Chemical Engineering/ Materials Science and Engineering Joint Major

Bachelor of Science (BS)

The joint major programs are designed for students who wish to undertake study in two areas of engineering in order to qualify for employment in either field or for positions in which competence in two fields is required. The joint majors contain comparable proportions of coursework in both major fields. While they require slightly increased course loads, they can be completed in four years. Both majors are shown on the student's transcript of record. Students in this joint major program are concurrently enrolled in both the College of Engineering and the College of Chemistry, but their college of residence will be Chemistry.

Many of the engineering problems facing the nation in the next decades will require solutions by engineers who have training in both chemical process engineering and materials engineering. Three typical examples are coal gasification and liquefaction, extraction of metals from low-grade ores and wastes, and environmental control of metallurgical processes. Students completing this joint major will successfully compete for positions in diverse industries and top graduate programs.

Admission to the Joint Major

Admission to the joint major programs is closed to freshmen. Continuing students may petition for a change to a joint major program after their first year. For further details regarding how to declare the joint major, please contact the College of Chemistry.

Other Joint Major Offered with the College of Engineering

Chemical Engineering/Nuclear Engineering (http://guide.berkeley.edu/undergraduate/degree-programs/chemical-engineering-nuclear-joint-major/)

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.

Please note, the Academic Guide is updated only once a year. For the most current information on requirements please a look at the College of Chemistry website (https://chemistry.berkeley.edu/ugrad/degrees/cheme/joint-majors/).

Lower Division Requirements

MATH 1A	Calculus	4
MATH 1B	Calculus	4
MATH 53	Multivariable Calculus	4
MATH 54	Linear Algebra and Differential Equations	4
CHEM 1A & 1AL	General Chemistry and General Chemistry Laboratory	5
or CHEM 4A	General Chemistry and Quantitative Analysis	
CHEM 1B	General Chemistry	5
or CHEM 4B	General Chemistry and Quantitative Analysis	
BIOLOGY 1A	General Biology Lecture	3
PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 7B	Physics for Scientists and Engineers	4
PHYSICS 7C	Physics for Scientists and Engineers	4
ENGIN 7	Introduction to Computer Programming for Scientists and Engineers	4
CHEM 12A	Organic Chemistry	5
MAT SCI 45	Properties of Materials	3
MAT SCI 45L	Properties of Materials Laboratory	1

Upper Division Requirements

CHEM 120A	Physical Chemistry	3
or PHYSICS 137A	Quantum Mechanics	
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
MAT SCI 102	Bonding, Crystallography, and Crystal Defects	3
MAT SCI 103	Phase Transformations and Kinetics	3
MAT SCI 112	Corrosion (Chemical Properties)	3
MAT SCI 120	Materials Production	3
MAT SCI 130	Experimental Materials Science and Design	3
Materials science electives: two courses		
Choose one course from the following:		
MAT SCI 104	Materials Characterization [3]	
MAT SCI 111	Properties of Electronic Materials [4]	
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 151	Polymeric Materials [3]	
Select one course from the following:		
MAT SCI 121	Metals Processing [3]	

MAT SCI 122	Ceramic Processing [3]
MAT SCI 123	ELECTRONIC MATERIALS PROCESSING [4]
MAT SCI 125	Thin-Film Materials Science [3]

All students in the College of Chemistry are required to complete the University requirements of American Cultures (http://guide.berkeley.edu/undergraduate/colleges-schools/chemistry/american-cultures-requirement/), American History and Institutions (http://guide.berkeley.edu/undergraduate/colleges-schools/chemistry/american-history-institutions-requirements/), and Entry-Level Writing (http://guide.berkeley.edu/undergraduate/colleges-schools/chemistry/entry-level-writing-requirement/). In addition, they must satisfy the following College requirements:

Reading and Composition (http://guide.berkeley.edu/undergraduate/colleges-schools/chemistry/reading-composition-requirement/)

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

- Chemical Engineering majors: A-level Reading and Composition course (e.g., English R1A) by end of the first year
- Chemical Biology and Chemistry majors: A- and B-level courses by end of the second year (http://guide.berkeley.edu/undergraduate/colleges-schools/chemistry/reading-composition-requirement/)
- R&C courses must be taken for a letter grade
- English courses at other institutions may satisfy the requirement(s); check with your Undergraduate Adviser
- After admission to Berkeley, credit for English at another institution will not be granted if the Entry Level Writing requirement has not been satisfied

Humanities and Social Sciences Breadth Requirement: Chemistry & Chemical Biology majors

The College of Chemistry's humanities and social sciences breadth requirement promotes educational experiences that enrich and complement the technical requirements for each major.

- 15 units total; includes Reading & Composition and American Cultures courses
- Remaining units must come from the following L&S breadth areas, excluding courses which only teach a skill (such as drawing or playing an instrument):

  Arts and Literature
  Foreign Language (http://guide.berkeley.edu/undergraduate/colleges-schools/chemistry/approved-foreign-language-courses/)[1,2]
  Historical Studies
  International Studies
  Philosophy and Values
  Social and Behavioral Sciences

  To find course options for breadth, go to the Berkeley Academic Guide Class Schedule (http://classes.berkeley.edu/), select the term of interest, and use the 'Breadth Requirements' filter to select the breadth area(s) of interest.

