry laboratory. An emphasis is placed on the separation and purification of organic compounds. Techniques covered will include extraction, distillation, sublimation, recrystalization, and chromatography. Detailed discussions and applications of infrared and nuclear magnetic resonance spectroscopy will be included.
Rules & Requirements

Prerequisites: CHEM 1A and CHEM 1AL with min grades of C-; or CHEM 4A with min grade of C-; or AP CHEM with min score of 4; or CHEM HL IB with min score of 5; or GCE A-Level CHEM with min grade of C. Corequisite: CHEM 3A with min grade of C- or coenrollment in CHEM 3A

Credit Restrictions: Students will receive no credit for CHEM 3AL after taking CHEM 12A.

Hours & Format

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

Summer: 8 weeks - 2 hours of lecture and 8 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

CHEM 3B Chemical Structure and Reactivity 4 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
Conjugation, aromatic chemistry, carbonyl compounds, carbohydrates, amines, carboxylic acids, amino acids, peptides, proteins, and nucleic acid chemistry. Ultraviolet spectroscopy and mass spectrometry will be introduced.
Rules & Requirements

Prerequisites: CHEM 3A with min grade of C-

Credit Restrictions: Students will receive no credit for 3B after taking 12B.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 0 hours of voluntary per week

Summer: 8 weeks - 6 hours of lecture, 2 hours of discussion, and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 3BL Organic Chemistry Laboratory 2 Units

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025
The synthesis and purification of organic compounds will be explored. Natural product chemistry will be introduced. Advanced spectroscopic methods including infrared, ultraviolet, and nuclear magnetic resonance spectroscopy and mass spectrometry will be used to analyze products prepared and/or isolated. Qualitative analysis of organic compounds will be covered.

Rules & Requirements

Prerequisites: CHEM 3AL with min grade of C-. Co-requisite: CHEM 3B with min grade of C- or co-enrollment in CHEM 3B

Credit Restrictions: Students will receive no credit for CHEM 3BL after taking CHEM 12B.

Hours & Format

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

Summer: 8 weeks - 2 hours of lecture and 8 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

CHEM N3AL Organic Chemistry Laboratory 2 Units

Terms offered: Summer 2018 8 Week Session, Summer 2017 8 Week Session, Summer 2015 8 Week Session
Introduction to the theory and practice of methods used in the organic chemistry laboratory. An emphasis is placed on the separation and purification of organic compounds. Techniques covered will include extraction, distillation, sublimation, recrystalization, and chromatography. Detailed discussions and applications of infrared and nuclear magnetic resonance spectroscopy will be included.

Rules & Requirements

Prerequisites: CHEM 1A and CHEM 1AL with min grades of C-; or CHEM 4A with min grade of C-; or AP CHEM with min score of 4; or CHEM HL IB with min score of 5; or GCE A-Level CHEM with min grade of C. Co-requisite: CHEM 3A with min grade of C- or co-enrollment in CHEM 3A. CHEM 4A with approval of instructor

Credit Restrictions: Students will receive no credit for CHEM N3AL after taking CHEM 12A.

Hours & Format

Summer: 8 weeks - 2 hours of web-based lecture and 8 hours of laboratory per week

Online: This is an online course.

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructor: Pedersen

CHEM 4A General Chemistry and Quantitative Analysis 5 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Series is intended for majors in physical, biological sciences, and engineering. It presents the foundation principles of chemistry, including stoichiometry, ideal and real gases, acid-base and solubility equilibria, oxidation-reduction reactions, thermochemistry, entropy, nuclear chemistry and radioactivity, the atoms and elements, the periodic table, quantum theory, chemical bonding, molecular structure, chemical kinetics, and descriptive chemistry. Examples and applications will be drawn from diverse areas of interest such as atmospheric, environmental, materials, polymer and computational chemistry, and biochemistry. Laboratory emphasizes quantitative work. Equivalent to 1A-1B plus 15 as prerequisite for further courses in chemistry.

Rules & Requirements

Prerequisites: High school chemistry; calculus (may be taken concurrently); high school physics is recommended

Credit Restrictions: Students will receive no credit for 4A after taking 1A. Deficiency in 4A may be removed by successfully completing 1A and 1AL together in the same semester.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 4 hours of laboratory, and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 4B General Chemistry and Quantitative Analysis 5 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Series is intended for majors in physical, biological sciences, and engineering. It presents the foundation principles of chemistry, including stoichiometry, ideal and real gases, acid-base and solubility equilibria, oxidation-reduction reactions, thermochemistry, entropy, nuclear chemistry and radioactivity, the atoms and elements, the periodic table, quantum theory, chemical bonding, molecular structure, chemical kinetics, and descriptive chemistry. Examples and applications will be drawn from diverse areas of interest such as atmospheric, environmental, materials, polymer and computational chemistry, and biochemistry. Laboratory emphasizes quantitative work. Equivalent to 1A-1B plus 15 as prerequisite for further courses in chemistry.

Rules & Requirements

Prerequisites: High school chemistry; calculus (may be taken concurrently); high school physics is recommended

Credit Restrictions: Deficiency in 4B may be removed by successfully completing 15.

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture, 4-4 hours of laboratory, and 0-2 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 12A Organic Chemistry 5 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
A study of all aspects of fundamental organic chemistry, including nomenclature, chemical and physical properties, reactions and syntheses of the major classes of organic compounds. The study includes theoretical aspects, reaction mechanisms, multistep syntheses, and the chemistry of polycyclic and heterocyclic compounds. This course is more extensive and intensive than 3A-3B and includes a greater emphasis on reaction mechanisms and multistep syntheses. 12A (F); 12B (SP)

Rules & Requirements

Prerequisites: 12A: 1B or 4B with grade of C- or higher; 12B: 12A with grade of C- or higher. For students majoring in chemistry or a closely related field such as chemical engineering or molecular and cell biology

Credit Restrictions: Students will receive no credit for 12A after taking both 3A and 3AL. Deficiency in 12A may be removed by successfully completing 3A and 3AL in the same semester. Students will receive no credit for 12A after taking 112A. Chem 12A is formerly known as Chem 112A.

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture, 1-1 hours of discussion, 5-5 hours of laboratory, and 0-2 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Chemistry 112A

CHEM 12B Organic Chemistry 5 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
A study of all aspects of fundamental organic chemistry, including nomenclature, chemical and physical properties, reactions and syntheses of the major classes of organic compounds. The study includes theoretical aspects, reaction mechanisms, multistep syntheses, and the chemistry of polycyclic and heterocyclic compounds. This course is more extensive and intensive than 3A-3B and includes a greater emphasis on reaction mechanisms and multistep syntheses. 12A (F); 12B (SP)
Rules & Requirements

Prerequisites: 12A: 1B or 4B with grade of C- or higher. 12B: 12A with grade of C- or higher. For students majoring in chemistry or a closely related field such as chemical engineering or molecular and cell biology

Credit Restrictions: Students will receive no credit for 12B after taking both 3B and 3BL. Deficiency in 12B may be removed by successfully completing 3B and 3BL in the same semester. Students will receive no credit for 12B after taking 112B. Chem 12B is formerly known as Chem 112B.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, 5 hours of laboratory, and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Chemistry 112B

CHEM 15 Analytical and Bioanalytical Chemistry 3 Units

Terms offered: Fall 2018, Fall 2017, Fall 2016
An introduction to analytical and bioanalytical chemistry including background in statistical analysis of data, acid-base equilibria, electrochemical, spectrometric, and chromatographic methods of analysis and some advanced topics in bioanalytical chemistry such as micro-fluidics, bioassay techniques, and enzymatic biosensors.
Rules & Requirements

Prerequisites: 1A and 1AL or equivalent

Credit Restrictions: Deficiency in 15 may be removed by successfully completing 4B.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 24 Freshman Seminar 1 Unit

Terms offered: Fall 2024, Spring 2024, Fall 2023
The Freshman Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small seminar setting. Freshman seminars are offered in all campus departments, and topics may vary from department to department and semester to semester. Enrollment limited to 15 freshmen.
Rules & Requirements

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

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final Exam To be decided by the instructor when the class is offered.

