Chemical Engineering

Bachelor of Science (BS)

The College of Chemistry offers a major in Chemical Engineering leading to the Bachelor of Science (BS) degree, through the Department of Chemical and Biomolecular Engineering. The program equips the student for professional work in development, design, and operation of chemical processes and of process equipment. Students with high scholastic attainment are well prepared to enter graduate programs. The curriculum is accredited by the Accreditation Board for Engineering and Technology (http://www.abet.org) (ABET).

Admission to the Major

For information on admission to the major, please see the College of Chemistry Admissions tab (http://guide.berkeley.edu/archive/2014-15/undergraduate/colleges-schools/chemistry/#admissionstext) in this Bulletin.

Minor Program

The Department of Chemical and Biomolecular Engineering offers an undergraduate minor in Chemical Engineering. For information regarding how to declare the minor, please contact the Department. Please be sure to consult with your college or school for information on rules regarding overlap of courses between majors and minors.

Joint Major Programs with the College of Engineering

Chemical Engineering/Materials Science and Engineering (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/chemical-engineering-materials-science-joint-major)
Chemical Engineering/Nuclear Engineering (http://guide.berkeley.edu/archive/2014-15/undergraduate/degree-programs/chemical-engineering-nuclear-joint-major)

In addition to the University, campus, and college requirements, listed in 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
CHM ENG 40	Introduction to Chemical Engineering Design	2
CHM ENG 140	Introduction to Chemical Process Analysis	4
CHM ENG 141	Chemical Engineering Thermodynamics	4
CHM ENG 150A	Transport Processes	4
ENGIN 7	Introduction to Computer Programming for Scientists and Engineers [1]	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
BIOLOGY 1A	General Biology Lecture	3
Students in the Biotechnology concentration are required to take MCELLBI 102 or CHEM 135 in place of BIOLOGY 1A		

Notes

1. Students should take CHEM 4A and CHEM 4B during their freshman year, and CHEM 112A and CHEM 112Bduring 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 or CHEM 112B.
4. All freshmen are required to complete CHM ENG 40 during their first semester.
5. A grade of C- or better in CHM ENG 140 is required before enrolling in any other Chemical Engineering courses.
6. ENGIN W7 may be substituted for ENGIN 7.
7. ENGIN 7 must be taken before or concurrently with CHM ENG 140 and before CHM ENG 150B.
8. Students should start MATH 1A in the first semester of their freshman year.
9. Students should start PHYSICS 7A in the second semester of the freshman year.

Upper-division Requirements

CHEM 120A	Physical Chemistry	3-4
or PHYSICS 137A	Quantum Mechanics	
CHM ENG 142	Chemical Kinetics and Reaction Engineering	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 185	Technical Communication for Chemical Engineers	3
ENGIN 45	Properties of Materials	3

EL ENG 40	Introduction to Microelectronic Circuits	4
Electives and Concentrations: Select one of the following: [1]		
Open Elective program: 9 units (see below for details)		
Concetration (see below for details)		

1 A course used toward satisfaction of the open elective program or a concentration cannot also be used toward satisfaction of another college or major requirement.
A maximum of 6 units of research can be applied toward electives.

Open Elective Program

Students who do not choose a concentration must complete the following requirements for the Open Elective program:

One Science elective, selected from Physical and Biological Sciences Electives List (see below)	3
CBE elective [1]	3
Engineering electives, selected from the Engineering Electives List [2]	6