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

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

[2] For Chemistry and Chemical Biology majors, elementary-level foreign language courses are not accepted toward the 15 unit breadth requirement if they are used (or are duplicates of high school courses used) to satisfy the Foreign Language requirement.

Foreign Language (Language Other Than English [LOTE]) Requirement

Applies to Chemistry and Chemical Biology majors only.

The LOTE requirement may be satisfied with one language other than English, in one of the following ways:

- By completing in high school the third year of one language other than English with minimum grades of C-.
- By completing at Berkeley the second semester of a sequence of courses in one language other than English, or the equivalent at another institution. Only LOTE courses that include reading and composition, as well as conversation, are accepted in satisfaction of this requirement. LOTE courses may be taken on a Pass/No Pass basis.
- By demonstrating equivalent knowledge of a language other than English 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.

Humanities and Social Sciences Breadth Requirement: Chemical Engineering major

- 22 units total; includes Reading and Composition and American Cultures courses
- Breadth Series requirement: As part of the 22 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 following lists of approved humanities and social science courses, excluding courses which only teach a skill (such as drawing or playing an instrument):

  Arts and Literature
  Foreign Language (http://guide.berkeley.edu/undergraduate/colleges-schools/chemistry/approved-foreign-language-courses/)[1,2]

Historical Studies
International Studies
Philosophy and Values

To find course options for breadth, go to the Berkeley Academic Guide Class Schedule (http://classes.berkeley.edu/), select the term of interest, and use the 'Breadth Requirements' filter to select the breadth area(s) of interest.

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

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

[2] For chemical engineering majors, no more that six units of language other than English may be counted toward the 22 unit breadth requirement.

Class Schedule Requirements

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

Semester Limit

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

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

Senior Residence

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

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

Juniors and seniors who participate in the UC Education Abroad Program (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

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

Chemistry or chemical biology majors must also achieve:

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

Chemical engineering students must also achieve:

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

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

Minimum Progress

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

1. Completed no fewer units than 15 multiplied by the number of semesters, less one, in which the student has been enrolled at Berkeley. Summer sessions do not count as semesters for this purpose.

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

University of California Requirements

Entry Level Writing (http://guide.berkeley.edu/undergraduate/education/#earningyourdegreetext)

All students who will enter the University of California as freshmen must demonstrate their command of the English language by satisfying the Entry Level Writing Requirement (ELWR). The UC Entry Level Writing Requirement website (https://admission.universityofcalifornia.edu/elwr/requirements/test-scores-grades.html) provides information on how to satisfy the requirement

American History and American Institutions (http://guide.berkeley.edu/undergraduate/education/#earningyourdegreetext)

The American History and Institutions (AH&I) requirements are based on the principle that a US resident graduated from an American university should have an understanding of the history and governmental institutions of the United States.

Campus Requirement

American Cultures (http://guide.berkeley.edu/undergraduate/education/#earningyourdegreetext)

The American Cultures requirement is a Berkeley campus requirement, one that all undergraduate students at Berkeley need to pass in order to graduate. You satisfy the requirement by passing, with a grade not lower than C- or P, an American Cultures course. You may take an American Cultures course any time during your undergraduate career at Berkeley. The requirement was instituted in 1991 to introduce students to the diverse cultures of the United States through a comparative framework. Courses are offered in more than fifty departments in many different disciplines at both the lower and upper division level.

For more detailed information regarding the courses listed below (e.g., elective information, GPA requirements, etc.), please see the Major Requirements tab.

			Freshman
	Fall Units		**Spring Units**
MATH 1A	4	MATH 1B	4
CHEM 4A or 1A ***and*** 1AL	5	CHEM 4B	5
English R1A or equivalent	4	PHYSICS 7A	4
Breadth Elective	3	ENGIN 7	4
MAT SCI 45[2]	3		
MAT SCI 45L[2]	1		
	20		**17**

			Sophomore
	Fall Units		**Spring Units**
MATH 53	4	MATH 54	4
PHYSICS 7B	4	PHYSICS 7C	4
CHEM 12A	5	BIOLOGY 1A	3
CHM ENG 140	4	CHM ENG 141	4
		CHM ENG 150A	4
	17		**19**

			Junior
	Fall Units		**Spring Units**
MAT SCI 102[1]	3	Materials Science Elective	3
CHEM 120A or PHYSICS 137A	3-4	MAT SCI 103	3
CHM ENG 142	4	Breadth Electives	9
CHM ENG 150B	4		
	14-15		**15**

			Senior
	Fall Units		**Spring Units**
Materials Science Elective	3-4	MAT SCI 112	3
MAT SCI 120	3	CHM ENG 160	4
MAT SCI 130	3	CHM ENG 162	4
CHM ENG 154	4	Breadth Elective	3
Breadth Elective	3		
	16-17		**14**

Total Units: 132-134

1 Permission is required from the instructor of MAT SCI 102 to take MAT SCI 45/MAT SCI 45L concurrently with MAT SCI 102.