CHEM 32 Preparation for General Chemistry 2 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Foundation and preparation for General Chemistry. Topics and concepts include elements, atoms, molecules, chemical reactions, chemical calculations, properties of gases and gas laws; thermodynamics, acid/base chemical equilibrium, and periodic trends. In addition, by practicing learning as a process, students will cultivate the habits, strategies, and mindset necessary to succeed in the sciences. Through rigorous practice and guided reflection, students will grow in their ability to master the subject matter and hone their disposition toward scientific learning.
Rules & Requirements

Credit Restrictions: Students will receive no credit for CHEM 32 after taking and passing any other Chemistry course.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Summer:
6 weeks - 5 hours of lecture and 2 hours of discussion per week
10 weeks - 3 hours of lecture and 3 hours of discussion per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam required, with common exam group.

CHEM 32L Preparation for General Chemistry Laboratory 1 Unit

Terms offered: Prior to 2007
An introduction to the experimental nature of chemistry. An emphasis is placed on gaining familiarity with equipment and experience with the rigorous approaches used in Chemistry laboratory courses. Areas of investigation include scientific calculations and statistical analysis, analytical measurements, acid-base chemistry, titration, equilibrium, solubility, and green chemistry.
Rules & Requirements

Prerequisites: Must be concurrently enrolled in Chem 32

Credit Restrictions: Students will receive no credit for CHEM 32L after completing CHEM 1AL. A deficient grade in CHEM 32L may be removed by taking CHEM 1AL.

Hours & Format

Summer: 6 weeks - 6 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

CHEM 34 Preparation for General Chemistry for CoC Majors 4 Units

Terms offered: Summer 2022 Second 6 Week Session
This course is designed to help develop fundamental laboratory techniques, study habits, chemical vocabulary, and knowledge of chemistry concepts needed to succeed in CHEM 4A. Students in the course will also come to know and belong to the larger College of Chemistry community, through panel discussions with CoC faculty, students, and staff, and immersion in current research via weekly lab tours and research talks from professors and graduate students. After completing the course, you will understand essential chemistry concepts relevant to CHEM 4A, including chemical calculations, statistics, quantitative analysis, models of atoms, the periodic table, molecules and chemical bonds, acid-base chemistry, thermochemistry, and equilibrium.
Rules & Requirements

Prerequisites: Students must be enrolled in a College of Chemistry major (Chemistry, Chemical Biology, or Chemical Engineering) to take CHEM 34. Nonmajors should enroll in CHEM 32

Hours & Format

Summer: 6 weeks - 8 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

CHEM 49 Supplementary Work in Lower Division Chemistry 1 - 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Students with partial credit in lower division chemistry courses may, with consent of instructor, complete the credit under this heading.
Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Summer:
6 weeks - 1-6 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

CHEM 96 Introduction to Research and Study in the College of Chemistry 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023
Introduces sophomores and new transfer students to research activities and programs of study in the College of Chemistry. Includes lectures by faculty, an introduction to college library and computer facilities, the opportunity to meet alumni and advanced undergraduates in an informal atmosphere, and discussion of college and campus resources.
Rules & Requirements

Prerequisites: Sophomore or junior standing in the College of Chemistry, or consent of instructor

Credit Restrictions: Students will receive no credit for CHEM 96 after completing CHEM C96.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam required.

CHEM 98 Supervised Group Study 1 - 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Group study of selected topics.
Rules & Requirements

Prerequisites: Consent of instructor

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

CHEM 98W Directed Group Study 1 Unit

Terms offered: Fall 2020, Fall 2019, Fall 2018
Topics vary with instructor. Enrollment restrictions apply.
Rules & Requirements

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of directed group study per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

CHEM 100 Communicating Chemistry 2 Units

Terms offered: Spring 2011, Spring 2010, Spring 2009
For undergraduate and graduate students interested in improving their ability to communicate their scientific knowledge by teaching chemistry in elementary schools. The course will combine instruction in inquiry-based chemistry teaching methods and learning pedagogy with 10 weeks of supervised teaching experience in a local school classroom. Thus, students will practice communicating scientific knowledge and receive mentoring on how to improve their presentations. Approximately three hours per week, including time spent in school classrooms.
Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of fieldwork per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: 20

CHEM 101 Greener Solutions: A Safer Design Partnership 3 Units

Terms offered: Prior to 2007
Green chemistry seeks to promote the design and adoption of safer chemicals and materials. Their
development and adoption depends on solving a number of design and selection challenges. The Greener
Solutions course guides interdisciplinary teams undergraduate students to solve these challenges in a
specific application
Objectives & Outcomes

Course Objectives: 1. Understand the principles of green chemistry and bio-inspired design and be able to apply them in
developing safer alternatives to a hazardous chemical or material in a specific application;
2. Understand principles of chemical exposure, hazard and risk and be able to apply them in the process of
evaluating alternatives to a chemical of concern;
3. Effectively access information and use tools to evaluate and compare the hazard profiles of chemicals
and materials;
4. Frame research questions and propose solutions, working in the applied setting of a partner company's
challenge; and
5. Communicate complex technical ideas clearly and effectively in written and oral form.
This 4-unit interdisciplinary, project-based course is intended for undergraduate students in public health,
chemical engineering, chemistry, environmental studies, and engineering. The course draws on
students' disciplinary expertise and teaches new skills to identify safer alternatives to hazardous chemicals
currently used in a product or manufacturing process

Student Learning Outcomes: Student teams complete interim assignments during the six-week, session-long research project, which culminates in a final report and presentation. While class lectures, discussion and assignments support the
technical aspects of the project, significant emphasis is also placed on developing the requisite processoriented skills: gathering information, working in teams, and communicating effectively in both written and oral forms.

Rules & Requirements

Prerequisites: Advanced undergraduate; general chemistry or equivalent knowledge. Recommended: General Chemistry (CHEM 1A, 1B, 4A, 4B)

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

Summer: 6 weeks - 3 hours of lecture, 3 hours of demonstration, and 3 hours of directed group study per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

CHEM 102 Foundations of Discovery Learning for College of Chemistry Transfer Students 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023
This course is offered to incoming junior transfer students majoring in chemistry, chemical biology, or chemical and biomolecular engineering within the College of Chemistry (CoC) at UC Berkeley. The course
is designed to assist transfer students with their transition into the CoC through: 1) discussions around best learning practices, stress management, CoC coursework, and careers, 2) interactions with the CoC community, including personalized mentorship from graduate students and faculty, and 3) rigorous preparation for creating and participating in discovery learning experiences, such as research or industrial internships. Students in the course will complete assignments relating to professional development and discovery learning.
Rules & Requirements

Prerequisites: Students must be junior transfers enrolled in a College of Chemistry major (Chemistry, Chemical Biology, or Chemical Engineering)

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

CHEM 103 Inorganic Chemistry in Living Systems 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2023
The basic principles of metal ions and coordination chemistry applied to the study of biological systems.
Rules & Requirements

Prerequisites: Chemistry 3A or 112A. Chemistry majors can only count 2 of the 3 units towards their Allied Subject requirement

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 104A Advanced Inorganic Chemistry 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
The chemistry of metals and nonmetals including the application of physical chemical principles.