1 CHM ENG 196 may not be used to fulfill this elective requirement.

2 Other Engineering courses may be approved by the CBE Department.

Physical and Biological Sciences Electives List

ANTHRO 1	Introduction to Biological Anthropology	4
ANTHRO C100	Human Paleontology	5
ANTHRO C103	Introduction to Human Osteology	6
ANTHRO 107	Evolution of the Human Brain	4
ANTHRO C131	Geoarchaeological Science	4
ANTHRO 132	Course Not Available	
ANTHRO 134	Analysis of the Archaeological Record	4
ANTHRO 135	Paleoethnobotany: Archaeological Methods and Laboratory Techniques	4
ASTRON 3	Introduction to Modern Cosmology	2
ASTRON 7A	Introduction to Astrophysics	4
ASTRON 7B	Introduction to Astrophysics	4
ASTRON 10	Introduction to General Astronomy	4
ASTRON C10	Introduction to General Astronomy	4
ASTRON C12	The Planets	3
ASTRON C162	Planetary Astrophysics	4
BIOLOGY 1B	General Biology Lecture and Laboratory	4
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 112B	Organic Chemistry	5
CHEM 113	Advanced Mechanistic Organic Chemistry	3
CHEM 114	Advanced Synthetic Organic Chemistry	3
CHEM 115	Organic Chemistry--Advanced Laboratory Methods	4
CHEM 120B	Physical Chemistry	3
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 135	Chemical Biology	3
CHEM 143	Nuclear Chemistry	2
CHEM 146	Radiochemical Methods in Nuclear Technology and Forensics	3
CHEM C150	Introduction to Materials Chemistry	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 196	Special Laboratory Study	2-4
CIV ENG C106	Air Pollution	3
CIV ENG C116	Chemistry of Soils	3
COG SCI C102	Scientific Approaches to Consciousness	3
COG SCI C110	Course Not Available	
COG SCI C126	Perception	3
COG SCI C127	Cognitive Neuroscience	3
COMPSCI C182	Course Not Available	
EPS 3	The Water Planet	2
EPS 8	Geologic Record of Climate Change	3
EPS C12	The Planets	3
EPS 20	Earthquakes in Your Backyard	3
EPS C20	Earthquakes in Your Backyard	3
EPS 50	The Planet Earth	4
EPS 80	Environmental Earth Sciences	3
EPS C82	Oceans	3
EPS 100A	Minerals: Their Constitution and Origin	4
EPS 103	Introduction to Aquatic and Marine Geochemistry	4
EPS 105	Course Not Available	
EPS 108	Geodynamics	4
EPS 117	Geomorphology	4
EPS C129	Biometeorology	3
EPS 130	Strong Motion Seismology	3
EPS C141	Course Not Available	
EPS C146	Geological Oceanography	4
EPS C162	Planetary Astrophysics	4
EPS C171	Geoarchaeological Science	4
EPS C180	Air Pollution	3
EPS C181	Atmospheric Physics and Dynamics	3
EPS C182	Atmospheric Chemistry and Physics Laboratory	3
EPS 185	Marine Geobiology	2
ENE,RES 102	Quantitative Aspects of Global Environmental Problems	4
ENGLISH C77	Introduction to Environmental Studies	4
ESPM 2	The Biosphere	3
ESPM 4	Course Not Available	
ESPM 15	Introduction to Environmental Sciences	3
ESPM C10	Environmental Issues	4
ESPM C11	Americans and the Global Forest	4
ESPM C12	Introduction to Environmental Studies	4
ESPM 40	Insects and Human Society	2
ESPM 42	Natural History of Insects	2

ESPM 44	Biological Control	2
ESPM 100	Environmental Problem Solving	4
ESPM 102A	Terrestrial Resource Ecology	4
ESPM 102B	Natural Resource Sampling	2
ESPM 102C	Resource Management	4
ESPM C103	Principles of Conservation Biology	4
ESPM 106	American Wildlife: Identification and Conservation	3
ESPM C107	Biology and Geomorphology of Tropical Islands	13
ESPM 108A	Trees: Taxonomy, Growth, and Structures	3
ESPM 108B	Environmental Change Genetics	3
ESPM 109	Course Not Available	
ESPM 110	Primate Ecology	4
ESPM 112	Microbial Ecology	3
ESPM 113	Insect Ecology	2
ESPM 114	Wildlife Ecology	3
ESPM 115B	Biology of Aquatic Insects	2
ESPM 117	Urban Garden Ecosystems	4
ESPM 118	Agricultural Ecology	3
ESPM 119	Chemical Ecology	2
ESPM 120	Soil Characteristics	3
ESPM C128	Chemistry of Soils	3
ESPM C129	Biometeorology	3
ESPM C130	Terrestrial Hydrology	4
ESPM 131	Soil Microbial Ecology	3
ESPM 134	Fire, Insects, and Diseases in Forest Ecosystems	3
ESPM 137	Landscape Ecology	3
ESPM C138	Introduction to Comparative Virology	4
ESPM 140	General Entomology	4
ESPM 142	Insect Behavior	3
ESPM 144	Insect Physiology	3
ESPM 145	Course Not Available	
ESPM 146	Course Not Available	
ESPM C148	Pesticide Chemistry and Toxicology	3
ESPM C149	Molecular Ecology	4
ESPM 152	Global Change Biology	3
ESPM 172	Photogrammetry and Remote Sensing	3
ESPM 174	Design and Analysis of Ecological Research	4
ESPM C180	Air Pollution	3
ESPM 181	Course Not Available	
ESPM 185	Applied Forest Ecology	4
ESPM 186	Management and Conservation of Rangeland Ecosystems	4
ESPM 187	Restoration Ecology	4
ENV SCI 10	Introduction to Environmental Sciences	3
ENV SCI 125	Environments of the San Francisco Bay Area	3
GEOG 1	Global Environmental Change	4
GEOG 35	Global Ecology and Development	4
GEOG 40	Introduction to Earth System Science	4
GEOG C82	Oceans	3
GEOG C136	Terrestrial Hydrology	4
GEOG 137	Top Ten Global Environmental Problems	4
GEOG 140A	Physical Landscapes: Process and Form	4
GEOG C141	Course Not Available	
GEOG 143	Global Change Biogeochemistry	3
GEOG 144	Principles of Meteorology	3
GEOG C145	Geological Oceanography	4
GEOG 148	Biogeography	4
GEOG 171	Special Topics in Physical Geography	3
INTEGBI 31	The Ecology and Evolution of Animal Behavior	3
INTEGBI 32	Bioinspired Design	3
INTEGBI 41	Marine Mammals	2
INTEGBI C82	Oceans	3
INTEGBI C101	Course Not Available	
INTEGBI C101L	Course Not Available	
INTEGBI 102	Course Not Available	
INTEGBI 102LF	Introduction to California Plant Life with Laboratory	4
INTEGBI 103	Course Not Available	
INTEGBI 103LF	Invertebrate Zoology with Laboratory	5
INTEGBI 104	Course Not Available	
INTEGBI 104LF	Natural History of the Vertebrates with Laboratory	5
INTEGBI 106	Course Not Available	
INTEGBI 106A	Physical and Chemical Environment of the Ocean	4
INTEGBI C107	Course Not Available	
INTEGBI C107L	Principles of Plant Morphology with Laboratory	4
INTEGBI 115	Introduction to Systems in Biology and Medicine	4
INTEGBI 117	Medical Ethnobotany	2
INTEGBI 117L	Course Not Available	
INTEGBI 118	Host-Pathogen Interactions: A Trans-Discipline Outlook	4
INTEGBI 123A	Course Not Available	
INTEGBI 123AL	Exercise Physiology with Laboratory	5
INTEGBI 131	General Human Anatomy	3
INTEGBI 135	The Mechanics of Organisms	4
INTEGBI 137	Human Endocrinology	4
INTEGBI C139	Course Not Available	
INTEGBI C142L	Introduction to Human Osteology	6
INTEGBI C143A	Biological Clocks: Physiology and Behavior	3
INTEGBI C143B	Hormones and Behavior	3
INTEGBI 144	Course Not Available	
INTEGBI 148	Comparative Animal Physiology	3
INTEGBI C149	Molecular Ecology	4
INTEGBI 151	Plant Physiological Ecology	4
INTEGBI 152	Environmental Toxicology	4
INTEGBI 153	Ecology	3
INTEGBI 154	Plant Ecology	3
INTEGBI 154L	Plant Ecology Laboratory	2
INTEGBI 155	Course Not Available	
INTEGBI C156	Principles of Conservation Biology	4
INTEGBI 157L	Course Not Available	
INTEGBI 158LF	Biology and Geomorphology of Tropical Islands	13
INTEGBI 159	The Living Planet: Impact of the Biosphere on the Earth System	3
INTEGBI 161	Population and Evolutionary Genetics	4
INTEGBI 162	Ecological Genetics	4