2 MAT SCI 45/45L can be taken in either the Fall or Spring semesters. Both offerings deliver the same fundamental content. The Fall offering draws more examples from hard materials (e.g. semiconductors, metals and ceramics), whereas the Spring offering will draw more examples from soft materials (e.g. polymers and biomaterials).

Chemical Engineering

Mission

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 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

1-An ability to identify, formulate, and solve complx engineering problems by applying the principles of engineering, science, and mathematics

2-An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3-An ability to communicate effectively with a range of audiences

4-An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in a global, economic, environmental, and societal context

5-An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6-An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7-An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Materials Science

Measured Curricular Outcomes

The program is designed around a set of curricular outcomes.

1. Be able to apply general math, science and engineering skills to the solution of engineering problems.
2. Be aware of the social, safety and environmental consequences of their work, and be able to engage in public debate regarding these issues.
3. Be able to apply core concepts in materials science to solve engineering problems.
4. Be knowledgeable of contemporary issues relevant to materials science and engineering.
5. Be able to select materials for design and construction.
6. Understand the importance of life-long learning.
7. Be able to design and conduct experiments, and to analyze data.
8. Understand the professional and ethical responsibilities of a materials scientist and engineer.
9. Be able to work both independently and as part of a team.
10. Be able to communicate effectively while speaking, employing graphics, and writing.
11. Possess the skills and techniques necessary for modern materials engineering practice.

Educational Objectives for Graduates

Stated succinctly, graduates from the program will have the following skills:

1. Know the fundamental science and engineering principles relevant to materials.
2. Understand the relationship between nano/microstructure, characterization, properties and processing, and design of materials.
3. Have the experimental and computational skills for a professional career or graduate study in materials.
4. Possess a knowledge of the significance of research, the value of continued learning, and environmental/social issues surrounding materials.
5. Be able to communicate effectively, to work in teams and to assume positions as leaders.

Chemical Engineering/Materials Science and Engineering

Expand all course descriptions [+]Collapse all course descriptions [-]

CHM ENG 24 Freshman Seminars 1 Unit

Terms offered: Spring 2022, Spring 2020, Spring 2019
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.
Freshman Seminars: Read More [+]
Rules & Requirements

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

Hours & Format

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

Additional Details

Subject/Course Level: 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.

Freshman Seminars: Read Less [-]

CHM ENG 40 Introduction to Chemical Engineering Design 2 Units

Terms offered: Spring 2021, Fall 2020, Spring 2020
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.
Introduction to Chemical Engineering Design: Read More [+]
Rules & Requirements

Prerequisites: Math 1B OR Chem 4A

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Introduction to Chemical Engineering Design: Read Less [-]

CHM ENG 84 Sophomore Seminar 1 or 2 Units

Terms offered: Spring 2013, Spring 2012, Spring 2010
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.
Sophomore Seminar: Read More [+]
Rules & Requirements

Prerequisites: At discretion of instructor

Repeat rules: 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 - 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.

Sophomore Seminar: Read Less [-]

CHM ENG 90 Science and Engineering of Sustainable Energy 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
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.
Science and Engineering of Sustainable Energy: Read More [+]
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

Science and Engineering of Sustainable Energy: Read Less [-]

CHM ENG 98 Directed Group Studies for Lower Division Undergraduates 1 - 3 Units

Terms offered: Spring 2022, Fall 2021, Spring 2021
Supervised research on a specific topic.
Directed Group Studies for Lower Division Undergraduates: Read More [+]
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 without restriction.

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.

Directed Group Studies for Lower Division Undergraduates: Read Less [-]

CHM ENG 98W Directed Group Study 1 Unit

Terms offered: Fall 2015
Directed group study consisting of supplementary problem sets, review sessions, and discussions related to chemical engineering. Topics vary with instructor.
Directed Group Study: Read More [+]
Rules & Requirements

Prerequisites: This Chemical Engineering 98W is planned for students who are concurrently enrolled in Chemical Engineering 140

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

Hours & Format

Fall and/or spring: 15 weeks - 3 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.

Directed Group Study: Read Less [-]

CHM ENG 101 Chemical Business Fundamentals I 4 Units

Terms offered: Prior to 2007
This upper division course for science and engineering students is the first of a two-course series that covers the business fundamentals for technology professionals. This course is only offered as part of a four-course summer minor program in Responsible Process Implementation within the Department of Chemical & Biomolecular Engineering. Through the use of applicable cases and examples from the chemical and process industries, students will learn the basic concept of business and the role that technology professionals are expected to play in a business environment.
Chemical Business Fundamentals I: Read More [+]
Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Chemical Business Fundamentals I: Read Less [-]

