Chemistry

UC Berkeley currently offers two Bachelors degrees in Chemistry: a Bachelor of Science (BS) through the College of Chemistry and a Bachelor of Arts (BA) through the College of Letters and Science. For specific information regarding degree requirements for each, please refer to the information below, and the appropriate Major Requirements and College Requirements tabs on this page.

BS in Chemistry, College of Chemistry

The BS in Chemistry is intended for students who are primarily interested in careers as professional chemists or wish to have a thorough grounding in chemistry in preparation for professional or graduate school in chemistry and related disciplines. Students in the BS program may also choose to pursue the Materials Chemistry Concentration.

Students interested in subsequent graduate studies in chemistry will receive a better preparation by pursuing the BS in Chemistry.

BA in Chemistry, College of Letters & Science

The BA in Chemistry includes a greater number of humanities and social science courses than the Bachelor of Science Degree and is intended for those interested in careers in teaching, medicine, or other sciences in which a basic understanding of chemical processes is necessary.

Students who want to pursue the BA degree should apply for admission to the College of Letters and Science.

Honors Program

To be eligible to receive honors in Chemistry at graduation, candidates for the BA degree must earn a grade point average (GPA) of at least 3.5 in upper division courses in the major and at least 3.3 overall at UC Berkeley; and complete at least three units of Chemistry H194 or another advanced chemistry course as approved by the department.

Minor Program

The College of Chemistry offers a minor program in Chemistry. Chemical Biology majors are not eligible to pursue this minor. Students must submit a notification of completion of the minor to the College of Chemistry Undergraduate Advising Office.

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 the upper-division.
3. A minimum GPA of 2.0 in all upper-division courses taken at the University is required to satisfy major requirements.
4. 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.

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	General Chemistry and Quantitative Analysis	4
CHEM 4B	General Chemistry and Quantitative Analysis	4
CHEM 112A	Organic Chemistry	5
CHEM 112B	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

Notes

1. Students should take CHEM 4A and CHEM 4B during their freshman year, and CHEM 112A and CHEM 112B during their sophomore year.
2. 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 112A before taking CHEM 112B.
3. A grade of C- or better is required in CHEM 112A before taking BIOLOGY 1A.
4. 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.
5. 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 112A and CHEM 112B. Students who join the program after completing only CHEM 3A plus CHEM 3AL at Berkeley are recommended to take CHEM 112B.
6. Students should start MATH 1A in the first semester of their freshman year.
7. Students should start PHYSICS 7A in the second semester of their freshman year.

Upper-division Requirements

For information regarding the upper-division requirements for the Materials Chemistry concentration, see below.

CHEM 104A	Advanced Inorganic Chemistry	3
CHEM 104B	Advanced Inorganic Chemistry	3
CHEM 120A	Physical Chemistry	3
CHEM 120B	Physical Chemistry	3
CHEM 125	Physical Chemistry Laboratory [1]	3
Select one of the following:		4
CHEM 105	Instrumental Methods in Analytical Chemistry	
CHEM 108	Inorganic Synthesis and Reactions	
CHEM 115	Organic Chemistry--Advanced Laboratory Methods	

CHEM 146	Radiochemical Methods in Nuclear Technology and Forensics	
Select 15 units of upper-division Chemistry and Allied Subjects courses (see below) [2]		15
One course must be an additional lecture course (or lab/lecture course) as approved by the student's staff adviser		

1 CHEM C182 may be substituted for CHEM 125

2 Advanced Placement, Advanced Level, and International Baccalaureate credit cannot be applied to 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.
No more than 4 units of research may be used to satisfy this requirement.

