

# Chemical Biology

## Bachelor of Science (BS)

The Bachelor of Science (BS) degree in Chemical Biology is intended for students who are interested in careers as professional chemists, or in the biological sciences including the biomedical, biotechnology, and pharmaceutical industries. Chemical Biology offers a solid background in chemistry, so that students understand the chemical principles of biological functions. In addition to an introductory set of math and physics courses and a broad selection of chemistry courses similar to those required for the chemistry major, students pursuing the chemical biology major take courses in general and cell biology, biochemistry, biological macromolecular synthesis, and bioinorganic chemistry. There is a strong emphasis on organic chemistry, quantitative thermodynamics, and kinetics necessary for understanding the logic of biological systems.

## Admission to the Major

For information on admission to the major, please see the College of Chemistry Admissions page (<http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/chemistry/#admissiontext>) in this Guide.

## Minor Program

There is no minor program in Chemical Biology.

In addition to the University, campus, and college requirements, listed on the College Requirements tab, students must fulfill the below requirements specific to their major program.

## General Guidelines

1. A minimum grade point average (GPA) of 2.0 must be maintained in all courses undertaken at UC Berkeley, including those from UC Summer Sessions, UC Education Abroad Program, UC Berkeley in Washington Program, and XB courses from University Extension.
2. A minimum GPA of 2.0 in all courses taken in the college is required in order to advance and continue in upper division courses.
3. A minimum GPA of 2.0 in all upper division courses taken at the University is required to satisfy major requirements.
4. Chemical Biology majors who receive a grade of D+ or lower in a chemistry course for which a grade of C- or higher is required must repeat the course at UC Berkeley.

For information regarding grade requirements in specific courses, please see the notes sections below.

For information regarding residence requirements and unit requirements, please see the College Requirements tab.

## Lower Division Requirements

CHEM 4A & CHEM 4B	General Chemistry and Quantitative Analysis and General Chemistry and Quantitative Analysis	8
CHEM 96	Introduction to Research and Study in the College of Chemistry	1
CHEM 12A	Organic Chemistry	5
CHEM 12B	Organic Chemistry	5
MATH 1A	Calculus	4
MATH 1B	Calculus	4
MATH 53	Multivariable Calculus	4

MATH 54	Linear Algebra and Differential Equations	4
PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 7B	Physics for Scientists and Engineers	4
BIOLOGY 1A	General Biology Lecture	3
BIOLOGY 1AL	General Biology Laboratory	2

## Notes

1. Students should take CHEM 4A and CHEM 4B during their freshman year, and CHEM 12A and CHEM 12B during their sophomore year.
2. Students who join the program after completing a general chemistry sequence that does not include quantitative analysis are required to take CHEM 4B, CHEM 15, or CHEM 105.
3. Students who join the program after completing CHEM 3A plus CHEM 3AL and CHEM 3B plus CHEM 3BL at Berkeley are allowed to substitute those courses for CHEM 12A and CHEM 12B. Students who join the program after completing only CHEM 3A plus CHEM 3AL at Berkeley are recommended to take CHEM 12B.
4. A grade of C- or better is required in CHEM 4A before taking CHEM 4B, in CHEM 4B before taking more advanced courses, and in CHEM 12A before taking CHEM 12B.
5. A grade of C- or better is recommended in CHEM 12A before taking BIOLOGY 1A.
6. Freshmen must take CHEM 96 during their first fall semester at Berkeley.
7. Students should start MATH 1A in the first semester of their freshman year.
8. Students should start PHYSICS 7A in the second semester of the freshman year. Substitution of PHYSICS 8A and PHYSICS 8B is allowed, but PHYSICS 7A and PHYSICS 7B are recommended.

## Upper Division Requirements

CHEM 103	Inorganic Chemistry in Living Systems	3
CHEM C110L	General Biochemistry and Molecular Biology Laboratory	4
CHEM 120A	Physical Chemistry <sup>1</sup>	3
CHEM 120B	Physical Chemistry <sup>1</sup>	3
CHEM 135	Chemical Biology <sup>2</sup>	3
MCELLBI 110	Molecular Biology: Macromolecular Synthesis and Cellular Function <sup>2</sup>	4

Select one of the following:

CHEM 105	Instrumental Methods in Analytical Chemistry
CHEM 125	Physical Chemistry Laboratory
CHEM C170L	Biochemical Engineering Laboratory
CHEM C182	Atmospheric Chemistry and Physics Laboratory

Select 7 units of upper division chemistry and allied subjects (see below for list) <sup>3</sup>

One must be an additional lecture course (or laboratory/lecture course) in chemistry as approved by your staff adviser

- <sup>1</sup> A grade of C- or higher is required in CHEM 120A and CHEM 120B if taken before CHEM 125 or CHEM C182.
- <sup>2</sup> BIOLOGY 1A plus BIOLOGY 1AL and CHEM 135 satisfy the prerequisites for MCELLBI 110.

<sup>3</sup> Advanced Placement, Advanced Level, and International Baccalaureate credit cannot be applied to this requirement. No more than 4 units of research (e.g., courses numbered 192, H194, and or 196) may be used to satisfy this requirement. If a course is used to satisfy another requirement, the course cannot also be used to satisfy the upper division Chemistry and Allied Subjects requirement.