CHM ENG 102 Chemical Business Fundamentals II 4 Units

Terms offered: Prior to 2007
This upper division course for science and engineering students is the continuation of a two-course series that covers the business fundamentals for technology professionals. This course is only offered as part of a four-course summer minor program in Responsible Process Implementation within the Department of Chemical & Biomolecular Engineering. It is intended to introduce the marketing, product development, and operational aspects of a business enterprise, to help technology professionals optimize their effectiveness when performing their duties within a multifunctional organization, and to illuminate the effects of their actions and decisions on the performance of a business entity.
Chemical Business Fundamentals II: Read More [+]
Rules & Requirements

Prerequisites: CHMENG S101

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Chemical Business Fundamentals II: Read Less [-]

CHM ENG 103 New Process Implementation: Concept to Commercialization 3 Units

Terms offered: Not yet offered
This upper division course for science and engineering students is to be taken in the second 6-week summer session of the summer minor program in Responsible Process Implementation within the Department of Chemical & Biomolecular Engineering. Students will use all of the materials presented in this program to address process design and control challenges. Specifically, they will learn how to make process design and control decisions that satisfy all of the technical requirements and optimize the economic benefits while addressing the ethical, environmental, and social impact.
New Process Implementation: Concept to Commercialization: Read More [+]
Rules & Requirements

Prerequisites: CHM ENG 101 & CHM 101

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

New Process Implementation: Concept to Commercialization: Read Less [-]

CHM ENG 104 Ethics and Professional Social Responsibility 1 Unit

Terms offered: Not yet offered
This upper division course for science and engineering students covers the concept of environmental ethics and responsibility in the chemical industry. This course is only offered as part of a summer minor program in Responsible Process Implementation by the Chemical and Biomolecular Engineering. It is intended to impress upon the importance of professional social responsibilities of engineering decision making. Topics of discussion include corporate citizenship, business and stakeholder relationship, environmental responsibilities, engineering and technology ethics and other key aspects of engineering professional social responsibilities such as social justice, health, safety and welfare of stakeholders.
Ethics and Professional Social Responsibility: Read More [+]
Rules & Requirements

Prerequisites: CHM ENG 101

Hours & Format

Summer: 6 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. Alternative to final exam.

Ethics and Professional Social Responsibility: Read Less [-]

CHM ENG 130 Mathematics and Statistics in Chemical Engineering 4 Units

Terms offered: Fall 2022
The purpose of this course is to teach students the analytical, numerical, and statistical methods required for setting up and solving mathematical problems, with emphasis on CBE applications. Methods for solving algebraic equations, initial value problems, boundary value problems, and partial differential equations, as well as probability theory, will be covered. Programming tools such as Python and Matlab will be used in this course. This is not a programming course. The majority of the learning will be through the active use of these programs by the students in solving assigned problems.
Mathematics and Statistics in Chemical Engineering: Read More [+]
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.

Mathematics and Statistics in Chemical Engineering: Read Less [-]

CHM ENG 140 Introduction to Chemical Process Analysis 4 Units

Terms offered: Fall 2022, Fall 2021, Spring 2021
Material and energy balances applied to chemical process systems. Determination of thermodynamic properties needed for such calculations. Sources of data. Calculation procedures.
Introduction to Chemical Process Analysis: Read More [+]
Rules & Requirements

Prerequisites: Chemistry 4B (may be taken concurrently) or Chemistry 1B; 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.

Introduction to Chemical Process Analysis: Read Less [-]

CHM ENG 141 Chemical Engineering Thermodynamics 4 Units

Terms offered: Spring 2022, Fall 2021, Spring 2021
Thermodynamic behavior of pure substances and mixtures. Properties of solutions, phase equilibria. Thermodynamic cycles. Chemical equilibria for homogeneous and heterogeneous systems.
Chemical Engineering Thermodynamics: Read More [+]
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.

Chemical Engineering Thermodynamics: Read Less [-]

CHM ENG 142 Chemical Kinetics and Reaction Engineering 4 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
Analysis and prediction of rates of chemical conversion in flow and nonflow processes involving homogeneous and heterogeneous systems.
Chemical Kinetics and Reaction Engineering: Read More [+]
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.

Chemical Kinetics and Reaction Engineering: Read Less [-]

CHM ENG 143 Computational Methods in Chemical Engineering 4 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
The purpose of Chemical Engineering Modeling and Computations in Chemical Engineering is to teach students the methodologies used in setting up mathematical models of simple chemical processes and operations, and the numerical techniques used to simulate them. Included are techniques to obtain physical properties of mixtures/solutions using equations of state. This is followed by simple processes such as vapor liquid equilibrium, separation operations such as distillation, heat transfer, and chemical reactions in ideal reactors such as stirred tank and plug flow. Later on, real chemical process equipment and processes are modeled and simulated, using many of the techniques learned earlier. Programming languages such as Matlab and...
Computational Methods in Chemical Engineering: Read More [+]
Objectives & Outcomes

Course Objectives: The focus of this course is on developing insights into chemical processes and operations through the use of modeling and computations. This is not a programming course. The instructors will provide introduction to the use of Aspen and the other codes, but the majority of the learning will be through the active use of these programs by the students in solving assigned problems.