Allied Subjects Courses

ASTRON C162	Planetary Astrophysics	4
BIO ENG 100	Ethics in Science and Engineering	3
BIO ENG 104	Biological Transport Phenomena	4
BIO ENG C105B	Course Not Available	
BIO ENG 111	Functional Biomaterials Development and Characterization	4
BIO ENG 112	Molecular Cell Biomechanics	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 C141	Course Not Available	
BIO ENG 143	Computational Methods in Biology	4
BIO ENG C144	Introduction to Protein Informatics	4
BIO ENG C144L	Protein Informatics Laboratory	3
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 174	Course Not Available	
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 185	Technical Communication for Chemical Engineers	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 108	Course Not Available	
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 105	Course Not Available	
EPS 111	Petroleum Geology	3
EPS C129	Biometeorology	3
EPS 131	Geochemistry	4
EPS C162	Planetary Astrophysics	4
EPS C180	Air Pollution	3
EPS C183	Carbon Cycle Dynamics	3
EPS C182	Atmospheric Chemistry and Physics Laboratory	3
EPS 185	Marine Geobiology	2
ECON C103	Introduction to Mathematical Economics	4
EDUC 223B	Special Problems in Mathematics, Science and Technology Education (graduate-level; requires consent of instructor)	2-6
EDUC 224A	Mathematical Thinking and Problem Solving (graduate-level; requires consent of instructor)	3
EL ENG 100	Electronic Techniques for Engineering	4
ENE,RES 102	Quantitative Aspects of Global Environmental Problems	4
ENGIN 117	Methods of Engineering Analysis	3
ENGIN 128	Advanced Engineering Design Graphics	3
ESPM 119	Chemical Ecology	2
ESPM 120	Soil Characteristics	3
ESPM C128	Chemistry of Soils	3
ESPM C129	Biometeorology	3
ESPM C138	Introduction to Comparative Virology	4
ESPM C148	Pesticide Chemistry and Toxicology	3
ESPM C180	Air Pollution	3
INTEGBI 106A	Physical and Chemical Environment of the Ocean	4
INTEGBI 115	Introduction to Systems in Biology and Medicine	4
MAT SCI 102	Bonding, Crystallography, and Crystal Defects	3
MAT SCI 103	Phase Transformations and Kinetics	3
MAT SCI 104	Materials Characterization	4
MAT SCI 111	Properties of Electronic Materials	4
MAT SCI 112	Corrosion (Chemical Properties)	3
MAT SCI 113	Mechanical Behavior of Engineering Materials	3
MAT SCI 117	Properties of Dielectric and Magnetic Materials	3
MAT SCI C118	Biological Performance of Materials	4
MAT SCI 120	Materials Production	3
MAT SCI 121	Metals Processing	3
MAT SCI 122	Ceramic Processing	3
MAT SCI 123	Semiconductor Processing	3
MAT SCI 125	Thin-Film Materials Science	3
MAT SCI 130	Experimental Materials Science and Design	3
MAT SCI 140	Nanomaterials for Scientists and Engineers	3
MAT SCI 151	Polymeric Materials	3
MATH C103	Introduction to Mathematical Economics	4
MATH 104	Introduction to Analysis	4
MATH H104	Honors Introduction to Analysis	4
MATH 105	Second Course in Analysis	4
MATH 110	Linear Algebra	4
MATH H110	Honors Linear Algebra	4
MATH 113	Introduction to Abstract Algebra	4
MATH H113	Honors Introduction to Abstract Algebra	4
MATH 114	Second Course in Abstract Algebra	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
MATH 126	Introduction to Partial Differential Equations	4
MATH 128A	Numerical Analysis	4
MATH 128B	Numerical Analysis	4
MATH 130	The Classical Geometries	4
MATH 135	Introduction to the Theory of Sets	4
MATH 136	Incompleteness and Undecidability	4
MATH 140	Metric Differential Geometry	4
MATH 142	Elementary Algebraic Topology	4
MATH 170	Mathematical Methods for Optimization	4
MATH 185	Introduction to Complex Analysis	4
MATH H185	Honors Introduction to Complex Analysis	4
MATH 187	Course Not Available	
MATH 189	Mathematical Methods in Classical and Quantum Mechanics	4
MEC ENG		
MEC ENG C105B	Course Not Available	
MEC ENG 107	Mechanical Engineering Laboratory	3
MEC ENG C115	Molecular Biomechanics and Mechanobiology of the Cell	4
MEC ENG C117	Structural Aspects of Biomaterials	4
MEC ENG 118	Introduction to Nanotechnology and Nanoscience	3
MEC ENG C124	Course Not Available	
MEC ENG C176	Orthopedic Biomechanics	4
MEC ENG C180	Engineering Analysis Using the Finite Element Method	3
MCELLBI C100A	Biophysical Chemistry: Physical Principles and the Molecules of Life	4
MCELLBI C103	Bacterial Pathogenesis	3
MCELLBI 104	Genetics, Genomics, and Cell Biology	4
MCELLBI 110	Molecular Biology: Macromolecular Synthesis and Cellular Function	4
MCELLBI C110L	General Biochemistry and Molecular Biology Laboratory	4
MCELLBI 111	Course Not Available	
MCELLBI C112	General Microbiology	4