## Upper Division Chemistry and Allied Subjects List

ASTRON C162	Planetary Astrophysics	4
BIO ENG 100	Ethics in Science and Engineering	3
BIO ENG 104	Biological Transport Phenomena	4
BIO ENG 111	Functional Biomaterials Development and Characterization	4
BIO ENG C112	Molecular Biomechanics and Mechanobiology of the Cell	4
BIO ENG 115	Cell Biology for Engineers	4
BIO ENG 116	Cell and Tissue Engineering	4
BIO ENG C117	Structural Aspects of Biomaterials	4
BIO ENG C118	Biological Performance of Materials	4
BIO ENG C119	Orthopedic Biomechanics	4
BIO ENG 121	BioMEMS and Medical Devices	4
BIO ENG 131	Introduction to Computational Molecular and Cell Biology	4
BIO ENG 132	Genetic Devices	4
BIO ENG 143	Computational Methods in Biology	4
BIO ENG 147	Principles of Synthetic Biology	4
BIO ENG 150	Introduction of Bionanoscience and Bionanotechnology	4
BIO ENG 151	Micro/Nanofluidics for Bioengineering and Lab-On-A-Chip	4
BIO ENG 163	Principles of Molecular and Cellular Biophotonics	4
BIO ENG C181	The Berkeley Lectures on Energy: Energy from Biomass	3
CHM ENG 140	Introduction to Chemical Process Analysis	4
CHM ENG 141	Chemical Engineering Thermodynamics	4
CHM ENG 142	Chemical Kinetics and Reaction Engineering	4
CHM ENG 150A	Transport Processes	4
CHM ENG 150B	Transport and Separation Processes	4
CHM ENG 154	Chemical Engineering Laboratory	4
CHM ENG 160	Chemical Process Design	4
CHM ENG 162	Dynamics and Control of Chemical Processes	4
CHM ENG 170A	Biochemical Engineering	3
CHM ENG 170B	Biochemical Engineering	3
CHM ENG C170L	Biochemical Engineering Laboratory	3
CHM ENG 171	Transport Phenomena	3
CHM ENG 176	Principles of Electrochemical Processes	3
CHM ENG C178	Polymer Science and Technology	3
CHM ENG 179	Process Technology of Solid-State Materials Devices	3
CHM ENG 180	Chemical Engineering Economics	3
CHM ENG H194	Research for Advanced Undergraduates	2-4
CHM ENG 195	Special Topics	2-4

CHM ENG C195A	The Berkeley Lectures on Energy: Energy from Biomass	3
CHM ENG 196	Special Laboratory Study	2-4
CHEM 100	Communicating Chemistry (limited to 2 units)	2
CHEM 103	Inorganic Chemistry in Living Systems	3
CHEM 104A	Advanced Inorganic Chemistry	3
CHEM 104B	Advanced Inorganic Chemistry	3
CHEM 105	Instrumental Methods in Analytical Chemistry	4
CHEM 108	Inorganic Synthesis and Reactions	4
CHEM C110L	General Biochemistry and Molecular Biology Laboratory	4
CHEM 113	Advanced Mechanistic Organic Chemistry	3
CHEM 114	Advanced Synthetic Organic Chemistry	3
CHEM 115	Organic Chemistry--Advanced Laboratory Methods	4
CHEM 122	Quantum Mechanics and Spectroscopy	3
CHEM 125	Physical Chemistry Laboratory	3
CHEM C130	Biophysical Chemistry: Physical Principles and the Molecules of Life	4
CHEM 130B	Biophysical Chemistry (2 units)	3
CHEM 135	Chemical Biology	3
CHEM C138	The Berkeley Lectures on Energy: Energy from Biomass	3
CHEM 143	Nuclear Chemistry	2
CHEM 146	Radiochemical Methods in Nuclear Technology and Forensics	3
CHEM C150	Introduction to Materials Chemistry	3
CHEM C170L	Biochemical Engineering Laboratory	3
CHEM C178	Polymer Science and Technology	3
CHEM C182	Atmospheric Chemistry and Physics Laboratory	3
CHEM C191	Quantum Information Science and Technology	3
CHEM 192	Individual Study for Advanced Undergraduates	1-3
CHEM H194	Research for Advanced Undergraduates	2-4
CHEM 195	Special Topics	3
CHEM 196	Special Laboratory Study	2-4
CIV ENG C106	Air Pollution	3
CIV ENG 111	Environmental Engineering	3
CIV ENG 112	Environmental Engineering Design	3
CIV ENG 114	Environmental Microbiology	3
CIV ENG 115	Water Chemistry	3
CIV ENG C116	Chemistry of Soils	3
CIV ENG C133	Engineering Analysis Using the Finite Element Method	3
COMPSCI 160	User Interface Design and Development	4
COMPSCI 162	Operating Systems and System Programming	4
COMPSCI 164	Programming Languages and Compilers	4
COMPSCI 170	Efficient Algorithms and Intractable Problems	4
COMPSCI 174	Combinatorics and Discrete Probability	4
COMPSCI 184	Foundations of Computer Graphics	4
COMPSCI C191	Quantum Information Science and Technology	3
EPS 103	Introduction to Aquatic and Marine Geochemistry	4
EPS 111	Petroleum Geology	3
EPS C129	Biometeorology	3
EPS 131	Geochemistry	4