INTEGBI 164	Human Genetics and Genomics	4
INTEGBI 165	Course Not Available	
INTEGBI 168	Systematics of Vascular Plants	2
INTEGBI 168L	Systematics of Vascular Plants with Laboratory	4
INTEGBI 169	Evolutionary Medicine	4
INTEGBI 174	Course Not Available	
INTEGBI 174LF	Ornithology with Laboratory	4
INTEGBI 183	Course Not Available	
INTEGBI 183L	Evolution of the Vertebrates with Laboratory	4
INTEGBI 184	Course Not Available	
INTEGBI 184L	Morphology of the Vertebrate Skeleton with Laboratory	4
INTEGBI C185L	Human Paleontology	5
INTEGBI C187	Human Biogeography of the Pacific	3
L & S C30U	Americans and the Global Forest	4
L & S C30V	Environmental Issues	4
L & S C30W	Course Not Available	
L & S C70T	The Planets	3
L & S C70U	Introduction to General Astronomy	4
L & S C70W	Physics and Music	2
L & S C70Y	Earthquakes in Your Backyard	3
LINGUIS C109	Course Not Available	
MAT SCI C150	Introduction to Materials Chemistry	3
MCELLBI 32	Introduction to Human Physiology	3
MCELLBI 41	Genetics and Society	3
MCELLBI 50	The Immune System and Disease	3
MCELLBI C61	Brain, Mind, and Behavior	3
MCELLBI C62	Drugs and the Brain	3
MCELLBI 64	Course Not Available	
MCELLBI C100A	Biophysical Chemistry: Physical Principles and the Molecules of Life	4
MCELLBI 100B	Biochemistry: Pathways, Mechanisms, and Regulation	4
MCELLBI 102	Survey of the Principles of Biochemistry and Molecular Biology	4
MCELLBI C103	Bacterial Pathogenesis	3
MCELLBI 104	Genetics, Genomics, and Cell Biology	4
MCELLBI 111	Course Not Available	
MCELLBI C112	General Microbiology	4
MCELLBI 113	Course Not Available	
MCELLBI C114	Introduction to Comparative Virology	4
MCELLBI 115	Course Not Available	
MCELLBI C116	Microbial Diversity	3
MCELLBI 130A	Cell and Systems Biology	4
MCELLBI 132	Biology of Human Cancer	4
MCELLBI 133L	Physiology and Cell Biology Laboratory	4
MCELLBI 135A	Topics in Cell and Developmental Biology: Molecular Endocrinology	3
MCELLBI 135E	Course Not Available	
MCELLBI 136	Physiology	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 C160	Course Not Available	
MCELLBI 160L	Neurobiology Laboratory	4
MCELLBI 163	Mammalian Neuroanatomy	4
MCELLBI 166	Biophysical Neurobiology	3
MCELLBI 167	Course Not Available	
NUSCTX 10	Introduction to Human Nutrition	3
NUSCTX 11	Introduction to Toxicology	3
NUSCTX 106	Course Not Available	
NUSCTX 107	Course Not Available	
NUSCTX 108A	Introduction and Application of Food Science	3
NUSCTX 110	Toxicology	4
NUSCTX C112	Course Not Available	
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	4
PHYSICS C21	Physics and Music	3
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 129	Particle Physics	4
PHYSICS 130	Quantum and Nonlinear Optics	3
PHYSICS 132	Course Not Available	
PHYSICS 137B	Quantum Mechanics	4
PHYSICS 138	Modern Atomic Physics	3
PHYSICS 141A	Solid State Physics	4
PHYSICS 177	Principles of Molecular Biophysics	3
PLANTBI 10	Plants, Agriculture, and Society	2
PLANTBI 40	The (Secret) Life of Plants	3
PLANTBI C102	Course Not Available	
PLANTBI C102L	Course Not Available	
PLANTBI C103	Bacterial Pathogenesis	3
PLANTBI C107	Course Not Available	
PLANTBI C107L	Principles of Plant Morphology with Laboratory	4
PLANTBI 110	Course Not Available	
PLANTBI 110L	Course Not Available	
PLANTBI C112	General Microbiology	4
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 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
PSYCH 110	Introduction to Biological Psychology	3
PSYCH 111	Course Not Available	
PSYCH C112	Course Not Available	
PSYCH C113	Biological Clocks: Physiology and Behavior	3
PSYCH 114	Biology of Learning and Neural Plasticity	3
PSYCH 115A	Course Not Available	
PSYCH C115B	Course Not Available	
PSYCH C116	Hormones and Behavior	3
PSYCH 117	Human Neuropsychology	3
PSYCH 119	Course Not Available	
PSYCH 122	Introduction to Human Learning and Memory	3
PSYCH C126	Perception	3
PSYCH C127	Cognitive Neuroscience	3
PSYCH C129	Scientific Approaches to Consciousness	3
PB HLTH C102	Bacterial Pathogenesis	3
PB HLTH 162A	Public Health Microbiology	3
PB HLTH C170B	Course Not Available	
PB HLTH 172	Course Not Available	
PB HLTH C172	Course Not Available	
UGIS C12	Course Not Available	