Student Learning Outcomes: The course will be consistent with the overall objectives of the Chemical Engineering curriculum as outlined in the ABET guidelines.

Rules & Requirements

Prerequisites: E7 and CHM ENG 140

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. Alternative to final exam.

Computational Methods in Chemical Engineering: Read Less [-]

CHM ENG 150A Transport Processes 4 Units

Terms offered: Spring 2022, Fall 2021, Spring 2021
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.
Transport Processes: Read More [+]
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.

Transport Processes: Read Less [-]

CHM ENG 150B Transport and Separation Processes 4 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
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.
Transport and Separation Processes: Read More [+]
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

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/Undergraduate

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

Transport and Separation Processes: Read Less [-]

CHM ENG 154 Chemical Engineering Laboratory 4 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
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.
Chemical Engineering Laboratory: Read More [+]
Rules & Requirements

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

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.

Chemical Engineering Laboratory: Read Less [-]

CHM ENG 160 Chemical Process Design 4 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
Design principles of chemical process equipment. Design of integrated chemical processes with emphasis upon economic considerations.
Chemical Process Design: Read More [+]
Rules & Requirements

Prerequisites: Chemical and Biomolecular Engineering 142, 150B, and 154. 154 can be taken concurrently

Hours & Format

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

Summer: 8 weeks - 6 hours of lecture 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.

Chemical Process Design: Read Less [-]

CHM ENG 161S Industrial Chemical Process Design 6 Units

Terms offered: Prior to 2007
Design of chemical processes and equipment, with an emphasis on industry-sponsored and/or industry-tailored processes
Industrial Chemical Process Design: Read More [+]
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

Industrial Chemical Process Design: Read Less [-]

CHM ENG 162 Dynamics and Control of Chemical Processes 4 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
Analysis of the dynamic behavior of chemical processes and methods and theory of their control. Implementation of computer control systems on process simulations.
Dynamics and Control of Chemical Processes: Read More [+]
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.

Dynamics and Control of Chemical Processes: Read Less [-]

CHM ENG 170A Biochemical Engineering 4 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
This course intends to introduce chemical engineers to the essential concepts of bioprocessing for applications in the biopharmaceutical, industrial biotech, and food tech industries. The course focuses on the use of chemical engineering skills and principles, including but not limited to kinetics and reactor design, thermodynamics and transport phenomena in the analysis and design of biologically-based processes, as well as the economical analysis and ethics. The main emphasis of 170A, the first of a two-semester sequence will be on the upstream bioprocess of how to make products by designing unit operations and processes around living systems of cells.
Biochemical Engineering: Read More [+]
Rules & Requirements

Prerequisites: BIO ENG 11 or MCB 102 (or equivalent) highly recommended. Chem Eng 150B and Chem Eng 142 or concurrent, or consent of instructor(s)

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.

Instructors: Zhang, Ryder

Biochemical Engineering: Read Less [-]

CHM ENG 170B Biochemical Engineering 4 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
This course intends to introduce chemical engineers to the essential concepts of bioprocessing for applications in the biopharmaceutical, industrial biotech, and food tech industries. The course focuses on the use of chemical engineering skills and principles, including but not limited to kinetics and reactor design, thermodynamics and transport phenomena in the analysis and design of biologically-based processes, as well as the economical analysis and ethics. The main emphasis of 170B, the second of a two-semester sequence will be on the downstream bioprocess of recovery, separations and purification of bio-based products.
Biochemical Engineering: Read More [+]
Rules & Requirements

Prerequisites: BIO ENG 11 or MCB 102 (or equivalent) highly recommended. Chem Eng 150B and Chem Eng 142 or concurrent, or consent of instructor(s)

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.

Instructors: Zhang, Ryder

Formerly known as: 170

Biochemical Engineering: Read Less [-]

CHM ENG C170L Biochemical Engineering Laboratory 3 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021, Fall 2018, Spring 2014, Spring 2013
Laboratory techniques for the cultivation of microorganisms in batch and continuous reactions. Enzymatic conversion processes. Recovery of biological products.
Biochemical Engineering Laboratory: Read More [+]
Rules & Requirements

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

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Also listed as: CHEM C170L

Biochemical Engineering Laboratory: Read Less [-]

CHM ENG 171 Transport Phenomena 3 Units

Terms offered: Spring 2021, Fall 2018, Spring 2011
Study of momentum, energy, and mass transfer in laminar and turbulent flow.
Transport Phenomena: Read More [+]
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.

Transport Phenomena: Read Less [-]

CHM ENG 176 Principles of Electrochemical Processes 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2019
Principles and application of electrochemical equilibria, kinetics, and transport processes. Technical electrolysis and electrochemical energy conversion.
Principles of Electrochemical Processes: Read More [+]
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.