EPS C162	Planetary Astrophysics	4	MATH 126	Introduction to Partial Differential Equations	4
EPS C180	Air Pollution	3	MATH 128A	Numerical Analysis	4
EPS C181	Atmospheric Physics and Dynamics	3	MATH 128B	Numerical Analysis	4
EPS C182	Atmospheric Chemistry and Physics Laboratory	3	MATH 130	The Classical Geometries	4
EPS C183	Carbon Cycle Dynamics	3	MATH 135	Introduction to the Theory of Sets	4
ECON C103	Introduction to Mathematical Economics	4	MATH 136	Incompleteness and Undecidability	4
EDUC 223B	Special Problems in Mathematics, Science and Technology Education (graduate-level; requires consent of instructor)	2-6	MATH 140	Metric Differential Geometry	4
EDUC 224A	Mathematical Thinking and Problem Solving (graduate-level; requires consent of instructor)	3	MATH 142	Elementary Algebraic Topology	4
ENGIN 117	Methods of Engineering Analysis	3	MATH 170	Mathematical Methods for Optimization	4
ENGIN 128	Advanced Engineering Design Graphics	3	MATH 185	Introduction to Complex Analysis	4
ESPM 119	Chemical Ecology	2	MATH H185	Honors Introduction to Complex Analysis	4
ESPM 120	Soil Characteristics	3	MATH 189	Mathematical Methods in Classical and Quantum Mechanics	4
ESPM C128	Chemistry of Soils	3	MEC ENG 107	Mechanical Engineering Laboratory	3
ESPM C129	Biometeorology	3	MEC ENG C115	Molecular Biomechanics and Mechanobiology of the Cell	4
ESPM C138	Introduction to Comparative Virology	4	MEC ENG C117	Structural Aspects of Biomaterials	4
ESPM C148	Pesticide Chemistry and Toxicology	3	MEC ENG 118	Introduction to Nanotechnology and Nanoscience	3
ESPM C180	Air Pollution	3	MEC ENG C176	Orthopedic Biomechanics	4
IND ENG 172	Probability and Risk Analysis for Engineers	3	MEC ENG C180	Engineering Analysis Using the Finite Element Method	3
INTEGBI 106A	Physical and Chemical Environment of the Ocean	4	MCELLBI C100A	Biophysical Chemistry: Physical Principles and the Molecules of Life	4
INTEGBI 115	Introduction to Systems in Biology and Medicine	4	MCELLBI C103	Bacterial Pathogenesis	3
MAT SCI 102	Bonding, Crystallography, and Crystal Defects	3	MCELLBI 104	Genetics, Genomics, and Cell Biology	4
MAT SCI 103	Phase Transformations and Kinetics	3	MCELLBI 110	Molecular Biology: Macromolecular Synthesis and Cellular Function	4
MAT SCI 104	Materials Characterization	4	MCELLBI C110L	General Biochemistry and Molecular Biology Laboratory	4
MAT SCI 111	Properties of Electronic Materials	4	MCELLBI C112	General Microbiology	4
MAT SCI 112	Corrosion (Chemical Properties)	3	MCELLBI C112L	General Microbiology Laboratory	2
MAT SCI 113	Mechanical Behavior of Engineering Materials	3	MCELLBI C114	Introduction to Comparative Virology	4
MAT SCI 117	Properties of Dielectric and Magnetic Materials	3	MCELLBI C116	Microbial Diversity	3
MAT SCI C118	Biological Performance of Materials	4	MCELLBI 118	The Cancer Karyotype: What it is and What it Does	1
MAT SCI 120	Materials Production	3	MCELLBI 133L	Physiology and Cell Biology Laboratory	4
MAT SCI 121	Metals Processing	3	MCELLBI 135A	Topics in Cell and Developmental Biology: Molecular Endocrinology	3
MAT SCI 122	Ceramic Processing	3	MCELLBI 140	General Genetics	4
MAT SCI 123	ELECTRONIC MATERIALS PROCESSING	4	MCELLBI 140L	Genetics Laboratory	4
MAT SCI 125	Thin-Film Materials Science	3	MCELLBI 141	Developmental Biology	4
MAT SCI 130	Experimental Materials Science and Design	3	MCELLBI 143	Evolution of Genomes, Cells, and Development	3
MAT SCI 140	Nanomaterials for Scientists and Engineers	3	MCELLBI C148	Microbial Genomics and Genetics	4
MAT SCI 151	Polymeric Materials	3	MCELLBI 150	Molecular Immunology	4
MATH C103	Introduction to Mathematical Economics	4	MCELLBI 150L	Immunology Laboratory	4
MATH 104	Introduction to Analysis	4	MCELLBI 160L	Neurobiology Laboratory	4
MATH H104	Honors Introduction to Analysis	4	NUC ENG 101	Nuclear Reactions and Radiation	4
MATH 105	Second Course in Analysis	4	NUC ENG 104	Radiation Detection and Nuclear Instrumentation Laboratory	4
MATH 110	Linear Algebra	4	NUC ENG 107	Introduction to Imaging	3
MATH H110	Honors Linear Algebra	4	NUC ENG 120	Nuclear Materials	4
MATH 113	Introduction to Abstract Algebra	4	NUC ENG 124	Radioactive Waste Management	3
MATH H113	Honors Introduction to Abstract Algebra	4	NUC ENG 130	Analytical Methods for Non-proliferation	3
MATH 114	Second Course in Abstract Algebra	4	NUC ENG 150	Introduction to Nuclear Reactor Theory	4
MATH 115	Introduction to Number Theory	4			
MATH 121A	Mathematical Tools for the Physical Sciences	4			
MATH 121B	Mathematical Tools for the Physical Sciences	4			
MATH 123	Ordinary Differential Equations	4			
MATH 125A	Mathematical Logic	4			