Engineering Electives List

BIO ENG 100	Ethics in Science and Engineering	3
BIO ENG 104	Biological Transport Phenomena	4
BIO ENG C105B	Course Not Available	
BIO ENG 110	Biomedical Physiology for Engineers	4
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 C117	Structural Aspects of Biomaterials	4
BIO ENG 121	BioMEMS and Medical Devices	4
BIO ENG C125	Introduction to Robotics	4
BIO ENG 132	Genetic Devices	4
BIO ENG C136L	Laboratory in the Mechanics of Organisms	3
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 C165	Medical Imaging Signals and Systems	4
BIO ENG C181	The Berkeley Lectures on Energy: Energy from Biomass	3
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 C195A	The Berkeley Lectures on Energy: Energy from Biomass (may be repeated for credit when the topic changes)	3
CHM ENG 196	Special Laboratory Study	2-4
CHEM C138	The Berkeley Lectures on Energy: Energy from Biomass	3
CIV ENG 103	Introduction to Hydrology	3
CIV ENG 105	Environmental Fluid Mechanics Design	3
CIV ENG 107	Climate Change Mitigation	3
CIV ENG 114	Environmental Microbiology	3
CIV ENG 115	Water Chemistry	3
CIV ENG 120	Structural Engineering	3
CIV ENG 130N	Mechanics of Structures	3
CIV ENG 131	Course Not Available	
CIV ENG C133	Engineering Analysis Using the Finite Element Method	3
CIV ENG 175	Geotechnical and Geoenvironmental Engineering	3
CIV ENG 176	Environmental Geotechnics	3
CIV ENG 180	Life-Cycle Design and Construction	4
CIV ENG 186	Design of Cyber-Physical Systems	3
CIV ENG 193	Engineering Risk Analysis	3
COMPSCI C149	Introduction to Embedded Systems	4
EL ENG 105	Microelectronic Devices and Circuits	4
EL ENG C125	Course Not Available	
EL ENG 130	Integrated-Circuit Devices	4
EL ENG 134	Fundamentals of Photovoltaic Devices	4
EL ENG 143	Microfabrication Technology	4
EL ENG C145B	Medical Imaging Signals and Systems	4
EL ENG C145O	Laboratory in the Mechanics of Organisms	3
EL ENG 147	Introduction to Microelectromechanical Systems (MEMS)	3
EL ENG C149	Introduction to Embedded Systems	4
ENGIN 117	Methods of Engineering Analysis	3
ENGIN 120	Principles of Engineering Economics	3
IND ENG 160	Operations Research I	3
IND ENG 162	Linear Programming	3
MAT SCI 112	Corrosion (Chemical Properties)	3
MAT SCI 113	Mechanical Behavior of Engineering Materials	3
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 136	Materials in Energy Technologies	4
MAT SCI 140	Nanomaterials for Scientists and Engineers	3
MAT SCI 151	Polymeric Materials	3