MCELLBI C112L	General Microbiology Laboratory	2
MCELLBI 113	Course Not Available	
MCELLBI C114	Introduction to Comparative Virology	4
MCELLBI 115	Course Not Available	
MCELLBI C116	Microbial Diversity	3
MCELLBI 118	The Cancer Karyotype: What it is and What it Does	1
MCELLBI 130A	Cell and Systems Biology	4
MCELLBI 130L	Course Not Available	
MCELLBI 133L	Physiology and Cell Biology Laboratory	4
MCELLBI 140	General Genetics	4
MCELLBI 140L	Genetics Laboratory	4
MCELLBI 141	Developmental Biology	4
MCELLBI 143	Evolution of Genomes, Cells, and Development	3
MCELLBI C148	Microbial Genomics and Genetics	4
MCELLBI 150	Molecular Immunology	4
MCELLBI 150L	Immunology Laboratory	4
MCELLBI C160	Course Not Available	
MCELLBI 160L	Neurobiology Laboratory	4
MCELLBI 167	Course Not Available	
NUC ENG 101	Nuclear Reactions and Radiation	4
NUC ENG 104	Radiation Detection and Nuclear Instrumentation Laboratory	4
NUC ENG 107	Introduction to Imaging	3
NUC ENG 120	Nuclear Materials	4
NUC ENG 124	Radioactive Waste Management	3
NUC ENG 130	Analytical Methods for Non-proliferation	4
NUC ENG 150	Introduction to Nuclear Reactor Theory	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 C112	Course Not Available	
NUSCTX 115	Principles of Drug Action	2
NUSCTX C119	Course Not Available	
NUSCTX 120	Course Not Available	
NUSCTX 150	Course Not Available	
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 135L	Course Not Available	
PLANTBI C144	Introduction to Protein Informatics	4
PLANTBI C144L	Protein Informatics Laboratory	3
PLANTBI C148	Microbial Genomics and Genetics	4
PLANTBI 150	Plant Cell Biology	3
PLANTBI 150L	Course Not Available	
PLANTBI 160	Plant Molecular Genetics	3
PLANTBI 160L	Course Not Available	
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 C143	Course Not Available	
PB HLTH 162A	Public Health Microbiology	3
PB HLTH 162L	Public Health Microbiology Laboratory	1
PB HLTH C170B	Course Not Available	
PB HLTH 172	Course Not Available	
PB HLTH C172	Course Not Available	
STAT 134	Concepts of Probability	3
STAT 135	Concepts of Statistics	4
STAT C141	Course Not Available	
STAT C143	Course Not Available	

Upper-division Requirements: Materials Chemistry Concentration

CHEM 104A	Advanced Inorganic Chemistry	3
CHEM 104B	Advanced Inorganic Chemistry	3
CHEM 120A	Physical Chemistry	3
CHEM 120B	Physical Chemistry	3
CHEM C150	Introduction to Materials Chemistry	3
Select two laboratory courses from the following:		
CHEM 105	Instrumental Methods in Analytical Chemistry	
or CHEM 125	Physical Chemistry Laboratory	
CHEM 108	Inorganic Synthesis and Reactions	
or CHEM 115	Organic Chemistry--Advanced Laboratory Methods	
Electives. Select 10 units of the following:		10