Rules & Requirements

Prerequisites: 1B, 4B, or 3A; 104A is prerequisite to 104B

Credit Restrictions: 104A: No restrictions; 104B: Chemical Biology majors can only count 2 of the 3 units towards their Allied Subject requirement for 104B after taking 103.

Hours & Format

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

Summer: 8 weeks - 6 hours of lecture and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 104B Advanced Inorganic Chemistry 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
The chemistry of metals and nonmetals including the application of physical chemical principles.

Rules & Requirements

Prerequisites: 104A or consent of instructor. Chemical Biology majors can only count 2 of the 3 units towards their Allied Subject requirement for 104B after taking 103

Hours & Format

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

Summer: 8 weeks - 6 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 105 Instrumental Methods in Analytical Chemistry 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Principles, instrumentation and analytical applications of atomic spectroscopies, mass spectrometry, separations, electrochemistry and micro-characterization. Discussion of instrument design and capabilities as well as real-world problem solving with an emphasis on bioanalytical, environmental, and forensic applications. Hands-on laboratory work using modern instrumentation, emphasizing independent projects involving real-life samples and problem solving.

Rules & Requirements

Prerequisites: 4B; or 1B and 15; or 1B and a UC GPA of 3.3 or higher

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 108 Inorganic Synthesis and Reactions 4 Units

Terms offered: Spring 2025, Fall 2022, Spring 2022
The preparation of inorganic compounds/materials using vacuum line, air-and moisture-exclusion, electrochemical, high-pressure, colloidal, solid state and other synthetic techniques. Kinetic and mechanistic studies of inorganic compounds/materials.

Rules & Requirements

Prerequisites: 4B or 15; 104B with grade of C- or higher, or 103; Chem C150 recommended

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM C110L General Biochemistry and Molecular Biology Laboratory 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Experimental techniques of biochemistry and molecular biology, designed to accompany the lectures in Molecular and Cell Biology 100B and 110.

Rules & Requirements

Prerequisites: 110 (may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 2-2 hours of lecture and 6-8 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Also listed as: MCELLBI C110L

CHEM 113 Advanced Mechanistic Organic Chemistry 3 Units

Terms offered: Spring 2025, Fall 2022, Fall 2020
Advanced topics in mechanistic and physical organic chemistry typically including kinetics, reactive intermediates, substitution reactions, linear free energy relationships, orbital interactions and orbital symmetry control of reactions, isotope effects, and photochemistry.

Rules & Requirements

Prerequisites: 3B or 112B with a minimum grade of B- or consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 114 Advanced Synthetic Organic Chemistry 3 Units

Terms offered: Spring 2024, Spring 2022, Spring 2020
Advanced topics in synthetic organic chemistry with a focus on selectivity. Topics include reductions, oxidations, enolate chemistry and the aldol reaction, reactions of non-stablized anions, olefination reactions, pericyclic reactions and application to the synthesis of complex structures.

Rules & Requirements

Prerequisites: 3B or 112B with a minimum grade of B- or consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 115 Organic Chemistry--Advanced Laboratory Methods 4 Units

Terms offered: Fall 2025, Summer 2025 Second 6 Week Session, Spring 2025
Advanced synthetic methods, chemical and spectroscopic structural methods, designed as a preparation for experimental research.

Rules & Requirements

Prerequisites: Chem 12B with a grade of C- or higher. Chem 3B and 3BL may be considered with a grade of C- or higher along with instructor consent

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 11 hours of laboratory per week

Summer:
6 weeks - 2.5 hours of lecture and 27.5 hours of laboratory per week
8 weeks - 2 hours of lecture and 20.5 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

CHEM 120A Physical Chemistry 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Kinetic, potential, and total energy of particles and forces between them; principles of quantum theory, including one-electron and many-electron atoms and its applications to chemical bonding, intermolecular interactions, and elementary spectroscopy.
Rules & Requirements

Prerequisites: 4B or equivalent; Physics 7B or 8B; Mathematics 53; Mathematics 54 or consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 120B Physical Chemistry 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Statistical mechanics, thermodynamics, equilibrium and applications to chemical systems: states of matter, solutions and solvation, chemical kinetics, molecular dynamics, and molecular transport.
Rules & Requirements

Prerequisites: 120A (or may be taken concurrently); 4B or equivalent; Mathematics 53; Mathematics 54 (may be taken concurrently); Physics 7B or 8B

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 121 Introduction to Computational Chemistry 3 Units

Terms offered: Spring 2025, Spring 2023, Fall 2021
This course demonstrates how computers are used to solve modern problems in physical chemistry. It focuses first on methods of electronic structure theory that reveal details of molecular structure and energetics, and secondly on simulation methods that explore fluctuations and dynamics of complex systems comprising many molecules. Students will use MATLAB to implement these numerical approaches for illustrative problems. No prior programming experience is required.
Rules & Requirements

Prerequisites: Chem 120A and Chem 120B are very strongly recommended as prerequisites, or co-requisites

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture and 1-2 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

CHEM 122 Quantum Mechanics and Spectroscopy 3 Units

Terms offered: Fall 2025, Fall 2023, Fall 2022
Postulates and methods of quantum mechanics and group theory applied to molecular structure and spectra.
Rules & Requirements

Prerequisites: 120A

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 125 Physical Chemistry Laboratory 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Experiments in thermodynamics, kinetics, molecular structure, and general physical chemistry.

Rules & Requirements

Prerequisites: Two of the following: 120A, 120B, C130, or 130B with grades of C- or higher (one of which may be taken concurrently)

Credit Restrictions: Deficiency in 125 may be removed by successfully completing C182. Consent of instructor is required to enroll in 125 after completing C182 or EPS C182.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 130B Biophysical Chemistry 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
The weekly one-hour discussion is for problem solving and the application of calculus in physical chemistry. Molecular structure, intermolecular forces and interactions, biomolecular spectroscopy, high-resolution structure determinations.

Rules & Requirements

Prerequisites: Chemistry C130 or Molecular and Cell Biology C100A, or consent of instructor. Chemistry and Chemical Biology majors can only count 2 of the 3 units towards their Allied Subject requirement

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM C130 Biophysical Chemistry: Physical Principles and the Molecules of Life 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Thermodynamic and kinetic concepts applied to understanding the chemistry and structure of biomolecules (proteins, DNA, and RNA). Molecular distributions, reaction kinetics, enzyme kinetics. Bioenergetics, energy transduction, and motor proteins. Electrochemical potential, membranes, and ion channels.

Rules & Requirements

Prerequisites: CHEM 3A or CHEM 112A, MATH 51, BIOLOGY 1A, and BIOLOGY 1AL; CHEM 3B or CHEM 112B recommended

Hours & Format

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

Summer: 8 weeks - 5.5 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: MCELLBI C100A

CHEM 135 Chemical Biology 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
One-semester introduction to biochemistry, aimed toward chemistry and chemical biology majors.

Rules & Requirements

Prerequisites: 3B or 12B; Biology 1A; or consent of instructor

Credit Restrictions: Students will receive no credit for 135 after taking Molecular and Cell Biology 100B or 102.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 136 Bioorganic Chemistry and Advanced Chemical Biology 3 Units

Terms offered: Not yet offered

Chem 136 is intended for advanced undergraduate students majoring in Chemistry, Chemical Biology, Chemical and Biomolecular Engineering, Molecular and Cell Biology, and related majors. The course will review, reinforce, and build upon organic and biophysical chemistry skills needed for research in Chemical Biology. This will include a review of reaction mechanisms and arrow pushing skills, the chemical reactions of biomolecules, a survey of biochemical structural features, and a discussion of reaction energetics. A strong background in organic chemistry will be expected. Following this, contemporary areas of ChemBio research will be surveyed, including drug design, immunotherapy techniques, CRISPR/Cas9 strategies, drug delivery, and more.