MEC ENG 102A	Introduction to Mechanical Systems for Mechatronics	4
MEC ENG 102B	Mechatronics Design	4
MEC ENG 104	Engineering Mechanics II	3
MEC ENG C105B	Course Not Available	
MEC ENG 106	Fluid Mechanics	3
MEC ENG 107	Mechanical Engineering Laboratory	3
MEC ENG 108	Mechanical Behavior of Engineering Materials	4
MEC ENG 109	Heat Transfer	3
MEC ENG 110	Introduction to Product Development	3
MEC ENG C115	Molecular Biomechanics and Mechanobiology of the Cell	4
MEC ENG C117	Structural Aspects of Biomaterials	4
MEC ENG 119	Introduction to MEMS (Microelectromechanical Systems)	3
MEC ENG 122	Processing of Materials in Manufacturing	3
MEC ENG 127	Composite Materials--Analysis, Design, Manufacture	3
MEC ENG 131	Vehicle Dynamics and Control	3
MEC ENG 135	Design of Microprocessor-Based Mechanical Systems	4
MEC ENG 140	Combustion Processes	3
MEC ENG 142	Course Not Available	
MEC ENG 146	Energy Conversion Principles	3
MEC ENG 151	Advanced Heat Transfer	3
MEC ENG 166	Course Not Available	
MEC ENG 171	Dynamics of Charged Particulate Systems: Modeling, Theory and Computation	3
MEC ENG C177L	Course Not Available	
MEC ENG C180	Engineering Analysis Using the Finite Element Method	3
MEC ENG 185	Introduction to Continuum Mechanics	3
NUC ENG 101	Nuclear Reactions and Radiation	4
NUC ENG 124	Radioactive Waste Management	3
PLANTBI C124	The Berkeley Lectures on Energy: Energy from Biomass	3
PLANTBI C144	Introduction to Protein Informatics	4
PLANTBI C144L	Protein Informatics Laboratory	3

Concentrations

The concentrations are biotechnology, chemical processing, environmental technology, materials science and technology, and applied physical science. Students who plan to declare a concentration must do so no later than the end of their junior year. Double concentrations are not permitted.

Biotechnology

CHEM 112B	Organic Chemistry	4-5
or MCELLBI C112	General Microbiology	
CHM ENG 170A	Biochemical Engineering	3
CHM ENG 170B	Biochemical Engineering	3
CHM ENG C170L	Biochemical Engineering Laboratory	3

Chemical Processing

CHEM 104A	Advanced Inorganic Chemistry	3-5
or CHEM 112B	Organic Chemistry	
Select 6 units from the following:		
CHM ENG 170A	Biochemical Engineering	
CHM ENG 170B	Biochemical Engineering	
CHM ENG C170L	Biochemical Engineering Laboratory	
CHM ENG 171	Transport Phenomena	
CHM ENG C178	Polymer Science and Technology	
CHM ENG 179	Process Technology of Solid-State Materials Devices	
CHM ENG 180	Chemical Engineering Economics	
CHM ENG H19	Research for Advanced Undergraduates (up to 4 units)	
Select 3 units from the following:		
CIV ENG C30	Introduction to Solid Mechanics	
CIV ENG 111	Environmental Engineering	
CIV ENG 114	Environmental Microbiology	
CIV ENG 173	Groundwater and Seepage	
MAT SCI 111	Properties of Electronic Materials	
MAT SCI 112	Corrosion (Chemical Properties)	
MAT SCI 113	Mechanical Behavior of Engineering Materials	
MAT SCI C118	Biological Performance of Materials	
MAT SCI 120	Materials Production	
MAT SCI 121	Metals Processing	
MAT SCI 122	Ceramic Processing	
MAT SCI 123	Semiconductor Processing	
MEC ENG 140	Combustion Processes	
MEC ENG 151	Advanced Heat Transfer	

Environmental Technology

CHEM 112B	Organic Chemistry	3-5
or CHEM 104A	Advanced Inorganic Chemistry	
CHM ENG 170A	Biochemical Engineering	3
Select 6 units from the following:		
CHM ENG 176	Principles of Electrochemical Processes	
CIV ENG 108	Course Not Available	
CIV ENG 111	Environmental Engineering	
CIV ENG 113N	Ecological Engineering for Water Quality Improvement	
CIV ENG C116	Chemistry of Soils	
CIV ENG 173	Groundwater and Seepage	
MEC ENG 140	Combustion Processes	