BIO ENG C118	Biological Performance of Materials
CHEM C178	Polymer Science and Technology
MAT SCI 104	Materials Characterization
MEC ENG 118	Introduction to Nanotechnology and Nanoscience
PHYSICS 141A	Solid State Physics
PHYSICS 141B	Solid State Physics

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. All courses taken to fulfill the major requirements below must be taken for graded credit, other than courses listed which are offered on a *Pass/Fail* basis only. Other exceptions to this requirement are noted as applicable.
2. No more than one upper-division course may be used to simultaneously fulfill requirements for a student's major and minor programs, with the exception of minors offered outside of the College of Letters and Science.
3. A minimum grade point average (GPA) of 2.0 must be maintained in both upper- and lower-division courses used to fulfill the major requirements.

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

Lower-division Requirements

CHEM 4A	General Chemistry and Quantitative Analysis [1, 2]	4
CHEM 4B	General Chemistry and Quantitative Analysis [1, 2]	4
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

1. A grade of C- or better is required in CHEM 4A before taking CHEM 4B, and in CHEM 4B before taking more advanced courses.
2. Students who declare the major after completing a general chemistry sequence that does not include quantitative analysis are required to take CHEM 4B, CHEM 15, or CHEM 105.

Upper-division Requirements

CHEM 104A	Advanced Inorganic Chemistry [1]	3
CHEM 104B	Advanced Inorganic Chemistry [1]	3
CHEM 112A	Organic Chemistry [2]	5
CHEM 112B	Organic Chemistry [2]	5
CHEM 120A	Physical Chemistry [3]	3
CHEM 120B	Physical Chemistry [3]	3
Select one of the following:		4
CHEM 105	Instrumental Methods in Analytical Chemistry	
CHEM 108	Inorganic Synthesis and Reactions	
CHEM 115	Organic Chemistry--Advanced Laboratory Methods	
CHEM 125	Physical Chemistry Laboratory [3]	
CHEM C170L	Biochemical Engineering Laboratory	
CHEM C182	Atmospheric Chemistry and Physics Laboratory	

1. CHEM 103 and CHEM 135 may be substituted for CHEM 104A and CHEM 104B.
2. A grade of C- or better is required in CHEM 112A before taking CHEM 112B.
3. A grade of C- or higher is required in CHEM 120A and CHEM 120B if taken before CHEM 125.

Students who have a strong interest in an area of study outside their major often decide to complete a minor program. These programs have set requirements and are noted officially on the transcript in the memoranda section, but are not noted on diplomas.

General Guidelines

1. All courses taken to fulfill the minor requirements below must be taken for graded credit.
2. A minimum of three of the upper-division courses taken to fulfill the minor requirements must be completed at UC Berkeley.
3. A minimum grade point average (GPA) of 2.0 is required for courses used to fulfill the minor requirements.
4. Students must consult with their college/school for information regarding overlap of courses between their majors and minors.

Requirements

Select one of the following options:		10
CHEM 3A & 3AL & CHEM 3B & CHEM 3BL	Chemical Structure and Reactivity and Organic Chemistry Laboratory and Chemical Structure and Reactivity and Organic Chemistry Laboratory	
CHEM 112A & CHEM 112B	Organic Chemistry and Organic Chemistry	
Select one of the following:		
CHEM 120A & CHEM 120B	Physical Chemistry and Physical Chemistry	
CHEM C130 & CHEM 130E	Biophysical Chemistry: Physical Principles and the Molecules of Life and Biophysical Chemistry	
Select two additional upper-division Chemistry courses taken at Berkeley, excluding courses numbered 190-199		

Undergraduate students in the College of Chemistry must fulfill the following requirements in addition to those required by the major program.