Rules & Requirements

Prerequisites: Chem 12A/B or Chem 3A/3B (or equivalent at prior institution) required Chem 135 or MCB 102A (or equivalent at prior institution) required. Concurrent enrollment OK Waiver of prerequisites required consent of course instructor

Repeat rules: Course may be repeated for credit with instructor consent.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

CHEM C138 The Berkeley Lectures on Energy: Energy from Biomass 3 Units

Terms offered: Fall 2015, Fall 2014, Fall 2013

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 placed 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-the-art research.

Rules & Requirements

Prerequisites: Chemistry 1B or Chemistry 4B, Mathematics 1B, Biology 1A

Repeat rules: Course may be repeated for credit under special circumstances: 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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

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

Also listed as: BIO ENG C181/CHM ENG C195A/PLANTBI C124

CHEM C142 Machine Learning, Statistical Models, and Optimization for Molecular Problems 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
An introduction to mathematical optimization, statistical models, and advances in machine learning for the physical sciences. Machine learning prerequisites are introduced including local and global optimization, various statistical and clustering models, and early meta-heuristic methods such as genetic algorithms and artificial neural networks. Building on this foundation, current machine learning techniques are covered including deep learning artificial neural networks, Convolutional neural networks, Recurrent and long short term memory (LSTM) networks, graph neural networks, decision trees.

Objectives & Outcomes

Course Objectives: To build on optimization and statistical modeling to the field of machine learning techniques
To introduce the basics of optimization and statistical modeling techniques relevant to chemistry students
To utilize these concepts on problems relevant to the chemical sciences.

Student Learning Outcomes: Students will be able to understand the landscape and connections between numerical optimization, stand-alone statistical models, and machine learning techniques, and its relevance for chemical problems

Rules & Requirements

Prerequisites: MATH 53 and MATH 54; CHEM 120A or CHEM 120B or BIO ENG 103

Credit Restrictions: Students will receive no credit for BIO ENG C142 after completing BIO ENG 142. A deficient grade in BIO ENG C142 may be removed by taking BIO ENG 142.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternate method of final assessment during regularly scheduled final exam group (e.g., presentation, final project, etc.).

Instructor: Teresa Head-Gordon

Formerly known as: Bioengineering C142/Chemistry C142

Also listed as: BIO ENG C142

CHEM 143 Nuclear Chemistry 2 Units

Terms offered: Fall 2019, Fall 2018, Fall 2017
Radioactivity, fission, nuclear models and reactions, nuclear processes in nature. Computer methods will be introduced.

Rules & Requirements

Prerequisites: Physics 7B or equivalent

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM C146 Radiochemical Methods in Nuclear Technology and Forensics 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Experimental illustrations of the interrelation between chemical and nuclear science and technology and nuclear forensics; radioactive decay and counting techniques; nuclear spectroscopy; fundamental radiochemical techniques; radiochemical separations techniques; tracers; activation analysis; forensic applications of radiochemistry; fusion, fission and nuclear reactors.

Objectives & Outcomes

Course Objectives: Familiarize students with principles of nuclear and radiochemistry and its many important applications in our daily lives; provide hands-on training.

Student Learning Outcomes: A solid understanding of nuclear and radiochemistry; proficiency in safe handling of radioactive materials in the laboratory, and appreciation for the wide application of radiochemical techniques in chemistry, nuclear technology, and nuclear forensics.

Rules & Requirements

Prerequisites: CHEM 4B or CHEM 15; and CHEM 143 is recommended

Credit Restrictions: Students will receive no credit for CHEM 146 after completing CHEM 144, or CHEM C144.

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture and 4.5 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Chemistry 146

Also listed as: NUC ENG C146

CHEM 149 Supplementary Work in Upper Division Chemistry 1 - 4 Units

Terms offered: Spring 2016, Spring 2015, Spring 2014
Students with partial credit in upper division chemistry courses may, with consent of instructor, complete the credit under this heading.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Summer:
6 weeks - 2.5-10 hours of independent study per week
8 weeks - 1.5-7.5 hours of independent study per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM C150 Introduction to Materials Chemistry 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
The application of basic chemical principles to problems in materials discovery, design, and characterization will be discussed. Topics covered will include inorganic solids, nanoscale materials, polymers, and biological materials, with specific focus on the ways in which atomic-level interactions dictate the bulk properties of matter.

Rules & Requirements

Prerequisites: CHEM 104A. CHEM 104B recommended

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: MAT SCI C150

CHEM 159 Polymer Organic Chemistry 3 Units

Terms offered: Spring 2025
This course will introduce concepts pertaining to the synthesis of modern polymers. We will focus on the major polymerization methods including step-growth, radical, anionic, cationic, ring-opening, and organometallic polymerizations with emphasis given to the mechanisms, kinetics, and thermodynamics of each polymerization method. More specialized topics such as “living” and “controlled” polymerizations, stereochemistry, and polymer sustainability will also be discussed in detail. Throughout the course we will emphasize the historical developments and people behind the advancements in the field of polymer science.

Rules & Requirements

Prerequisites: Required: 1st semester organic chemistry (Chem 3A or 12A) + concurrent enrollment in 2nd semester organic chemistry (Chem 3B or 12B).Strongly Preferred: 2 semesters of organic chemistry (3A/B + 12A/B) completed

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required, with common exam group.

CHEM C170L Biochemical Engineering Laboratory 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024, Fall 2018, Spring 2014, Spring 2013
Laboratory techniques for the cultivation of microorganisms in batch and continuous reactions. Enzymatic conversion processes. Recovery of biological products.

Rules & Requirements

Prerequisites: Chemical Engineering 170A (may be taken concurrently) or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 7 hours of laboratory and 1 hour of lecture per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: CHM ENG C170L

CHEM 171H Berkeley Changemaker: The Green Materials Innovation Challenge 3 Units

Terms offered: Spring 2024, Spring 2023
Project-based course partnering students with companies, government, and non-profits interested in adopting safer green chemistry for their products. Students will learn the principles of green chemistry by identifying solutions to a real-world green chemistry challenge provided by the external partner. After completing the course students will understand essential concepts related to green chemistry, hazard assessment, bio-inspired design, and life cycle analysis, and how to apply these concepts to evaluate alternatives to a hazardous chemical. Students will know how to read and think critically about a scientific article, collaborate effectively, and hone their communication skills.
Rules & Requirements

Prerequisites: 1 semester of Chemistry 1A or Biology 1A

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

CHEM C178 Polymer Science and Technology 3 Units

Terms offered: Fall 2025, Spring 2025, Spring 2023, Fall 2016, Spring 2016, Spring 2015
An interdisciplinary course on the synthesis, characterization, and properties of polymer materials. Emphasis on the molecular origin of properties of polymeric materials and technological applications. Topics include single molecule properties, polymer mixtures and solutions, melts, glasses, elastomers, and crystals. Experiments in polymer synthesis, characterization, and physical properties.
Rules & Requirements

Prerequisites: Junior standing

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Also listed as: CHM ENG C178

CHEM 179 Numerical Algorithms applied to Computational Quantum Chemistry 3 Units

Terms offered: Fall 2025, Spring 2025, Spring 2024
Introduction to numerical algorithms, their application to computational quantum chemistry, and best practices for software implementation and reuse. This course covers a toolbox of useful algorithms from applied mathematics that are used in physical simulations. Illustrated via computer implementation of density functional theory for modeling chemical reaction mechanisms from quantum mechanics. Topics covered include local optimization, numerical derivatives and integration, dense linear algebra the symmetric eigenvalue problem, the singular value decomposition, and the fast Fourier transform. Students are guided through principles of procedural and object-oriented programming C++ and usage of efficient numerical libraries.
Rules & Requirements