Materials Science and Technology

Select one of the following:		
CHEM 104A	Advanced Inorganic Chemistry	
CHEM 108	Inorganic Synthesis and Reactions	
CHEM 112B	Organic Chemistry	
Select 3 units from the following:		
CHM ENG 176	Principles of Electrochemical Processes	
CHM ENG C178	Polymer Science and Technology	
CHM ENG 179	Process Technology of Solid-State Materials Devices	

Select 6 units from the following:

CIV ENG C30	Introduction to Solid Mechanics
EL ENG 130	Integrated-Circuit Devices
EL ENG 143	Microfabrication Technology
MAT SCI 102	Bonding, Crystallography, and Crystal Defects
MAT SCI 103	Phase Transformations and Kinetics
MAT SCI 111	Properties of Electronic Materials
MAT SCI 112	Corrosion (Chemical Properties)
MAT SCI 120	Materials Production
MAT SCI 121	Metals Processing
MAT SCI 122	Ceramic Processing
MAT SCI 123	Semiconductor Processing
MAT SCI 125	Thin-Film Materials Science
MEC ENG 122	Processing of Materials in Manufacturing [1]
MEC ENG 127	Composite Materials--Analysis, Design, Manufacture
CHM ENG C178	Polymer Science and Technology
CHM ENG 179	Process Technology of Solid-State Materials Devices
CHM ENG 180	Chemical Engineering Economics
CHM ENG 185	Technical Communication for Chemical Engineers
CHM ENG C195A	The Berkeley Lectures on Energy: Energy from Biomass

[1] Students may take MEC ENG 122 without the prerequisites of CIV ENG 130N and MEC ENG 108.

Applied Physical Science

6 units chosen from Physical and Biological Sciences List	6
3 units of CHM ENG electives (excluding CHM ENG 196)	3
3 units chosen from Engineering Electives list	3

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

Upper-division

CHM ENG 140	Introduction to Chemical Process Analysis	4
CHM ENG 141	Chemical Engineering Thermodynamics [1]	4
CHM ENG 150A	Transport Processes [1]	4

Select two of the following:

CHM ENG 142	Chemical Kinetics and Reaction Engineering
CHM ENG 150B	Transport and Separation Processes
CHM ENG 162	Dynamics and Control of Chemical Processes
CHM ENG 170A	Biochemical Engineering
CHM ENG 170B	Biochemical Engineering
CHM ENG 171	Transport Phenomena
CHM ENG 176	Principles of Electrochemical Processes

[1] Students who have completed courses in other departments at Berkeley that are essentially equivalent to CHM ENG 141 and CHM ENG 150A can substitute other courses from the above list.

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.

Mission

The mission of the Department of Chemical and Biomolecular Engineering is:

- To educate people for careers of leadership and innovation in chemical engineering and related fields
- To expand the base of engineering knowledge through original research and by developing technology to serve the needs of society
- To benefit the public through service to industry, government, and the engineering profession.

Fulfillment of this mission is achieved in part by the Department of Chemical and Biomolecular Engineering's accredited undergraduate degree program in chemical engineering. The undergraduate curriculum comprises both a technical curriculum, and breadth requirements.

The goals of chemical engineering breadth requirements are to teach the arts of writing clearly and persuasively, to develop the skills to read carefully and evaluate evidence effectively, and to instill an awareness of humanity in historical and social contexts. The Berkeley Campus American Cultures requirement affirms the value of diversity in acquiring knowledge.

The technical curriculum in chemical engineering seeks to provide students with a broad education emphasizing an excellent foundation in scientific and engineering fundamentals.

Learning Goals for the Major

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to design and conduct experiments, as well as to analyze and interpret data.
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. An ability to function on multi-disciplinary teams
5. An ability to identify, formulate, and solve engineering problems
6. An understanding of professional and ethical responsibility
7. An ability to communicate effectively
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. A recognition of the need for and an ability to engage in life-long learning
10. A knowledge of contemporary issues
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Chemical Engineering

CHM ENG 24 Freshman Seminars 1 Unit
The Berkeley 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. Berkeley Seminars are offered in all campus departments, and topics vary from department to department and semester to semester.
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: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 40 Introduction to Chemical Engineering Design 2 Units
Design and analysis of processes involving chemical change. Strategies for design, such as creative thinking and (re)definition of the design goal. Methods for analyzing designs, such as mathematical modeling, empirical analysis by graphics, and dynamic scaling by dimensional analysis. Design choices in light of process efficiency, product quality, economics, safety, and environmental issues.
Rules & Requirements

Prerequisites: Mathematics 1A, which may be taken concurrently

Hours & Format

Fall and/or spring: 15 weeks - 1.5 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 84 Sophomore Seminar 1 or 2 Units
Sophomore seminars are small interactive courses offered by faculty members in departments all across the campus. Sophomore seminars offer opportunity for close, regular intellectual contact between faculty members and students in the crucial second year. The topics vary from department to department and semester to semester. Enrollment limited to 15 sophomores.
Rules & Requirements