For detailed lists of courses that fulfill college requirements, please see the College of Chemistry (http://guide.berkeley.edu/archive/2014-15/undergraduate/colleges-schools/chemistry/#collegerequirementstext) page in this bulletin.

Entry Level Writing

All students who will enter the University of California as freshmen must demonstrate their command of the English language by fulfilling the

Entry Level Writing Requirement. Fulfillment of this requirement is also a prerequisite to enrollment in all reading and composition courses at UC Berkeley.

American History and American Institutions

The American History and Institutions requirements are based on the principle that a U.S. resident graduated from an American university should have an understanding of the history and governmental institutions of the United States.

American Cultures

American Cultures is the one requirement that all undergraduate students at Cal need to take and pass in order to graduate. The requirement offers an exciting intellectual environment centered on the study of race, ethnicity and culture of the United States. AC courses offer students opportunities to be part of research-led, highly accomplished teaching environments, grappling with the complexity of American Culture.

Foreign Language

Applies to Chemistry and Chemical Biology majors only.

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.

Reading and Composition

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

- Chemical Engineering majors – A-level R&C course (e.g., English R1A) by end of freshman year
- Chemical Biology and Chemistry majors – A- and B-level courses by end of sophomore year

Breadth Elective Requirement – Chemistry & Chemical Biology majors

- 15 units total; includes Reading & Composition (R1A + R1B) and American Cultures courses
- Remaining units must come from the College of Chemistry's list of acceptable Humanities and Social Science courses (Group II)
- Breadth elective courses may be taken on a Pass/No Pass basis (excluding R&C)
- AP, IB, and GCE A-level exam credit may be used to satisfy the breadth requirement

Breadth Elective Requirement – Chemical Engineering major

- 19 unit total; includes Reading & Composition (R1A only) and American Cultures courses
- Breadth Series requirement: As part of the 19 units, students must complete two courses, at least one being upper division, in the same or very closely allied humanities or social science department(s). AP credit may be used to satisfy the lower division aspect of the requirement.
- Breadth Series courses and all remaining units must come from the College of Chemistry's list of acceptable Humanities and Social Science courses (Group II)
- Breadth elective courses may be taken on a Pass/No Pass basis (excluding R&C)
- AP, IB, and GCE A-level exam credit may be used to satisfy the breadth requirement

Class Schedule Requirements

Minimum units per semester

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 majors who entered as transfer students – 5 semester

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 (EAP) 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 EAP) 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

Grades

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 Berkeley.

Students in the College of Chemistry must achieve:

- C- or higher in CHEM 4A (http://guide.berkeley.edu/search/?P=CHEM%204A) General Chemistry and Quantitative Analysis before taking CHEM 4B (http://guide.berkeley.edu/search/?P=CHEM%204B) General Chemistry and Quantitative Analysis
- C- or higher in CHEM 4B (http://guide.berkeley.edu/search/?P=CHEM%204B) General Chemistry and Quantitative Analysis before taking more advanced courses
- C- or higher in CHEM 112A (http://guide.berkeley.edu/search/?P=CHEM%20112A) Organic Chemistry before taking CHEM 112B (http://guide.berkeley.edu/search/?P=CHEM%20112B) Organic Chemistry 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 (http://guide.berkeley.edu/search/?P=CHEM%20120A) Physical Chemistry and CHEM 120B (http://guide.berkeley.edu/search/?P=CHEM%20120B) Physical Chemistry if taken before CHEM 125 (http://guide.berkeley.edu/search/?P=CHEM%20125) Physical Chemistry Laboratory or CHEM C182 (http://guide.berkeley.edu/search/?P=CHEM%20C182) Atmospheric Chemistry and Physics Laboratory
- 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 Chemical and Biomolecular Engineering (CBE) 140 before taking any other CBE courses
- C- or higher in CHM ENG 150A (http://guide.berkeley.edu/search/?P=CHM%20ENG%20150A) Transport Processes 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 (http://guide.berkeley.edu/search/?P=CHM%20ENG%20140) Introduction to Chemical Process Analysis 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.