NUC ENG 161	Nuclear Power Engineering	4
NUC ENG 162	Radiation Biophysics and Dosimetry	3
NUC ENG 170A	Nuclear Design: Design in Nuclear Power Technology and Instrumentation	3
NUC ENG 170B	Nuclear Design: Design in Bionuclear, Nuclear Medicine, and Radiation Therapy	3
NUC ENG 180	Introduction to Controlled Fusion	3
NUSCTX 103	Nutrient Function and Metabolism	3
NUSCTX 108A	Introduction and Application of Food Science	3
NUSCTX 110	Toxicology	4
NUSCTX 115	Principles of Drug Action	2
NUSCTX 160	Metabolic Bases of Human Health and Diseases	4
NUSCTX 171	Nutrition and Toxicology Laboratory	4
PHYSICS 7C	Physics for Scientists and Engineers (must be completed with a grade of C- or better)	4
PHYSICS 105	Analytic Mechanics	4
PHYSICS 110A	Electromagnetism and Optics	4
PHYSICS 110B	Electromagnetism and Optics	4
PHYSICS 112	Introduction to Statistical and Thermal Physics	4
PHYSICS 130	Quantum and Nonlinear Optics	3
PHYSICS 137B	Quantum Mechanics	4
PHYSICS 138	Modern Atomic Physics	3
PHYSICS 141A	Solid State Physics	4
PHYSICS 141B	Solid State Physics	3
PHYSICS C191	Quantum Information Science and Technology	3
PLANTBI C103	Bacterial Pathogenesis	3
PLANTBI C112	General Microbiology	4
PLANTBI C112L	General Microbiology Laboratory	2
PLANTBI C114	Introduction to Comparative Virology	4
PLANTBI C116	Microbial Diversity	3
PLANTBI 120	Biology of Algae	2
PLANTBI 120L	Laboratory for Biology of Algae	2
PLANTBI 122	Bioenergy	2
PLANTBI C124	The Berkeley Lectures on Energy: Energy from Biomass	3
PLANTBI 135	Physiology and Biochemistry of Plants	3
PLANTBI C148	Microbial Genomics and Genetics	4
PLANTBI 150	Plant Cell Biology	3
PLANTBI 160	Plant Molecular Genetics	3
PLANTBI 170	Modern Applications of Plant Biotechnology	2
PLANTBI 180	Environmental Plant Biology	2
PB HLTH C102	Bacterial Pathogenesis	3
PB HLTH 142	Introduction to Probability and Statistics in Biology and Public Health	4
PB HLTH 162A	Public Health Microbiology	3
PB HLTH 162L	Public Health Microbiology Laboratory	1
STAT 134	Concepts of Probability	4
STAT 135	Concepts of Statistics	4
STAT 140	Probability for Data Science	4

All students in the College of Chemistry are required to complete the University requirements of American Cultures (<http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/chemistry/american-cultures-requirement>), American History and Institutions ([\[guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/chemistry/american-history-institutions-requirements\]\(http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/chemistry/american-history-institutions-requirements\)\), and Entry-Level Writing \(<http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/chemistry/entry-level-writing-requirement>\). In addition, they must fulfill the following college requirements:](http://</a></p>
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## Reading and Composition (<http://guide.berkeley.edu/archive/2017-18/undergraduate/colleges-schools/chemistry/reading-composition-requirement>)

**In order to provide a solid foundation in reading, writing, and critical thinking the college requires lower division work in composition.**

- Chemical Biology and Chemistry majors: A and B-level courses by end of the second year

## Humanities and Social Sciences Breadth Requirement

The College of Chemistry's Humanities and Social Sciences breadth requirement promotes educational experiences that enrich and complement the technical requirements for each major.

### Chemistry & Chemical Biology majors

- 15 units total; includes Reading & Composition and American Cultures courses.
- Remaining units must come from the following lists of approved humanities and social science courses, excluding courses which only teach a skill (such as drawing or playing an instrument):

Arts and Literature (<https://ls.berkeley.edu/seven-course-breadth-arts-and-literature>)

Foreign Language (<https://berkeley.app.box.com/v/ugrad-foreign-lang-apprvd>)<sup>1,2</sup>

Historical Studies (<https://ls.berkeley.edu/seven-course-breadth-historical-studies>)

International Studies (<https://ls.berkeley.edu/seven-course-breadth-international-studies>)

Philosophy and Values (<https://ls.berkeley.edu/seven-course-breadth-philosophy-and-values>)

Social and Behavioral Sciences (<https://ls.berkeley.edu/seven-course-breadth-social-and-behavioral-sciences>)

- Breadth courses may be taken on a *Pass/No Pass* basis (excluding Reading and Composition).
- AP, IB, and GCE A-level exam credit (<http://chemistry.berkeley.edu/academics/current-undergraduates/exam-credit-info>) may be used to satisfy the breadth requirement.

<sup>1</sup> Elementary-level courses may not be in the student's native language and may not be structured primarily to teach the reading of scientific literature.

<sup>2</sup> For chemistry and chemical biology majors, elementary-level foreign language courses are not accepted toward the 15 unit breadth requirement if they are used (or are duplicates of high school courses used) to satisfy the Foreign Language requirement.



## Foreign Language

**The Foreign Language requirement may be satisfied with one foreign language, in one of the following ways:**

- By completing in high school the third year of one foreign language with minimum grades of C-.
- By completing at Berkeley the second semester of a sequence of courses in one foreign language or the equivalent at another institution. Only foreign language courses that include reading and composition as well as conversation are accepted in satisfaction of this requirement. Foreign language courses may be taken on a *Pass/No Pass* basis.
- By demonstrating equivalent knowledge of a foreign language through examination, including a College Entrance Examination Board (CEEB) Advanced Placement Examination with a score of 3 or higher (if taken before admission to college), an SAT II: Subject Test with a score of 590 or higher, or a proficiency examination offered by some departments at Berkeley or at another campus of the University of California.

## Class Schedule Requirements

- Minimum units per semester: 13.
- Maximum units per semester: 19.5.
- 12 units of course work each semester must satisfy degree requirements.
- Chemical Engineering freshmen and chemistry majors are required to enroll in a minimum of one chemistry course each semester.
- After the freshman year, Chemical Engineering majors must enroll in a minimum of one chemical and biomolecular engineering course each semester.

## Semester Limit

- Students who entered as freshmen: 8 semesters.
- Chemistry & Chemical Biology majors who entered as transfer students: 4 semesters.
- Chemical Engineering and Joint majors who entered as transfer students: 5 semesters.

Summer Sessions are excluded when determining the limit on semesters. Students who wish to delay graduation to complete a minor, a double major, or simultaneous degrees must request approval for delay of graduation before what would normally be their final two semesters. The College of Chemistry does not have a rule regarding maximum units that a student can accumulate.