Prerequisites: At discretion of instructor

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:
5 weeks - 3-6 hours of seminar per week
10 weeks - 1.5-3 hours of seminar per week
15 weeks - 1-2 hours of seminar per week

Summer:
6 weeks - 2.5-5 hours of seminar per week
8 weeks - 1.5-3.5 hours of seminar and 2-4 hours of seminar per week

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 90 Science and Engineering of Sustainable Energy 3 Units
An introduction is given to the science and technologies of producing electricity and transportation fuels from renewable energy resources (biomass, geothermal, solar, wind, and wave). Students will be introduced to quantitative calculations and comparisions of energy technologies together with the economic and political factors affecting the transition from nonrenewable to sustainable energy resources. Mass and energy balances are used to analyze the conversion of energy resources.
Rules & Requirements

Prerequisites: Chemistry 1A or 4A

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Instructors: Bell, Segalman

CHM ENG 98 Directed Group Studies for Lower Division Undergraduates 1 - 3 Units
Supervised research on a specific topic.
Rules & Requirements

Prerequisites: 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 - 1-3 hours of directed group study per week

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 98W Directed Group Study 1 Unit
Directed group study consisting of supplementary problem sets, review sessions, and discussions related to chemical engineering. Topics vary with instructor.
Rules & Requirements

Prerequisites: This 98W is planned for students who are concurrently enrolled in CHM ENG 140

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

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 140 Introduction to Chemical Process Analysis 4 Units
Material and energy balances applied to chemical process systems. Determination of thermodynamic properties needed for such calculations. Sources of data. Calculation procedures.
Rules & Requirements

Prerequisites: Chemistry 4B or 1B with a grade of C- or better; and PHYSICS 7B (may be taken concurrently)

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 141 Chemical Engineering Thermodynamics 4 Units
Thermodynamic behavior of pure substances and mixtures. Properties of solutions, phase equilibria. Thermodynamic cycles. Chemical equilibria for homogeneous and heterogeneous systems.
Rules & Requirements

Prerequisites: 140 with a grade of C- or higher; Engineering 7, which may be taken concurrently

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 142 Chemical Kinetics and Reaction Engineering 4 Units
Analysis and prediction of rates of chemical conversion in flow and nonflow processes involving homogeneous and heterogeneous systems.
Rules & Requirements

Prerequisites: 141 with a grade of C- or higher; 150B, which may be taken concurrently

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 150A Transport Processes 4 Units
Principles of fluid mechanics and heat transfer with application to chemical processes. Laminar and turbulent flow in pipes and around submerged objects. Flow measurement. Heat conduction and convection; heat transfer coefficients.
Rules & Requirements

Prerequisites: 140 with a grade of C- or higher; MATH 54, which may be taken concurrently

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 150B Transport and Separation Processes 4 Units
Principles of mass transfer with application to chemical processes. Diffusion and convection. Simultaneous heat and mass transfer; mass transfer coefficients. Design of staged and continuous separations processes.
Rules & Requirements

Prerequisites: Chemical and Biomolecular Engineering 141 with a grade of C- or higher; Chemical and Biomolecular Engineering 150A with a grade of C- or higher; Engineering 7

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 154 Chemical Engineering Laboratory 4 Units
Experiments in physical measurements, fluid mechanics, heat and mass transfer, kinetics, and separation processes. Emphasis on investigation of basic relationships important in engineering. Experimental design, analysis of results, and preparation of engineering reports are stressed.
Rules & Requirements

Prerequisites: Chemical and Biomolecular Engineering 141, 142, 150B, and 185

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture and 8 hours of laboratory per week

Summer: 8 weeks - 2 hours of lecture and 16 hours of laboratory per week

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 160 Chemical Process Design 4 Units
Design principles of chemical process equipment. Design of integrated chemical processes with emphasis upon economic considerations.
Rules & Requirements

Prerequisites: Chemical and Biomolecular Engineering 142, 150B, and 154

Hours & Format

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

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 161S Industrial Chemical Process Design 6 Units
Design of chemical processes and equipment, with an emphasis on industry-sponsored and/or industry-tailored processes
Objectives & Outcomes

Course Objectives: Teach students the strategies used in the design of chemical processes through an authentic industrial project.

Student Learning Outcomes: • Develop an ability to function on multi-disciplinary teams.
• Develop the ability to design an integrated chemical engineering-based process to meet stated objectives within realistic constraints.
• Establish proficiency in the design process and project management fundamentals.
• Gain an understanding of professional and ethical responsibilities.