Undergraduate students in the College of Letters and Science must fulfill the following requirements in addition to those required by their major program.

For detailed lists of courses that fulfill college requirements, please see the College of Letters and Sciences (http://guide.berkeley.edu/archive/2014-15/undergraduate/colleges-schools/letters-science) page in this bulletin.

Entry Level Writing

All students who will enter the University of California as freshmen must demonstrate their command of the English language by fulfilling the Entry Level Writing Requirement. Fulfillment of this requirement is also a prerequisite to enrollment in all reading and composition courses at UC Berkeley.

American History and American Institutions

The American History and Institutions requirements are based on the principle that a U.S. resident graduated from an American university should have an understanding of the history and governmental institutions of the United States.

American Cultures

American Cultures is the one requirement that all undergraduate students at Cal need to take and pass in order to graduate. The requirement offers an exciting intellectual environment centered on the study of race,

ethnicity and culture of the United States. AC courses offer students opportunities to be part of research-led, highly accomplished teaching environments, grappling with the complexity of American Culture.

Quantitative Reasoning

The Quantitative Reasoning requirement is designed to ensure that students graduate with basic understanding and competency in math, statistics, or computer science. The requirement may be satisfied by exam or by taking an approved course.

Foreign Language

The Foreign Language requirement may be satisfied by demonstrating proficiency in reading comprehension, writing, and conversation in a foreign language equivalent to the second semester college level, either by passing an exam or by completing approved course work.

Reading and Composition

In order to provide a solid foundation in reading, writing and critical thinking the College requires two semesters of lower division work in composition. Students must complete a first-level reading and composition course by the end of their second semester and a second-level course by the end of their fourth semester.

Breadth Requirements

The undergraduate breadth requirements provide Berkeley students with a rich and varied educational experience outside of their major program. As the foundation of a liberal arts education, breadth courses give students a view into the intellectual life of the University while introducing them to a multitude of perspectives and approaches to research and scholarship. Engaging students in new disciplines and with peers from other majors, the breadth experience strengthens interdisciplinary connections and context that prepares Berkeley graduates to understand and solve the complex issues of their day.

Unit Requirements

- 120 total units, including at least 60 L&S units
- Of the 120 units, 36 must be upper division units
- Of the 36 upper division units, 6 must be taken in courses offered outside your major department

Residence Requirements

For units to be considered in "residence," you must be registered in courses on the Berkeley campus as a student in the College of Letters and Science. Most students automatically fulfill the residence requirement by attending classes here for four years. In general, there is no need to be concerned about this requirement, unless you go abroad for a semester or year or want to take courses at another institution or through University Extension during your senior year. In these cases, you should make an appointment to see an adviser to determine how you can meet the Senior Residence Requirement.

Note: Courses taken through UC Extension do not count toward residence.

Senior Residence Requirement

After you become a senior (with 90 semester units earned toward your B.A. degree), you must complete at least 24 of the remaining 30 units in residence in at least two semesters. To count as residence, a semester must consist of at least 6 passed units. Intercampus Visitor, EAP, and UC Berkeley-Washington Program (UCDC) units are excluded.

You may use a Berkeley summer session to satisfy one semester of the Senior Residence Requirement, provided that you successfully complete 6 units of course work in the Summer Session and that you have been enrolled previously in the College.

Modified Senior Residence Requirement

Participants in the UC Education Abroad Program (EAP) or the UC Berkeley-Washington Program (UCDC) may meet a Modified Senior Residence Requirement by completing 24 (excluding EAP) of their final 60 semester units in residence. At least 12 of these 24 units must be completed after you have completed 90 units.

Upper Division Residence Requirement

You must complete in residence a minimum of 18 units of upper division courses (excluding EAP units), 12 of which must satisfy the requirements for your major.