## Senior Residence

After 90 units toward the bachelor's degree have been completed, at least 24 of the remaining units must be completed in residence in the College of Chemistry, in at least two semesters (the semester in which the 90 units are exceeded, plus at least one additional semester).

To count as a semester of residence for this requirement, a program must include at least 4 units of successfully completed courses. A summer session can be credited as a semester in residence if this minimum unit requirement is satisfied.

Juniors and seniors who participate in the UC Education Abroad Program (UCEAP) for a *full year* may meet a modified senior residence requirement. After 60 units toward the bachelor's degree have been completed, at least 24 (excluding UCEAP) of the remaining units must

be completed in residence in the College of Chemistry, in at least two semesters. At least 12 of the 24 units must be completed after the student has already completed 90 units. Undergraduate dean's approval for the modified senior residence requirement must be obtained before enrollment in the Education Abroad Program.

## Minimum Total Units

A student must successfully complete at least 120 semester units in order to graduate.

## Minimum Academic Requirements

A student must earn at least a C average (2.0 GPA) in all courses undertaken at UC including those from UC Summer Sessions, UC Education Abroad Program, and UC Berkeley Washington Program as well as XB courses from University Extension.

## Minimum Course Grade Requirements

Students in the College of Chemistry who receive a grade of D+ or lower in a chemical and biomolecular engineering or chemistry course for which a grade of C- or higher is required must repeat the course *at UC Berkeley*.

Students in the College of Chemistry must achieve:

- C- or higher in CHEM 4A before taking CHEM 4B.
- C- or higher in CHEM 4B before taking more advanced courses. C- or higher in CHEM 12A before taking CHEM 12B.
- GPA of at least 2.0 in all courses taken in the college in order to advance to and continue in the upper division.

Chemistry or Chemical Biology majors must also achieve:

- C- or higher in CHEM 120A and CHEM 120B if taken before CHEM 125 or CHEM C182.
- 2.0 GPA in all upper division courses taken at the University to satisfy major requirements.

Chemical Engineering students must also achieve:

- C- or higher in CHM ENG 140 before taking any other chemical and biomolecular engineering (CBE) courses.
- C- or higher in CHM ENG 150A to be eligible to take any other course in the 150 series.
- 2.0 GPA in all upper division courses taken at the University to satisfy major requirements.

Chemical Engineering students who do not achieve a grade of C- or higher in CHM ENG 140 on their first attempt are advised to change to another major. If the course is not passed with a grade of C- or higher on the second attempt, continuation in the Chemical Engineering program is normally not allowed.

## Minimum Progress

To make normal progress toward a degree, undergraduates must successfully complete 30 units of coursework each year. The continued enrollment of students who do not maintain normal progress will be subject to the approval of the undergraduate dean. To achieve minimum academic progress, the student must meet two criteria:

1. Completed no fewer units than 15 multiplied by the number of semesters, less one, in which the student has been enrolled at

Berkeley. Summer sessions do not count as semesters for this purpose.

2. A student's class schedule must contain at least 13 units in any term, unless otherwise authorized by the staff adviser or the undergraduate dean.

## Mission

Each Chemistry graduate will have completed an integrated, rigorous program which includes foundational course work in chemistry and in-depth course work in chemistry or chemistry-related fields. The ACS-certified degree further emphasizes laboratory experience and the development of professional skills. Advanced coursework and educational activities outside the traditional classroom, such as independent research, provide students the opportunity to conduct individual research projects or participate as a member of a research team. Many undergraduate students also benefit from taking our graduate courses in synthetic and physical chemistry.

At graduation, Chemistry majors will have a set of fundamental competencies that are knowledge-based, performance/skills-based, and effective.

## Learning Goals for the Major

All our graduates will be able to:

1. Master a broad set of chemical knowledge concerning the fundamentals in the basic areas of the discipline (organic, inorganic, analytical, physical, and biological chemistry).
2. Solve problems competently by identifying the essential parts of a problem and formulating a strategy for solving the problem. They will be able to rationally estimate the solution to a problem, apply appropriate techniques to arrive at a solution, test the correctness of the solution, and interpret their results.
3. Use computers in data acquisition and processing and use available software as a tool in data analysis.
4. Employ modern library search tools to locate and retrieve scientific information about a topic, chemical, chemical technique, or an issue relating to chemistry.
5. Successfully pursue their career objectives in advanced education in professional and/or graduate schools, in a scientific career in government or industry, in a teaching career in the school systems, or in a related career following graduation.

## Skills

All our graduates will demonstrate the ability to:

1. Understand the objective of their chemical experiments, properly carry out the experiments, and appropriately record and analyze the results.
2. Use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments.
3. Know and follow the proper procedures and regulations for safe handling and use of chemicals.
4. Communicate the concepts and results of their laboratory experiments through effective writing and oral communication skills.

## Chemical Biology

### CHEM 1A General Chemistry 3 Units

Terms offered: Fall 2018, Summer 2018 8 Week Session, Spring 2018  
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.

General Chemistry: [Read More](#) [+]

#### Rules & Requirements

**Prerequisites:** High school chemistry recommended

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

#### 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.

General Chemistry: [Read Less](#) [-]

## 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.

General Chemistry (Digital): Read More [ + ]

### 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

General Chemistry (Digital): Read Less [ - ]

## CHEM 1AL General Chemistry Laboratory 1 Unit

Terms offered: Fall 2018, Summer 2018 8 Week Session, Spring 2018

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. Concurrent enrollment in 1A is recommended.

General Chemistry Laboratory: Read More [ + ]

### Rules & Requirements

**Prerequisites:** 1A (may be taken concurrently)

**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.

General Chemistry Laboratory: Read Less [ - ]

## CHEM 1B General Chemistry 4 Units

Terms offered: Summer 2018 8 Week Session, Spring 2018, Summer 2017 8 Week Session

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.