Prerequisites: (1) Computing: Either (a) both CHEM 274A and CHEM 274B OR (b) CS 61A or CS/DATA C88C AND CS 9F; (2) Math: MATH 53 and MATH 54 or equivalent; (3) Familiarity with UNIX/Linux command line, and (4) An undergraduate physical chemistry course or permission of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

CHEM C182 Atmospheric Chemistry and Physics Laboratory 3 Units

Terms offered: Spring 2024, Spring 2023, Spring 2022
Fluid dynamics, radiative transfer, and the kinetics, spectroscopy, and measurement of atmospherically relevant species are explored through laboratory experiments, numerical simulations, and field observations.
Rules & Requirements

Prerequisites: Earth and Planetary Science 50 and 102 with grades of C- or higher (one of which may be taken concurrently) or two of the following: Chemistry 120A, 120B, C130, or 130B with grades of C- or higher (one of which may be taken concurrently)

Credit Restrictions: Deficiency in C182 may be removed by successfully completing 125. Consent of instructor is required to enroll in C182 after completing 125.

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture and 5 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Chemistry C182/Earth and Planetary Science C182

Also listed as: EPS C182

CHEM C191 Introduction to Quantum Computing 4 Units

Terms offered: Spring 2025, Spring 2024, Fall 2023
This multidisciplinary course provides an introduction to fundamental conceptual aspects of quantum mechanics from a computational and informational theoretic perspective, as well as physical implementations and technological applications of quantum information science. Basic sections of quantum algorithms, complexity, and cryptography, will be touched upon, as well as pertinent physical realizations from nanoscale science and engineering.

Rules & Requirements

Prerequisites: Linear Algebra (EECS 16A or PHYSICS 89 or MATH 54) AND either discrete mathematics (COMPSCI 70 or MATH 55), or quantum mechanics (PHYSICS 7C or PHYSICS 137A or CHEM 120A)

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Also listed as: COMPSCI C191/PHYSICS C191

CHEM C191A Introduction to Quantum Computing I 4 Units

Terms offered: Fall 2025
This is the first semester of a multidisciplinary two-semester sequence in Quantum Computing. This semester provides an introduction to fundamental conceptual aspects of quantum mechanics in the language of qubits and quantum gates, and a first introduction to quantum computation. Topics in part one include basic concepts and results in quantum information, quantum algorithms, and an introduction to quantum error correction.

Rules & Requirements

Prerequisites: Linear Algebra: Either EECS 16A, Physics 89, Math 54, or equivalent. Some background in either quantum mechanics (Physics 137A, Chemistry 120A, or equivalent) or discrete mathematics (CS 70, Math 55, or equivalent) is expected

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Also listed as: EECS C191A/PHYSICS C191A

CHEM C191B Introduction to Quantum Computing II 4 Units

Terms offered: Not yet offered
This is the second semester of a multidisciplinary two-semester sequence in Quantum Computing. This second semester covers fundamentals of control of qubits, methods of quantum error mitigation, quantum benchmarking, quantum supremacy and tests of quantumness, advanced quantum error correction including fault-tolerant quantum computing and error thresholds, theory/practice of near-term fault fault tolerance, discussions of different physical platforms for quantum computing, and alternative paradigms for quantum computing.

Rules & Requirements

Prerequisites: C191A or equivalent (with permission of instructor)

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Also listed as: EECS C191B/PHYSICS C191B

CHEM 192 Individual Study for Advanced Undergraduates 1 - 3 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015
All properly qualified students who wish to pursue a problem of their own choice, through reading or nonlaboratory study, may do so if their proposed project is acceptable to the member of the staff with whom they wish to work.

Rules & Requirements

Prerequisites: Consent of instructor and adviser

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

CHEM H193 Senior Honors Thesis 3 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015
A senior honors thesis is written in consultation with the student's faculty research advisor. This is a required course for students wishing to graduate with honors in Chemistry or Chemical Biology.
Rules & Requirements

Prerequisites: Senior standing, approval of faculty research advisor, overall GPA of 3.4 or higher at Berkeley

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 9-0 hours of independent study per week

Summer: 8 weeks - 16.5 hours of independent study per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

CHEM H194 Research for Advanced Undergraduates 2 - 6 Units

Terms offered: Spring 2023, Fall 2022, Summer 2022 Second 6 Week Session
Students may pursue original research under the direction of one of the members of the staff.
Rules & Requirements

Prerequisites: Minimum GPA of 3.4 overall at Berkeley and consent of instructor and adviser

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 0-6 hours of independent study and 0-6 hours of laboratory per week

Summer:
6 weeks - 0-15 hours of independent study and 0-15 hours of laboratory per week
8 weeks - 0-11.5 hours of independent study and 0-11.5 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

CHEM 195 Special Topics 3 Units

Terms offered: Spring 2024, Spring 2023, Spring 2022
Special topics will be offered from time to time. Examples are: photochemical air pollution, computers in chemistry.
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Summer: 10 weeks - 4.5 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

CHEM 196 Special Laboratory Study 2 - 6 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Special laboratory work for advanced undergraduates.
Rules & Requirements

Prerequisites: Consent of instructor and adviser

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of independent study and 0-1 hours of laboratory per week

Summer:
6 weeks - 2.5-10 hours of independent study and 0-2.5 hours of laboratory per week
8 weeks - 2-7.5 hours of independent study and 0-2 hours of laboratory per week
10 weeks - 1.5-6 hours of independent study and 0-1.5 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

CHEM 197 Field Study in Chemistry 1 - 4 Units

Terms offered: Spring 2021, Spring 2020, Summer 2016 8 Week Session

Supervised experience in off-campus organizations relevant to specific aspects and applications of chemistry. Written report required at the end of the term. Course does not satisfy unit or residence requirements for the bachelor's degree.

Rules & Requirements

Prerequisites: Upper division standing and consent of instructor

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Summer: 8 weeks - 6 hours of fieldwork per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

CHEM 198 Directed Group Study 1 - 4 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021

Group study of selected topics.

Rules & Requirements

Prerequisites: Completion of 60 units of undergraduate study and in good standing

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

CHEM 199 Supervised Independent Study and Research 1 - 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Enrollment is restricted by regulations listed in the .

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Summer:

6 weeks - 1-5 hours of independent study per week

8 weeks - 1-4 hours of independent study per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

CHEM 200 Chemistry Fundamentals 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023

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 and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 201 Fundamentals of Inorganic Chemistry 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023

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

Terms offered: Spring 2025, Spring 2024, Spring 2023
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

Terms offered: Spring 2024, Spring 2022, Spring 2020
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

Terms offered: Fall 2025, Fall 2024, Fall 2023
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 and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 220B Statistical Mechanics 3 Units

Terms offered: Spring 2025, Spring 2023, Spring 2022
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

Terms offered: Fall 2025, Fall 2024, Fall 2023
Basic principles/postulates of quantum mechanics, Hilbert space and representation theory, quantum theory of measurements, advanced descriptions of harmonic oscillator and theory of angular momentum, time independent and time dependent approximation methods, applications to quantum mechanics of atoms and molecules.
Rules & Requirements

Prerequisites: Chem120A or Physics137A, Chem120B and Chem122, or equivalents

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture and 0-2 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 221B Advanced Quantum Mechanics 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
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

Terms offered: Fall 2017, Spring 2017, Spring 2015
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

Terms offered: Spring 2025, Spring 2024, Spring 2022
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