Mission

The chemistry major provides training for students planning careers in the chemical sciences and also for those whose interests lie in biology, medicine, earth sciences, secondary education, business, and law. More than half of the total Berkeley undergraduate population will, at some stage of their degree program, take a course from the Department of Chemistry. The curriculum of the Department is designed to satisfy the diverse needs of all these students.

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 of the Major

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.

Skills

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.

Effective

Graduates will be able to:

1. 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.
   The relationship between the Major's core curriculum and student learning outcomes can be seen in the Appendix in Table I.

Chemistry

CHEM 1A General Chemistry 3 Units
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 Chemistry 1A after taking Chemistry 4A.

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.

CHEM 1AD General Chemistry (Digital) 3 Units
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 4A.

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 1 Unit
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.
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 and 3 hours of laboratory per week

Summer: 8 weeks - 2 hours of lecture and 6 hours of laboratory 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
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: Chemistry 1A and Chemistry 1AL or equivalent, or a score of 3, 4, or 5 on the Chemistry AP test

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 and 4 hours of laboratory per week

Summer: 8 weeks - 6 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 W1A General Chemistry 3 Units
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 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.

CHEM 3A Chemical Structure and Reactivity 3 Units
Introduction to organic chemical structures, bonding, and chemical reactivity. The organic chemistry of alkanes, alkyl halides, alcohols, alkenes, alkynes, and organometallics.
Rules & Requirements

Prerequisites: 1A with a grade of C- or higher, or a score of 4 or 5 on the Chemistry AP test

Credit Restrictions: Students will receive no credit for Chemistry 3A after completing Chemistry 112A; a deficient grade in Chemistry 112A may be removed by taking 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.

CHEM 3AL Organic Chemistry Laboratory 2 Units
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: 1A and 1AL or equivalent with a grade of C- or higher, or a score of 4 or 5 on Chemistry AP test; 3A (may be taken concurrently)

Credit Restrictions: Students will receive no credit for 3AL after taking 112A.

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 3 Units
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: 3A with a grade of C- or higher

Credit Restrictions: Students will receive no credit for 3B after taking 112B.

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 3BL Organic Chemistry Laboratory 2 Units
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: 3AL; 3B (may be taken concurrently)

Credit Restrictions: Students will receive no credit for 3BL after taking 112B.

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
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: 3A may be taken concurrently, or after passing 3A with a grade of C- or better

Credit Restrictions: Students will receive no credit for N3AL after taking 112A.

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 4 Units
This series is intended for majors in physical and biological sciences and in 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 special 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 one unit of credit for 4A after taking 1A. Students will receive three units of credit for 4A after taking 1AL.

Hours & Format

Fall and/or spring: 15 weeks - 3 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 4B General Chemistry and Quantitative Analysis 4 Units
Series is intended for majors in physical and 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 are drawn from diverse areas of special 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 future chemistry courses.
Rules & Requirements

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

Credit Restrictions: Students will receive two units of credit for 4B after taking 1B; 1 unit after taking 15.

Hours & Format

Fall and/or spring: 15 weeks - 3 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 15 Analytical and Bioanalytical Chemistry 3 Units
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: Students will receive 2 units credit for 15 after taking 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
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 as topic varies. 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.

CHEM 49 Supplementary Work in Lower Division Chemistry 1 - 4 Units
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. Course may be repeated for credit when topic changes.

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
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.
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.

CHEM 98 Supervised Group Study 1 - 4 Units
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
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. Course may be repeated for credit when topic changes.

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.

CHEM 100 Communicating Chemistry 2 Units
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. Course may be repeated for credit when topic changes.

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 103 Inorganic Chemistry in Living Systems 3 Units
The basic principles of metal ions and coordination chemistry applied to the study of biological systems.
Rules & Requirements

Prerequisites: Chemistry 3A or 112A

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
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: 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.