General Chemistry: Read More [\[+\]](#)

### 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.

General Chemistry: Read Less [\[-\]](#)

## 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.

General Chemistry: Read More [\[+\]](#)

### Rules & Requirements

**Prerequisites:** High school chemistry is recommended

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

General Chemistry: Read Less [\[-\]](#)

## CHEM 3A Chemical Structure and Reactivity 3 Units

Terms offered: Fall 2018, Summer 2018 8 Week Session, Spring 2018

Introduction to organic chemical structures, bonding, and chemical reactivity. The organic chemistry of alkanes, alkyl halides, alcohols, alkenes, alkynes, and organometallics.

Chemical Structure and Reactivity: Read More [\[+\]](#)

### 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 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.

Chemical Structure and Reactivity: Read Less [\[-\]](#)



## CHEM 3AL Organic Chemistry Laboratory 2 Units

Terms offered: Fall 2018, Spring 2018, Fall 2017

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, recrystallization, and chromatography. Detailed discussions and applications of infrared and nuclear magnetic resonance spectroscopy will be included.

Organic Chemistry Laboratory: Read More [ + ]

### 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 3AL after taking 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.

Organic Chemistry Laboratory: Read Less [ - ]

## CHEM 3B Chemical Structure and Reactivity 3 Units

Terms offered: Fall 2018, Summer 2018 8 Week Session, Spring 2018  
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.

Chemical Structure and Reactivity: Read More [ + ]

### Rules & Requirements

**Prerequisites:** CHEM 3A and CHEM 3AL with min grades 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 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.

Chemical Structure and Reactivity: Read Less [ - ]

## CHEM 3BL Organic Chemistry Laboratory 2 Units

Terms offered: Fall 2018, Summer 2018 8 Week Session, Spring 2018

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.

Organic Chemistry Laboratory: Read More [ + ]

### 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 3BL after taking 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.

Organic Chemistry Laboratory: Read Less [ - ]

## 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, recrystallization, and chromatography. Detailed discussions and applications of infrared and nuclear magnetic resonance spectroscopy will be included.

Organic Chemistry Laboratory: [Read More](#) [+]

### 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. Chemistry 4A

**Credit Restrictions:** Students will receive no credit for N3AL after taking 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

Organic Chemistry Laboratory: [Read Less](#) [-]

## CHEM 4A General Chemistry and Quantitative Analysis 4 Units

Terms offered: Fall 2018, Fall 2017, Fall 2016

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.

General Chemistry and Quantitative Analysis: [Read More](#) [+]

### 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.

General Chemistry and Quantitative Analysis: [Read Less](#) [-]

## CHEM 4B General Chemistry and Quantitative Analysis 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016

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.

General Chemistry and Quantitative Analysis: Read More [+]

### 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 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.

General Chemistry and Quantitative Analysis: Read Less [-]

## CHEM 12A Organic Chemistry 5 Units

Terms offered: Fall 2018, Fall 2017, Fall 1978

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)  
Organic Chemistry: Read More [+]

### 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 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 112A

Organic Chemistry: Read Less [-]

## CHEM 12B Organic Chemistry 5 Units

Terms offered: Spring 2018

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)  
Organic Chemistry: Read More [ + ]

### 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

Organic Chemistry: Read Less [ - ]

## 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.  
Analytical and Bioanalytical Chemistry: Read More [ + ]

### 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.

Analytical and Bioanalytical Chemistry: Read Less [ - ]

## CHEM 24 Freshman Seminar 1 Unit

Terms offered: Spring 2017, Spring 2016, Spring 2015

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.  
Freshman Seminar: Read More [ + ]

### Rules & Requirements

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

Freshman Seminar: Read Less [ - ]

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

Terms offered: Fall 2017, Fall 2016, Spring 2016

Students with partial credit in lower division chemistry courses may, with consent of instructor, complete the credit under this heading.  
Supplementary Work in Lower Division Chemistry: Read More [ + ]

### 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.

Supplementary Work in Lower Division Chemistry: Read Less [ - ]

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

Terms offered: Fall 2017, Fall 2016, Fall 2015

Introduces freshmen 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.

Introduction to Research and Study in the College of Chemistry: Read More [+]

### Rules & Requirements

**Prerequisites:** Freshman standing in the College of Chemistry, or consent of instructor

**Credit Restrictions:** Students will receive no credit for Chemistry 96 after taking Chemistry C96 or Chemical and Biomolecular Engineering 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.

Introduction to Research and Study in the College of Chemistry: Read Less [-]

## CHEM 98 Supervised Group Study 1 - 4 Units

Terms offered: Fall 2018, Fall 2017, Spring 2017

Group study of selected topics.

Supervised Group Study: Read More [+]

### 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.

Supervised Group Study: Read Less [-]

## CHEM 98W Directed Group Study 1 Unit

Terms offered: Spring 2013, Fall 2012, Spring 2009

Topics vary with instructor. Enrollment restrictions apply.

Directed Group Study: Read More [+]

### 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 - 1 hour 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.

Directed Group Study: Read Less [-]

## 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.

Communicating Chemistry: Read More [+]

### 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

Communicating Chemistry: Read Less [-]



## CHEM 103 Inorganic Chemistry in Living Systems 3 Units

Terms offered: Fall 2018, Fall 2017, Fall 2016

The basic principles of metal ions and coordination chemistry applied to the study of biological systems.

Inorganic Chemistry in Living Systems: [Read More](#) [+]

### 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.

Inorganic Chemistry in Living Systems: [Read Less](#) [-]

## CHEM 104A Advanced Inorganic Chemistry 3 Units

Terms offered: Fall 2018, Fall 2017, Fall 2016

The chemistry of metals and nonmetals including the application of physical chemical principles.