Terms offered: Spring 2020, Spring 2015, Spring 2014, Spring 2013
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 Interdisciplinary Approach to Sustainability 3 Units

Terms offered: Spring 2016, Spring 2015, Spring 2014, Spring 2013
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 236 Bioorganic Chemistry and Advanced Chemical Biology 3 Units

Terms offered: Fall 2025

Chem 236 is intended for Chemical Biology grad students who previously completed BS or BA degrees in Chemistry, Biochemistry, or Biology. Undergraduates are welcome to take the course if they have a solid command of the background material. The course will review, reinforce, and build upon organic and biophysical chemistry skills needed for ChemBio research. This will include a review of reaction mechanisms and arrow pushing skills, the chemical reactions of biomolecules, a survey of biochemical structural features, and a discussion of reaction energetics. Following this, contemporary areas of Chemical Biology will be surveyed, including drug design, immunotherapy techniques, CRISPR/Cas9 strategies, drug delivery, and more

Rules & Requirements

Prerequisites: Chem 12A/B or Chem 3A/3B (or equivalent at prior institution) required Chem 135 or MCB 102 (or equivalent at prior institution) required. Concurrent enrollment OK Waiver of prerequisites required consent of course instructor

Repeat rules: Course may be repeated for credit with instructor consent.

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 C236 Energy Solutions: Carbon Capture and Sequestration 3 Units

Terms offered: Fall 2018, Spring 2017, Spring 2015, Spring 2014, Spring 2013

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

Terms offered: Fall 2015, Fall 2014, Fall 2013

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: Course may be repeated for credit under special circumstances: 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 C242 Machine Learning, Statistical Models, and Optimization for Molecular Problems 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
An introduction to mathematical optimization, statistical models, and advances in machine learning for the physical sciences. Machine learning prerequisites are introduced including local and global optimization, various statistical and clustering models, and early meta-heuristic methods such as genetic algorithms and artificial neural networks. Building on this foundation, current machine learning techniques are covered including deep learning artificial neural networks, Convolutional neural networks, Recurrent and long short term memory (LSTM) networks, graph neural networks, decision trees.
Objectives & Outcomes

Course Objectives: To build on optimization and statistical modeling to the field of machine learning techniques
To introduce the basics of optimization and statistical modeling techniques relevant to chemistry students
To utilize these concepts on problems relevant to the chemical sciences.

Student Learning Outcomes: Students will be able to understand the landscape and connections between numerical optimization, stand-alone statistical models, and machine learning techniques, and its relevance for chemical problems.

Rules & Requirements

Prerequisites: Math 53 and Math 54; Chem 120A or 120B or BioE 103; or consent of intructor

Credit Restrictions: Students will receive no credit for BIO ENG C242 after completing BIO ENG 242. A deficient grade in BIO ENG C242 may be removed by taking BIO ENG 242.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Instructor: Teresa Head-Gordon

Formerly known as: Bioengineering C242/Chemistry C242

Also listed as: BIO ENG C242

CHEM 243 Advanced Nuclear Structure and Reactions 3 Units

Terms offered: Spring 2013, Fall 2009, Fall 2008
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

Terms offered: Fall 2025, Fall 2024, Fall 2023
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

Terms offered: Spring 2015, Spring 2014, Spring 2013
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

Terms offered: Fall 2018, Fall 2017, Fall 2016
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

Terms offered: Spring 2019, Spring 2018, Spring 2014
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

Terms offered: Fall 2025, Fall 2024, Fall 2022
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

Terms offered: Fall 2025, Fall 2024, Fall 2022
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

Terms offered: Spring 2023, Spring 2022, Fall 2019
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

Terms offered: Spring 2023, Spring 2022, Fall 2019
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

Terms offered: Spring 2023, Spring 2022, Fall 2019
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

Terms offered: Spring 2015, Spring 2014, Spring 2013
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 259 Polymer Organic Chemistry 3 Units

Terms offered: Spring 2025
This course will introduce concepts pertaining to the synthesis of modern polymers. We will focus on the major polymerization methods including step-growth, radical, anionic, cationic, ring-opening, and organometallic polymerizations with emphasis given to the mechanisms, kinetics, and thermodynamics of each polymerization method. More specialized topics such as “living” and “controlled” polymerizations, stereochemistry, and polymer sustainability will also be discussed in detail. Throughout the course we will emphasize the historical developments and people behind the advancements in the field of polymer science.

Rules & Requirements

Prerequisites: Required: 1st semester organic chemistry (Chem 3A or 12A) + concurrent enrollment in 2nd semester organic chemistry (Chem 3B or 12B). Strongly Preferred: 2 semesters of organic chemistry (3A/B + 12A/B) completed

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 260 Reaction Mechanisms 2 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
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 and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

Formerly known as: 260A-260B

CHEM 261A Organic Reactions I 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023
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 and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 261B Organic Reaction II 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023
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 and 0 hours of voluntary per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 261C Organic Reactions III 1 Unit

Terms offered: Fall 2013, Fall 2012, Fall 2011
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

Terms offered: Spring 2025, Spring 2024, Spring 2023
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

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course will provide an exposure to the range of catalytic reactions of organometallic systems, the identity of the catalysts for these reactions, and the scope and limitations of these reactions. Emphasis will be placed on understanding the mechanisms of homogeneous catalytic processes. Students will see the types of molecular fragments generated by catalytic organometallic chemistry and see the synthetic disconnections made possible by these reactions. The scope of transformations will encompass those forming commodity chemicals on large scale, pharmaceuticals on small scale, and both commodity and specialty polymers
Rules & Requirements

Prerequisites: 262 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.

CHEM 263B Synthetic Design II 1 Unit

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course will provide an exposure to the range of catalytic reactions of organometallic systems, the identity of the catalysts for these reactions, and the scope and limitations of these reactions. Emphasis will be placed on understanding the mechanisms of homogeneous catalytic processes. Students will see the types of molecular fragments generated by catalytic organometallic chemistry and see the synthetic disconnections made possible by these reactions. The scope of transformations will encompass those forming commodity chemicals on large scale, pharmaceuticals on small scale, and both commodity and specialty polymers.
Rules & Requirements

Prerequisites: 263A 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.

CHEM 265 Nuclear Magnetic Resonance Theory and Application 1 Unit

Terms offered: Spring 2025, Spring 2024, Spring 2023
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

Terms offered: Spring 2025, Spring 2023, Spring 2022
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

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

Terms offered: Spring 2025, Spring 2024, Spring 2023
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

Terms offered: Spring 2025, Spring 2024, Spring 2023
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

Terms offered: Spring 2025, Spring 2024, Spring 2023
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

Terms offered: Spring 2025, Spring 2024, Spring 2023
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

Terms offered: Spring 2025, Spring 2024, Spring 2023
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 272 Python for the Molecular Science 3 Units

Terms offered: Summer 2025
This course introduces programming concepts and techniques required for scientific computing using Python. Students will learn basic syntax, use cases, and ecosystems for Python programming in the molecular sciences. Students will become familiar with tools and practices commonly used in software development such as version control, documentation, and testing. The course will also provide a brief introduction to C++ and compare the functionalities of the two languages.
Rules & Requirements

Prerequisites: Admission to the MSSE program

Hours & Format

Summer: 13 weeks - 3 hours of lecture, 1 hour of discussion, and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 273 Numerical Methods for Computational Science 3 Units

Terms offered: Summer 2025
In computational molecular science, numerical methods are essential for solving mathematical problems that are too complex for analytical solutions. Using Python and its scientific libraries as a tool, this course covers the key numerical methods required for computational science from the following core mathematical areas: Linear Algebra, Calculus, Probability and Statistics, and Numerical Analysis.
Rules & Requirements