Principles of Electrochemical Processes: Read Less [-]

CHM ENG C178 Polymer Science and Technology 3 Units

Terms offered: Fall 2021, Fall 2020, Spring 2020, Fall 2016, Spring 2016, Spring 2015
An interdisciplinary course on the synthesis, characterization, and properties of polymer materials. Emphasis on the molecular origin of properties of polymeric materials and technological applications. Topics include single molecule properties, polymer mixtures and solutions, melts, glasses, elastomers, and crystals. Experiments in polymer synthesis, characterization, and physical properties.
Polymer Science and Technology: Read More [+]
Rules & Requirements

Prerequisites: Junior standing

Hours & Format

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Also listed as: CHEM C178

Polymer Science and Technology: Read Less [-]

CHM ENG 179 Process Technology of Solid-State Materials Devices 3 Units

Terms offered: Spring 2022, Spring 2021, Fall 2019
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.
Process Technology of Solid-State Materials Devices: Read More [+]
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.

Process Technology of Solid-State Materials Devices: Read Less [-]

CHM ENG 180 Chemical Engineering Economics 3 Units

Terms offered: Fall 2022, Fall 2020, Fall 2019
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.
Chemical Engineering Economics: Read More [+]
Rules & Requirements

Prerequisites: Chemical and Biomolecular Engineering 142 and 150B. 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.

Chemical Engineering Economics: Read Less [-]

CHM ENG 182 Nanoscience and Engineering Biotechnology 3 Units

Terms offered: Fall 2022, Fall 2021, Spring 2020
This nanoscale science and biomolecular engineering course will cover emerging topics in applied biotechnology and nanotechnology. Topics include enzyme kinetics, enzyme inhibition, recombinant protein generation, cell culture, genome editing, drug design, nanoparticle-based gene and drug delivery, fluorescence imaging, and sensors. The course will also probe the interface of biology with nanomaterials, and standard microscopic techniques to image biological structures and nanoscale materials.
Nanoscience and Engineering Biotechnology: Read More [+]
Rules & Requirements

Prerequisites: Bio 1A or BioE 11 and Physics 7A

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. Alternate method of final assessment during regularly scheduled final exam group (e.g., presentation, final project, etc.).

Instructor: Landry

Nanoscience and Engineering Biotechnology: Read Less [-]

CHM ENG 183 Climate Solutions Technologies 3 Units

Terms offered: Fall 2020
This course for upper division students in science and engineering disciplines covers energy and climate and specific technologies that can be implemented to reduce global warming. Topics include renewable energy (wind and solar), carbon management technologies including Carbon Capture, Utilization and Storage, and Negative Emissions Technologies. The technologies will be described and compared from an upper level chemical engineering perspective that includes fundamental concepts in thermodynamics and separations. We will also cover carbon economics and policies and life-cycle analysis. The course will be framed from a systems-thinking perspective. Throughout the course we will focus on key aspects of communicating climate science.
Climate Solutions Technologies: Read More [+]
Objectives & Outcomes

Course Objectives: After taking this course, students should be able to discuss and explain to peers the role of CO2 in the earth’s climate, the greenhouse effect, the carbon cycle and how it relates to the fate of greenhouse gases on many time scales, and the role of fossil fuel combustion in the energy landscape and in CO2 emissions.
Students in this class will gain experience in applying principles of systems thinking, engineering design and analysis to specific technologies that are relevant for mitigating climate change in the immediate future.
Students will appreciate the critical role that communication plays in the path to implementation of solutions and will be comfortable engaging in a discussion about climate solutions with technical and non-technical peers.
Students will gain a basic understanding of economics relative to climate policies, and of climate solutions currently being discussed by policymakers; they will gain an understanding of how these individual solutions fit into a global scheme.
Students will gain knowledge about the most current technologies available for producing energy renewably, managing carbon, and reducing atmospheric greenhouse gas concentrations.

Rules & Requirements

Prerequisites: Chem 1A,B or 4A,B, Phys 7A,B, Math 1A,B

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. Alternative to final exam.

Instructor: Went

Climate Solutions Technologies: Read Less [-]

CHM ENG H193 Senior Honors Thesis 3 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015
A senior honors thesis is written in consultation with the student's faculty research advisor. This is a required course for students wishing to graduate with honors in Chemical Engineering.
Senior Honors Thesis: Read More [+]
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.

Senior Honors Thesis: Read Less [-]

CHM ENG H194 Research for Advanced Undergraduates 2 - 4 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
Original research under direction of one of the members of the staff.
Research for Advanced Undergraduates: Read More [+]
Rules & Requirements

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

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

Hours & Format

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

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

Additional Details

Subject/Course Level: Chemical & Biomolecular Engineering/ Undergraduate

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

Research for Advanced Undergraduates: Read Less [-]

CHM ENG 195 Special Topics 2 - 4 Units

Terms offered: Spring 2021, Spring 2020, Fall 2019
Lectures and/or tutorial instruction on special topics. Please refer to the Notes section in the Academic Guide for the current course description.
Special Topics: Read More [+]
Rules & Requirements

Prerequisites: Consent of instructor

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

Hours & Format

Fall and/or spring: 15 weeks - 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.