Advanced Inorganic Chemistry: [Read More](#) [+]

### Rules & Requirements

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

**Credit Restrictions:** 104A: No restrictions; 104B: Students will receive two units of credit 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.

Advanced Inorganic Chemistry: [Read Less](#) [-]

## CHEM 104B Advanced Inorganic Chemistry 3 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016

The chemistry of metals and nonmetals including the application of physical chemical principles.

Advanced Inorganic Chemistry: [Read More](#) [+]

### 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.

Advanced Inorganic Chemistry: [Read Less](#) [-]

## CHEM 105 Instrumental Methods in Analytical Chemistry 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016

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.

Instrumental Methods in Analytical Chemistry: [Read More](#) [+]

### 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.

Instrumental Methods in Analytical Chemistry: [Read Less](#) [-]

## CHEM 108 Inorganic Synthesis and Reactions 4 Units

Terms offered: Fall 2018, Fall 2017, Fall 2016

The preparation of inorganic compounds using vacuum line, air-and moisture-exclusion, electrochemical, high-pressure, and other synthetic techniques. Kinetic and mechanistic studies of inorganic compounds.

Inorganic Synthesis and Reactions: [Read More](#) [+]

### Rules & Requirements

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

### 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.

Inorganic Synthesis and Reactions: [Read Less](#) [-]

## CHEM C110L General Biochemistry and Molecular Biology Laboratory 4 Units

Terms offered: Fall 2018, Spring 2018, Fall 2017

Experimental techniques of biochemistry and molecular biology, designed to accompany the lectures in Molecular and Cell Biology 100B and 110.

General Biochemistry and Molecular Biology Laboratory: [Read More](#) [+]

### 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

General Biochemistry and Molecular Biology Laboratory: [Read Less](#) [-]

## CHEM 113 Advanced Mechanistic Organic Chemistry 3 Units

Terms offered: Fall 2018, Fall 2016, Fall 2015

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.

Advanced Mechanistic Organic Chemistry: [Read More](#) [+]

### 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.

Advanced Mechanistic Organic Chemistry: [Read Less](#) [-]

## CHEM 114 Advanced Synthetic Organic Chemistry 3 Units

Terms offered: Spring 2018, Spring 2017, Spring 2015

Advanced topics in synthetic organic chemistry with a focus on selectivity. Topics include reductions, oxidations, enolate chemistry and the aldol reaction, reactions of non-stabilized anions, olefination reactions, pericyclic reactions and application to the synthesis of complex structures.

Advanced Synthetic Organic Chemistry: [Read More](#) [+]

### 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.

Advanced Synthetic Organic Chemistry: [Read Less](#) [-]

## CHEM 115 Organic Chemistry--Advanced Laboratory Methods 4 Units

Terms offered: Fall 2018, Summer 2018 First 6 Week Session, Spring 2018

Advanced synthetic methods, chemical and spectroscopic structural methods, designed as a preparation for experimental research.

Organic Chemistry--Advanced Laboratory Methods: Read More [\[+\]](#)

### Rules & Requirements

**Prerequisites:** 112B with a grade of C- or higher

### 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.

Organic Chemistry--Advanced Laboratory Methods: Read Less [\[-\]](#)

## CHEM 120A Physical Chemistry 3 Units

Terms offered: Fall 2018, Spring 2018, Fall 2017

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.

Physical Chemistry: Read More [\[+\]](#)

### 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.

Physical Chemistry: Read Less [\[-\]](#)

## CHEM 120B Physical Chemistry 3 Units

Terms offered: Fall 2018, Fall 2017, Fall 2016

Statistical mechanics, thermodynamics, equilibrium and applications to chemical systems: states of matter, solutions and solvation, chemical kinetics, molecular dynamics, and molecular transport.

Physical Chemistry: Read More [\[+\]](#)

### Rules & Requirements

**Prerequisites:** 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 per week

### Additional Details

**Subject/Course Level:** Chemistry/Undergraduate

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

Physical Chemistry: Read Less [\[-\]](#)

## CHEM 122 Quantum Mechanics and Spectroscopy 3 Units

Terms offered: Fall 2017, Spring 2017, Spring 2015

Postulates and methods of quantum mechanics and group theory applied to molecular structure and spectra.

Quantum Mechanics and Spectroscopy: Read More [\[+\]](#)

### 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.

Quantum Mechanics and Spectroscopy: Read Less [\[-\]](#)

## CHEM 125 Physical Chemistry Laboratory 3 Units

Terms offered: Fall 2018, Spring 2018, Fall 2017

Experiments in thermodynamics, kinetics, molecular structure, and general physical chemistry.

Physical Chemistry Laboratory: Read More [ + ]

### 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.

Physical Chemistry Laboratory: Read Less [ - ]

## CHEM 130B Biophysical Chemistry 3 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016

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.

Biophysical Chemistry: Read More [ + ]

### 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.

Biophysical Chemistry: Read Less [ - ]

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

Terms offered: Fall 2018, Spring 2018, Fall 2017

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.

Biophysical Chemistry: Physical Principles and the Molecules of Life: Read More [ + ]

### Rules & Requirements

**Prerequisites:** Chemistry 3A or 112A, Mathematics 1A, Biology 1A and 1AL; Chemistry 3B or 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

Biophysical Chemistry: Physical Principles and the Molecules of Life: Read Less [ - ]

## CHEM 135 Chemical Biology 3 Units

Terms offered: Fall 2018, Fall 2017, Fall 2016

One-semester introduction to biochemistry, aimed toward chemistry and chemical biology majors.

Chemical Biology: Read More [ + ]

### Rules & Requirements

**Prerequisites:** 3B or 112B; 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.

Chemical Biology: Read Less [ - ]

## 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.

The Berkeley Lectures on Energy: Energy from Biomass: Read More [\[+\]](#)

### 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. 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

The Berkeley Lectures on Energy: Energy from Biomass: Read Less [\[-\]](#)

## CHEM 143 Nuclear Chemistry 2 Units

Terms offered: Fall 2018, Fall 2017, Fall 2016

Radioactivity, fission, nuclear models and reactions, nuclear processes in nature. Computer methods will be introduced.