Prerequisites: Admittance to the MSSE degree

Hours & Format

Summer: 13 weeks - 3 hours of lecture, 1 hour of discussion, and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 274A Programming Languages for Molecular Sciences: Python and C++ 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Course provides in-depth coverage of programming concepts and techniques required for
scientific computing, data science, and high-performance computing using C++ and Python. Course will compare and contrast the functionalities of the two languages. Topics include classes, overloading, data abstraction, information hiding, encapsulation, file processing, exceptions, and
low-level language features. Exercises based on molecular science problems will
provide hands-on experience needed to learn these languages. Course serves as a
prereq to later MSSE courses: Data Science, Machine Learning Algorithms, Software
Engineering for Scientific Computing, Numerical Algorithms Applied to Computational Quantum
Chemistry, and Applications Parallel Comp.
Rules & Requirements

Prerequisites: Prior exposure to basic programming methodology or the consent of the instructor

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture, 2-2 hours of discussion, and 0-2 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 274B Software Engineering Fundamentals for Molecular Sciences 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Course will advance students' understanding of fundamental knowledge and techniques for
developing complex software. Students will gain an in-depth view of computer system
architecture as well as abstraction techniques as means to manage program complexity. Students
will collaboratively develop a software engineering package, gaining experience in all
aspects of the software development process. Course serves as a prerequisite to later MSSE
courses: Data Science, Machine Learning Algorithms, Software Engineering for Scientific
Computing, Numerical Algorithms Applied to Computational Quantum Chemistry, and
Applications of Parallel Computers

Rules & Requirements

Prerequisites: Chem 274A - MSSE's Introduction to Programming Languages – C++ and Python -

Hours & Format

Fall and/or spring: 15 weeks - 3-3 hours of lecture, 2-2 hours of discussion, and 0-2 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 275A Introduction to Programming Languages C++ and Python 3 Units

Terms offered: Fall 2021, Fall 2020
This course provides in-depth coverage of programming concepts and techniques required for scientific computing, data science, and high-performance computing using C++ and Python. The course will compare and contrast the functionalities of the two languages. Topics include classes, overloading, data abstraction, information hiding, encapsulation, inheritance, polymorphism, file processing, templates, exceptions, container classes, and low-level language features. Numerous exercises based on molecular science problems will provide the hands-on experience needed to learn these languages

Objectives & Outcomes

Student Learning Outcomes: Upon successfully completing this course, students will be able to
A.
Develop the necessary skills to effectively interact with machine learning environments.
B.
Acquire the skills needed to develop high-performance computing software.

Rules & Requirements

Prerequisites: Prior exposure to basic programming methodology or the consent of the instructor

Hours & Format

Fall and/or spring: 8 weeks - 5 hours of web-based lecture and 6 hours of web-based discussion per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 275B Introduction to Software Engineering Best Practices 3 Units

Terms offered: Fall 2021, Fall 2020

This course will advance students' understanding of the different steps involved in software design. Students will acquire hands-on experience in practical problems such as specifying, designing, building, testing, and delivering reliable software systems for scientific computing. Students will collaboratively develop a software engineering package, thus gaining experience in all aspects of the software development process from the feasibility study to the final delivery of the product. This course is a prerequisite to MSSE courses in Software Engineering for Scientific Computing, Computational Chemistry and Materials Science, and Parallel Computing.

Objectives & Outcomes

Student Learning Outcomes: Upon successfully completing this course, students will have the skills needed to develop high-performance computing software.

Rules & Requirements

Prerequisites: Chem 275 - MSSE's Introduction to Programming Languages – C++ and Python

Hours & Format

Fall and/or spring: 8 weeks - 5 hours of web-based lecture and 6 hours of web-based discussion per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 277B Machine Learning Algorithms 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

An introduction to mathematical optimization and statistics and "non-algorithmic" computation using machine learning. Machine learning prerequisites are introduced including local and global optimization, various statistical and clustering models, and early meta-heuristic methods such as genetic algorithms and artificial neural networks. Building on this foundation, current machine learning techniques are covered including Deep Learning networks, Convolutional neural networks, Recurrent and long short term memory (LSTM) networks, and support vector machines and Gaussian ridge regression. Various case studies in applying optimization, statistical modeling, and machine learning methods as classification and regression task

Objectives & Outcomes

Student Learning Outcomes: A.
To introduce the basics of optimization and statistical modeling techniques relevant to machine learning
B.
To build on optimization and statistical modeling to the recent field of machine learning techniques.
C.
To understand data and algorithms relevant to machine learning

Rules & Requirements

Prerequisites: The students will have had MSSE courses (1) Chem 270 - Intro to Programming, (2) Chem 271 - Software Best Practices, and (3) DS100 courses

Hours & Format

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

Summer: 8 weeks - 4.5 hours of lecture and 5.5 hours of discussion per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 278 Ethical Topics for Professional Software Engineering 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023
This course will expose students to applied ethics in professional ethics, information technology, intellectual property, and corporate ethics that are topic relevant to the MSSE degree.

Rules & Requirements

Prerequisites: Acceptance into the MSSE program

Hours & Format

Fall and/or spring: 5 weeks - 1 hour of web-based lecture and 1 hour of web-based discussion per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 279 Numerical Algorithms applied to Computational Quantum Chemistry 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Introduction to numerical algorithms, their application to computational quantum chemistry, and best practices for software implementation and reuse. This course covers a toolbox of useful algorithms from applied mathematics that are used in physical simulations. Illustrated via computer implementation of density functional theory for modeling chemical reaction mechanisms from quantum mechanics. Topics covered include local optimization, numerical derivatives and integration, dense linear algebra the symmetric eigenvalue problem, the singular value decomposition, and the fast Fourier transform. Students are guided through principles of procedural and object-oriented programming C++ and usage of efficient numerical libraries..

Objectives & Outcomes

Course Objectives: 1.
To introduce computer-based physical simulation via computational quantum chemistry.
2.
To develop the core numerical algorithms needed to efficiently implement computational quantum chemistry methods, as well as other physical simulations.
3.
To reinforce programming skills directed to sustainable software as well as intelligent use of optimized libraries to implement numerical kernels.

Rules & Requirements

Prerequisites: Students will have had MSSE courses (1) Chem 275A Intro to Programming, (2) Chem 275B Software Best Practices, and (3) Data Science 100 courses. In addition, undergraduate physical chemistry (Chem 120A or equivalent) or permission of instructor is required

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 280 Foundations of Programming and Software Engineering for Molecular Sciences 2 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This course provides an overview of topics relevant to programming and creating software projects. The course will be taught in collaboration with members of the Molecular Sciences Software Institute (MolSII). Students will learn basic syntax, use cases, and ecosystems for Python and C ++. Students will become familiar with tools and practices commonly used in software development such as version control, documentation, and testing. Central to this course is a hands on molecular simulation project where students work in groups to create a software package using concepts taught in the course.

Rules & Requirements

Prerequisites: Acceptance to MSSE program

Hours & Format

Fall and/or spring: 2 weeks - 20 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 281 Software Engineering for Scientific Computing 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

The course covers computer architecture and software features that have the
greatest impact on performance. It addresses debugging and performance tunning, detecting
memory and stack overwrites, malloc corruption, hotspot, paging, cache misses. A toolbox with
common algorithms: sorting, searching, hashing, trees, graph traversing, is followed by common
patterns used in object-oriented design. It describes programming paradigms, dynamic libraries,
distributed architectures, and services. Lectures on linear algebra and performance libraries are
provided as background for future courses. HPC paradigms and GPU programming are introduced.
Software packaging, extensibility, and interactivity is followed by team development, testing and
hardening.