Rules & Requirements

Prerequisites: Prerequisites: Chemical and Biomolecular Engineering 142, 150B, and 154

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Instructors: Bryan, Sciamanna

CHM ENG 162 Dynamics and Control of Chemical Processes 4 Units
Analysis of the dynamic behavior of chemical processes and methods and theory of their control. Implementation of computer control systems on process simulations.
Rules & Requirements

Prerequisites: Chemical and Biomolecular Engineering 142 and 150B; Mathematics 53 and 54

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 170A Biochemical Engineering 3 Units
This course intends to introduce chemical engineers to the basic concepts of biochemical engineering. The course focuses on the use of chemical engineering skills and principles in the analysis and design of biologically-based processes. The main emphasis will be on biochemical kinetics, heat and mass transfer, thermodynamics, and transport phenomena as they apply to enzyme catalysis, microbial growth and metabolism, fermentation and bioreactor design, product recovery and downstream processing. Fundamental topics in biological sciences will be introduced as necessary throughout the course.
Rules & Requirements

Prerequisites: Chemical and Biomolecular Engineering 142, 150B, or consent of instructor; BIOLOGY 1A

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Instructor: Clark

CHM ENG 170B Biochemical Engineering 3 Units
The second of a two-semester sequence intended to introduce chemical engineers to the basic concepts of biochemical engineering. The course focuses on the use of chemical engineering skills and principles in the analysis and design of biologically-based processes. The emphasis will be on biochemical kinetics, protein engineering, cell growth and metabolism, bioreactor design, downstream processing, pharmacokinetics, drug delivery, and ethics.
Rules & Requirements

Prerequisites: 170A: Chemistry 135 or Molecular and Cell Biology 102, which may be taken concurrently

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Instructor: Clark

Formerly known as: 170

CHM ENG 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: Chemical & Biomolecular Engineering/ Undergraduate

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

Also listed as: CHEM C170L

CHM ENG 171 Transport Phenomena 3 Units
Study of momentum, energy, and mass transfer in laminar and turbulent flow.
Rules & Requirements

Prerequisites: 150B

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 176 Principles of Electrochemical Processes 3 Units
Principles and application of electrochemical equilibria, kinetics, and transport processes. Technical electrolysis and electrochemical energy conversion.
Rules & Requirements

Prerequisites: Chemical and Biomolecular Engineering 141, 142, and 150B

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 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: Chemical & Biomolecular Engineering/ Undergraduate

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

Instructor: Segalman

Also listed as: CHEM C178

CHM ENG 179 Process Technology of Solid-State Materials Devices 3 Units
Chemical processing and properties of solid-state materials. Crystal growth and purification. Thin film technology. Application of chemical processing to the manufacture of semiconductors and solid-state devices.
Rules & Requirements

Prerequisites: Engineering 45; one course in electronic circuits recommended; senior standing

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 180 Chemical Engineering Economics 3 Units
Optimal design of chemical processes and unit operations, emphasizing the interactions between technical and economic considerations. Analysis of process risks. Chemical and biomolecular process design in the presence of uncertainties. Interest rate determinants and their effects on chemical process feasibility and choices. Relationships between structure and behavior of firms in the chemical processing industries. Multivariable input-output analyses.
Rules & Requirements

Prerequisites: Chemical and Biomolecular Engineering 142 and 150B, both of which may be taken concurrently. Consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 185 Technical Communication for Chemical Engineers 3 Units
Development of technical writing and oral presentation skills in formats commonly used by chemical engineers.
Rules & Requirements

Prerequisites: 140; ENGLISH R1A or equivalent; consent of instructor

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

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 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 Chemical Engineering.
Rules & Requirements

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

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG H194 Research for Advanced Undergraduates 2 - 4 Units
Original research under direction of one of the members of the staff.
Rules & Requirements

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

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

Hours & Format

Fall and/or spring: 15 weeks - 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: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 195 Special Topics 2 - 4 Units
Lectures and/or tutorial instruction on special topics.
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 - 2-4 hours of independent study per week

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG C195A 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: Chemical & Biomolecular Engineering/ Undergraduate

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

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

Also listed as: BIO ENG C181/CHEM C138/PLANTBI C124

CHM ENG 196 Special Laboratory Study 2 - 4 Units
Special laboratory or computational work under direction of one of the members of the staff.
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 - 2-3 hours of independent study per week

Summer:
6 weeks - 5-8 hours of independent study per week
8 weeks - 3.5-6 hours of independent study per week
10 weeks - 3-4.5 hours of independent study per week

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 197 Field Study in Chemical Engineering 1 - 4 Units
Supervised experience in off-campus organizations relevant to specific aspects and applications of chemical engineering. 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

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 fieldwork per week

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Instructor: Strauss

CHM ENG 198 Directed Group Study for Undergraduates 1 - 3 Units
Supervised research on a specific topic. Enrollment is restricted; see Introduction to Courses and Curricula section in the General Catalog.
Rules & Requirements

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

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

Hours & Format

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

Summer: 6 weeks - 2.5-7.5 hours of lecture per week

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

CHM ENG 199 Supervised Independent Study and Research 1 - 4 Units
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
10 weeks - 1.5-6 hours of independent study per week

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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