Nuclear Chemistry: Read More [\[+\]](#)

### 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.

Nuclear Chemistry: Read Less [\[-\]](#)

## CHEM 146 Radiochemical Methods in Nuclear Technology and Forensics 3 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016

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.

Radiochemical Methods in Nuclear Technology and Forensics: Read More [\[+\]](#)

### 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:** 4B or 15; 143 is recommended

### 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.

**Instructor:** Nitsche

Radiochemical Methods in Nuclear Technology and Forensics: Read Less [\[-\]](#)



## 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.

Supplementary Work in Upper Division Chemistry: Read More [\[+\]](#)

### 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.

Supplementary Work in Upper Division Chemistry: Read Less [\[-\]](#)

## CHEM C150 Introduction to Materials Chemistry 3 Units

Terms offered: Spring 2018, Spring 2017, Spring 2015, Spring 2014, Spring 2012

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.

Introduction to Materials Chemistry: Read More [\[+\]](#)

### Rules & Requirements

**Prerequisites:** 104A; 104B is 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

Introduction to Materials Chemistry: Read Less [\[-\]](#)

## CHEM C170L Biochemical Engineering Laboratory 3 Units

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

Laboratory techniques for the cultivation of microorganisms in batch and continuous reactions. Enzymatic conversion processes. Recovery of biological products.

Biochemical Engineering Laboratory: Read More [\[+\]](#)

### 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

Biochemical Engineering Laboratory: Read Less [\[-\]](#)

## CHEM C178 Polymer Science and Technology 3 Units

Terms offered: Spring 2018, 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.

Polymer Science and Technology: Read More [\[+\]](#)

### Rules & Requirements

**Prerequisites:** Junior standing

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Chemistry/Undergraduate

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

**Instructor:** Segalman

**Also listed as:** CHM ENG C178

Polymer Science and Technology: Read Less [\[-\]](#)

## CHEM C182 Atmospheric Chemistry and Physics Laboratory 3 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016

Fluid dynamics, radiative transfer, and the kinetics, spectroscopy, and measurement of atmospherically relevant species are explored through laboratory experiments, numerical simulations, and field observations. Atmospheric Chemistry and Physics Laboratory: Read More [ + ]

### 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.

**Also listed as:** EPS C182

Atmospheric Chemistry and Physics Laboratory: Read Less [ - ]

## CHEM C191 Quantum Information Science and Technology 3 Units

Terms offered: Spring 2017, Fall 2014, Spring 2012

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.

Quantum Information Science and Technology: Read More [ + ]

### 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:** Crommie, Vazirani, Whaley

**Also listed as:** COMPSCI C191/PHYSICS C191

Quantum Information Science and Technology: Read Less [ - ]

## 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.

Individual Study for Advanced Undergraduates: Read More [ + ]

### 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.

Individual Study for Advanced Undergraduates: Read Less [ - ]

## 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.

Senior Honors Thesis: Read More [ + ]

### 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.

Senior Honors Thesis: Read Less [ - ]

## CHEM H194 Research for Advanced Undergraduates 2 - 4 Units

Terms offered: Fall 2016, Summer 2016 8 Week Session, Spring 2016  
Students may pursue original research under the direction of one of the members of the staff.

Research for Advanced Undergraduates: Read More [\[+\]](#)

### 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 hours of independent study per week

### Summer:

0 weeks - 2-4 hours of independent study per week

6 weeks - 2-4 hours of independent study per week

8 weeks - 2-4 hours of independent study per week

### Additional Details

**Subject/Course Level:** Chemistry/Undergraduate

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

Research for Advanced Undergraduates: Read Less [\[-\]](#)

## CHEM 195 Special Topics 3 Units

Terms offered: Fall 2018, Spring 2018, Spring 2016  
Special topics will be offered from time to time. Examples are: photochemical air pollution, computers in chemistry.  
Special Topics: Read More [\[+\]](#)

### 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.

Special Topics: Read Less [\[-\]](#)

## CHEM 196 Special Laboratory Study 2 - 4 Units

Terms offered: Spring 2016, Fall 2015, Summer 2015 8 Week Session  
Special laboratory work for advanced undergraduates.

Special Laboratory Study: Read More [\[+\]](#)

### 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 - 1-1 hours of independent study per week

### Summer:

6 weeks - 2.5-2.5 hours of independent study per week

8 weeks - 2-2 hours of independent study per week

10 weeks - 1.5-1.5 hours of independent study per week

### Additional Details

**Subject/Course Level:** Chemistry/Undergraduate

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

Special Laboratory Study: Read Less [\[-\]](#)

## CHEM 197 Field Study in Chemistry 1 - 4 Units

Terms offered: Summer 2016 8 Week Session, Spring 2016, Summer 2015 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.

Field Study in Chemistry: Read More [\[+\]](#)

### 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.

Field Study in Chemistry: Read Less [\[-\]](#)

## **CHEM 198 Directed Group Study 1 - 4 Units**

Terms offered: Fall 2018, Summer 2018 Second 6 Week Session, Fall 2017

Group study of selected topics.

Directed Group Study: Read More [\[+\]](#)

### **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.

Directed Group Study: Read Less [\[-\]](#)

## **CHEM 199 Supervised Independent Study and Research 1 - 4 Units**

Terms offered: Spring 2016, Fall 2015, Spring 2015

Enrollment is restricted by regulations listed in the .

Supervised Independent Study and Research: Read More [\[+\]](#)

### **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.

Supervised Independent Study and Research: Read Less [\[-\]](#)