CHEM 104B Advanced Inorganic Chemistry 3 Units
The chemistry of metals and nonmetals including the application of physical chemical principles.
Rules & Requirements

Prerequisites: 104A or consent of instructor

Credit Restrictions: Students will receive two units of credit for 104B 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
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
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.
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.

CHEM C110L General Biochemistry and Molecular Biology Laboratory 4 Units
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 112A Organic Chemistry 5 Units
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. 112A (F); 112B (SP)
Rules & Requirements

Prerequisites: 112A: 1B or 4B with grade of C- or higher; 112B: 112A 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 112A after taking both 3A and 3AL; two units of credit after taking 3A (lecture only).

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

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

CHEM 112B Organic Chemistry 5 Units
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. 112A (F); 112B (SP)
Rules & Requirements

Prerequisites: 112A: 1B or 4B with grade of C- or higher. 112B: 112A 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 112B after taking both 3B and 3BL; 2 units of credit for 112B after taking 3B (lecture only).

Hours & Format

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

Additional Details

Subject/Course Level: Chemistry/Undergraduate

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

Instructors: Hawkins, Schultz, Streitwieser

CHEM 113 Advanced Mechanistic Organic Chemistry 3 Units
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
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
Advanced synthetic methods, chemical and spectroscopic structural methods, designed as a preparation for experimental research.
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: 8 weeks - 2 hours of lecture and 20 hours of laboratory per week

Additional Details

Subject/Course Level: Chemistry/Undergraduate

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

CHEM 120A Physical Chemistry 3 Units
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

Credit Restrictions: Students will receive two units of credit for 120A after taking 130B.

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 120B Physical Chemistry 3 Units
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: 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.

CHEM 122 Quantum Mechanics and Spectroscopy 3 Units
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
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: Students will receive 1 unit of credit for 125 after taking C182 or Earth and Planetary Science 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
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

Credit Restrictions: Students will receive two units of credit for Chemistry 130B after completing Chemistry 120A and no credit after completing both Chemistry 120A and 120B.

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
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: 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

CHEM 135 Chemical Biology 3 Units
One-semester introduction to biochemistry, aimed toward chemistry and chemical biology majors.
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.

CHEM C138 The Berkeley Lectures on Energy: Energy from Biomass 3 Units
After an introduction to the different aspects of our global energy consumption, the course will focus on the role of biomass. The course will illustrate how the global scale of energy guides the biomass research. Emphasis will be 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: 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 143 Nuclear Chemistry 2 Units
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 146 Radiochemical Methods in Nuclear Technology and Forensics 3 Units
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: 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

CHEM 149 Supplementary Work in Upper Division Chemistry 1 - 4 Units
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. Course may be repeated for credit when topic changes.

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
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: 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

CHEM C170L Biochemical Engineering Laboratory 3 Units
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 - 6 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 C178 Polymer Science and Technology 3 Units
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 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

CHEM C182 Atmospheric Chemistry and Physics Laboratory 3 Units
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: Students will receive 1 unit of credit for C182 after taking 125.

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.

Also listed as: EPS C182

CHEM C191 Quantum Information Science and Technology 3 Units
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.
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

CHEM 192 Individual Study for Advanced Undergraduates 1 - 3 Units
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. Course may be repeated for credit when topic changes.

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
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 when topic changes.

Hours & Format

Fall and/or spring: 15 weeks - 9-0 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 - 4 Units
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. Course may be repeated for credit when topic changes.

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.

CHEM 195 Special Topics 3 Units
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. Course may be repeated for credit when topic changes.

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 - 4 Units
Special laboratory work for advanced undergraduates.
Rules & Requirements

Prerequisites: Consent of instructor and adviser

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

Hours & Format

Fall and/or spring: 15 weeks - 1-1 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.

CHEM 197 Field Study in Chemistry 1 - 4 Units
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. Course may be repeated for credit when topic changes.

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
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. Course may be repeated for credit when topic changes.

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
Enrollment is restricted by regulations listed in the .
Rules & Requirements

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

Hours & Format

Fall and/or spring: 15 weeks - 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.