Objectives & Outcomes

Course Objectives: The objective of this recurrent
course is to equip students with the skills and tools every software engineer must master for a
successful professional career.

Rules & Requirements

Prerequisites: Students will have had MSSE courses (1) C275A Intro to Programming, (2) C275B Software Best Practices. Students are expected to be familiar with programming in C++ and have a basic understanding of LINUX. Additional materials will be provided for students to peruse as necessary

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 282 MSSE Leadership Bootcamp 2 Units

Terms offered: Spring 2024, Spring 2023, Spring 2022
This boot camp for the Master of Molecular Science and Software Engineering program is a two-week intensive course that introduces program participants to the leadership, management and entrepreneurial skills necessary in today's professional environment. Using the capstone project as a baseline, this course aims to provide program participants an understanding of the key aspects of management and leadership disciplines; team and organization dynamics; leading and participating in cross functional teams; engineering economic, finance and accounting concepts; effective communication skills and project management.
Rules & Requirements

Prerequisites: Concurrent enrollment in Chem 283 Capstone Project Course

Hours & Format

Fall and/or spring: 2 weeks - 17-17 hours of lecture and 25-25 hours of discussion per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 282A MSSE Leadership Bootcamp 1 Unit

Terms offered: Spring 2025
This is the first of the two one-unit courses that make up the Master of Molecular Science and Software Engineering (MSSE) program leadership course. Together, these two one-unit courses aim to introduce program participants to a number of key professional skills that will enhance their performance in today's business environment. Topics covered in this course include key aspects of management and leadership disciplines; engineering, economic, finance and accounting concepts; effective communication skills, and a technologist's role in marketing and business strategy formulation and execution.
Hours & Format

Fall and/or spring: 2 weeks - 12.5 hours of lecture per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 282B MSSE Leadership and Project Management 1 Unit

Terms offered: Spring 2025
MSSE Leadership and Project Management (CHEM 282B) will be taken concurrently with the capstone project (CHEM 283) course. Tightly integrating with the Capstone Project Course, this course aims to reinforce the key aspects of leading and participating in cross functional teams and project management. Program participants will also be able to apply the project management and teamwork skills in completing their capstone team projects.
Rules & Requirements

Prerequisites: Must be taken in the same semester as CHEM 283

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 283 MSSE Capstone Project Course 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course provides students with a multifaceted experience managing a project involving the application and development of software for Computational Sciences. Students exercise leadership, team building, and critical thinking skills resulting in a Capstone project deliverables and final report. Capstone projects are an essential part of the MSSE program because students transfer skills learned in other MSSE courses to a real-world application in particular applying several software engineering, algorithmic and scientific concepts This course is also designed to be tightly integrated with MSSE's Leadership Bootcamp. Capstone projects are developed with MSSE industrial and academic partners, individually or in cross-functional teams.
Rules & Requirements

Prerequisites: All courses in the MSSE program curriculum are prerequisite of the Capstone Project course. Concurrent enrollment in Chem 282-MSSE Leadership Bootcamp and CS267-Applications of Parallel Computers is required

Hours & Format

Fall and/or spring: 15 weeks - 1-1 hours of lecture and 2-2 hours of discussion per week

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 284 High Performance Computing for the Molecular Sciences 3 Units

Terms offered: Not yet offered
This course introduces parallel programming concepts commonly encountered in computational molecular sciences codes, including distributed-memory parallelization, shared-memory parallelization, and GPU parallelization. Students will become familiar with MPI, OpenMP, and CUDA, while also learning specific strategies for addressing performance challenges associated with key computational chemistry algorithms. Special emphasis is placed on the execution of machine learning techniques within a high performance computing environment, as well as challenges arising from processing large amounts of data.
Rules & Requirements

Prerequisites: Admission to the Master of Molecular Science and Software Engineering. CHEM 277B: Machine Learning Algorithms or instructor approval

Credit Restrictions: Students will receive no credit for CHEM 284 after completing COMPSCI 267.

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Graduate

Grading: Letter grade.

CHEM 295 Special Topics 1 - 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
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 without restriction.

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 297 Field Study in Chemistry for Graduate Students 1 - 4 Units

Terms offered: Not yet offered
Supervised experience in off-campus organizations relevant to specific aspects and applications of chemistry as part of the student's progress towards a PhD degree. Written report required at the end of the term. Course does not satisfy unit or residence requirements for the bachelor's degree.
Rules & Requirements

Prerequisites: Graduate student in good standing and consent of instructor; a written proposal for the internship, signed by the faculty sponsor must receive approval from the department chair

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

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

Summer: 8 weeks - 6-6 hours of fieldwork 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

Terms offered: Fall 2025, Spring 2025, Fall 2024
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 without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-3 hours of colloquium 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

Terms offered: Fall 2025, Spring 2025, Fall 2024
Facilities are available to graduate students pursuing original investigations toward an advanced
degree in Chemistry or related fields at the University of California, Berkeley. Investigations may
include experiment, theory, data analysis, and dissemination of accomplishments or discoveries
in the form of oral and written presentations or manuscripts submitted for peer-reviewed
publication. Such work is done under the supervision and direction of a faculty member or their
designee.

Objectives & Outcomes

Course Objectives: Provide opportunities for graduate students to engage in original research under the direction,
support, and mentorship of a faculty member in the chemistry department at UC Berkeley.

Student Learning Outcomes: Students will learn the skills and techniques necessary to complete a PhD in the field of
Chemistry and ultimately become a world expert in their thesis research area. Students will
show progress in the following areas related to their chosen field of study, including, but not
limited to the following:
Creativity, intellectual ownership, initiative, technical proficiency, resilience, communication both
orally and in writing, ability to solve challenging problems, broad understanding of relevant
disciplinary background (literature), the ability to initiate new research directions aimed toward
solving important scientific challenges.

Rules & Requirements

Prerequisites: Graduate standing. Consent of Instructor Required

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 0-0 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

Terms offered: Fall 2025, Spring 2025, Fall 2024
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 without restriction.

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

Terms offered: Fall 2025, Fall 2024, Fall 2023
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 without restriction.

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

Terms offered: Fall 2017, Spring 2017, Fall 2016
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 for credit up to a total 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

Terms offered: Fall 2017, Spring 2017, Fall 2016
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 for credit up to a total 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 Teacher Scholars 2 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
The Chemistry Undergraduate Teacher Scholar Program places undergraduate students as apprentice instructors in lower division laboratory and discussion sections. In a weekly meeting with instructors, participants learn about teaching, review chemistry knowledge, and are coached to mentor students.
Rules & Requirements

Prerequisites: Chemistry 1A or Chemistry 4A or equivalent. Consent of instructor required

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1.5-1.5 hours of lecture and 1-1 hours 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

Terms offered: Fall 2017, Spring 2017, Fall 2016
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 without restriction.

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

Terms offered: Spring 2015, Spring 2014, Spring 2013

Rules & Requirements

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

Repeat rules: Course may be repeated for credit up to a total 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

Terms offered: Fall 2017, Spring 2017, Fall 2016

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 without restriction.

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

Terms offered: Fall 2023, Fall 2021

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 without restriction.

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

Terms offered: Fall 2017, Spring 2017, Fall 2016

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 without restriction.

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.

CHEM 700 QB3 Colloquium for Graduate Students 0.0 Units

Terms offered: Spring 2023, Spring 2022, Spring 2021
Weekly Graduate colloquium on topics of interest in QB3 research.

Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-2 hours of colloquium per week

Additional Details

Subject/Course Level: Chemistry/Graduate examination preparation

Grading: Offered for satisfactory/unsatisfactory grade only.

Formerly known as: Chemistry 999