Special Topics: Read Less [-]

CHM ENG C195A The Berkeley Lectures on Energy: Energy from Biomass 3 Units

Terms offered: Fall 2015, Fall 2014, Fall 2013
After an introduction to the different aspects of our global energy consumption, the course will focus on the role of biomass. The course will illustrate how the global scale of energy guides the biomass research. Emphasis will be placed on the integration of the biological aspects (crop selection, harvesting, storage and distribution, and chemical composition of biomass) with the chemical aspects to convert biomass to energy. The course aims to engage students in state-of-the-art research.
The Berkeley Lectures on Energy: Energy from Biomass: Read More [+]
Rules & Requirements

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

Repeat rules: Course may be repeated for credit under special circumstances: Repeatable when topic changes with consent of instructor.

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

The Berkeley Lectures on Energy: Energy from Biomass: Read Less [-]

CHM ENG 196 Special Laboratory Study 2 - 4 Units

Terms offered: Summer 2022 8 Week Session, Summer 2021 8 Week Session, Spring 2021
Special laboratory or computational work under direction of one of the members of the staff.
Special Laboratory Study: Read More [+]
Rules & Requirements

Prerequisites: Consent of instructor

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

Hours & Format

Fall and/or spring: 15 weeks - 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.

Special Laboratory Study: Read Less [-]

CHM ENG 197 Field Study in Chemical Engineering 1 - 4 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
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.
Field Study in Chemical Engineering: Read More [+]
Rules & Requirements

Prerequisites: Upper division standing and consent of instructor

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

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

Field Study in Chemical Engineering: Read Less [-]

CHM ENG 198 Directed Group Study for Undergraduates 1 - 3 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
Supervised research on a specific topic. Enrollment is restricted; see Introduction to Courses and Curricula section in the General Catalog.
Directed Group Study for Undergraduates: Read More [+]
Rules & Requirements

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

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

Hours & Format

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

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.

Directed Group Study for Undergraduates: Read Less [-]

CHM ENG 199 Supervised Independent Study and Research 1 - 4 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015
Supervised Independent Study and Research: Read More [+]
Rules & Requirements

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

Hours & Format

Fall and/or spring: 15 weeks - 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.

Supervised Independent Study and Research: Read Less [-]

Materials Science and Engineering

Expand all course descriptions [+]Collapse all course descriptions [-]

MAT SCI 24 Freshman Seminar 1 Unit

Terms offered: Spring 2022, Spring 2020, Spring 2019
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 vary from department to department and semester to semester. Enrollment limited to 20 freshmen.
Freshman Seminar: Read More [+]
Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final Exam To be decided by the instructor when the class is offered.

Freshman Seminar: Read Less [-]

MAT SCI 45 Properties of Materials 3 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
Application of basic principles of physics and chemistry to the engineering properties of materials. Emphasis on establishing structure, property, processing, and performance interrelationships in metals, ceramics, and polymers. While core concepts are fully covered each semester, examples and contextualization in Fall editions focuses on metals, ceramics, and functional/electronic properties and in Spring editions on polymers and soft-materials.
Properties of Materials: Read More [+]
Rules & Requirements

Prerequisites: Students should have completed high school AP or honors chemistry and physics

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructors: Martin, Messersmith

Properties of Materials: Read Less [-]

MAT SCI 45L Properties of Materials Laboratory 1 Unit

Terms offered: Fall 2022, Spring 2022, Fall 2021
This course presents laboratory applications of the basic principles introduced in the lecture-based course MSE45 – Properties of Materials.
Properties of Materials Laboratory: Read More [+]
Rules & Requirements

Credit Restrictions: Students will receive no credit for MSE 45L after taking E45L

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructors: Martin, Messersmith

Properties of Materials Laboratory: Read Less [-]

MAT SCI 102 Bonding, Crystallography, and Crystal Defects 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
Bonding in solids; classification of metals, semiconductors, and insulators; crystal systems; point, line, and planar defects in crystals; examples of crystallographic and defect analysis in engineering materials; relationship to physical and mechanical properties.
Bonding, Crystallography, and Crystal Defects: Read More [+]
Rules & Requirements

Prerequisites: MAT SCI 45

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Chrzan

Bonding, Crystallography, and Crystal Defects: Read Less [-]

MAT SCI 103 Phase Transformations and Kinetics 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
The nature, mechanisms, and kinetics of phase transformations and microstructural changes in the solid state. Atom diffusion in solids. Phase transformations through the nucleation and growth of new matrix or precipitate phases. Martensitic transformations, spinodal decomposition. The use of phase transformations to control microstructure.
Phase Transformations and Kinetics: Read More [+]
Rules & Requirements

Prerequisites: MAT SCI 102 and ENGIN 40

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Phase Transformations and Kinetics: Read Less [-]

MAT SCI 104 Materials Characterization 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
This 3-unit course will cover basic principles and techniques used for the characterization of engineering materials. The course is designed to introduce undergraduate students to the basic principles of structural, chemical and property characterization techniques. The course is grounded in modern x-ray diffraction and electron microscopy techniques for characterization of the chemical and structural properties of a material. The course introduces the fundamental theoretical framework for diffraction, spectrometry and imaging methods.
Materials Characterization: Read More [+]
Objectives & Outcomes

Course Objectives: Materials characterization lies at the heart of understanding the property-structure-processing relationships of materials. The goal of the course is to prepare undergraduate students from materials science to understand the basic principles behind material characterization tools and techniques. More specifically, this class will provide students (1) a thorough introduction to the principles and practice of diffraction, (2) introductory exposure to a range of common characterization methods for the determination of structure and composition of solids. A successful student will learn (1) the theory of x-ray and electron diffraction, (2) basic elements of electron microscopy, (3) basic aspects of optical and scanning probe techniques.

Rules & Requirements

Prerequisites: MAT SCI 102. A basic knowledge of structure, bonding and crystallography will be assumed

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructors: Scott, Minor

Materials Characterization: Read Less [-]

MAT SCI 104L Materials Characterization Laboratory 1 Unit

Terms offered: Spring 2022, Spring 2021, Spring 2020
This 1-unit laboratory course covers X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron microscopy (TEM), as well as lab writeup protocols and academic integrity. Students will get hands-on experience using the XRD, SEM and TEM equipment to perform microstructural characterization of materials. Students will also design and run their own project on a topic of their choosing.
Materials Characterization Laboratory: Read More [+]
Objectives & Outcomes

Course Objectives: Practical experience on the most common materials characterization equipment for structural and chemical analysis of materials. Introduction to laboratory procedures and independent projects.

Rules & Requirements

Prerequisites: MAT SCI 102; and MAT SCI 104 must be taken concurrently. A basic knowledge of structure, bonding and crystallography will be assumed. Undergraduate student in engineering, physics or chemistry

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructors: Scott, Minor

Materials Characterization Laboratory: Read Less [-]

MAT SCI 111 Properties of Electronic Materials 4 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
Introduction to the physical principles underlying the electric properties of modern solids with emphasis on semiconductors; control of defects and impurities through physical purification, bulk and thin film crystal growth and doping processes, materials basis of electronic and optoelectronic devices (diodes, transistors, semiconductor lasers) and optical fibers; properties of metal and oxide superconductors and their applications.
Properties of Electronic Materials: Read More [+]
Rules & Requirements

Prerequisites: PHYSICS 7A, PHYSICS 7B, and PHYSICS 7C; or PHYSICS 7A, PHYSICS 7B and consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructors: Dubon, Wu, Yao

Properties of Electronic Materials: Read Less [-]

MAT SCI 112 Corrosion (Chemical Properties) 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
Electrochemical theory of corrosion. Mechanisms and rates in relation to physiochemical and metallurgical factors. Stress corrosion and mechanical influences on corrosion. Corrosion protection by design, inhibition, cathodic protection, and coatings.
Corrosion (Chemical Properties): Read More [+]
Rules & Requirements

Prerequisites: MAT SCI 45 and ENGIN 40

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Devine

Corrosion (Chemical Properties): Read Less [-]

MAT SCI 113 Mechanical Behavior of Engineering Materials 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
This course covers elastic and plastic deformation under static/dynamic loads. Prediction/prevention of failure by yielding, fracture, fatigue, wear and environmental effects are addressed. Design issues of materials selection for load-bearing applications are discussed. Case studies of engineering failures are presented. Topics include engineering materials, structure-property relationships, mechanical behavior of metals, ceramics, polymers and composites, complex stress/strain states, stress concentrations, multiaxial loading, plasticity, yield criteria, dislocations, strengthening mechanisms, creep, fracture mechanics and fatigue.
Mechanical Behavior of Engineering Materials: Read More [+]
Rules & Requirements

Prerequisites: CIV ENG C30/MEC ENG C85 and MAT SCI 45

Credit Restrictions: Students will receive no credit for 113 after taking C113 or Mechanical Engineering C124. Deficiency in C113 or Mechanical Engineering C124 maybe removed by taking 113.

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Ritchie

Mechanical Behavior of Engineering Materials: Read Less [-]

MAT SCI 117 Properties of Dielectric and Magnetic Materials 3 Units

Terms offered: Spring 2021, Spring 2017, Spring 2011
Introduction to the physical principles underlying the dielectric and magnetic properties of solids. Processing-microstructure-property relationships of dielectric materials, including piezoelectric, pryoelectric, and ferroelectric oxides, and of magnetic materials, including hard- and soft ferromagnets, ferrites and magneto-optic and -resistive materials. The course also covers the properties of grain boundary devices (including varistors) as well as ion-conducting and mixed conducting materials for applications in various devices such as sensors, fuel cells, and electric batteries.
Properties of Dielectric and Magnetic Materials: Read More [+]
Rules & Requirements

Prerequisites: PHYSICS 7A, PHYSICS 7B, and PHYSICS 7C; or PHYSICS 7A, PHYSICS 7B, and consent of instructor. MAT SCI 111 is recommended

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Properties of Dielectric and Magnetic Materials: Read Less [-]

MAT SCI C118 Biological Performance of Materials 4 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
This course is intended to give students the opportunity to expand their knowledge of topics related to biomedical materials selection and design. Structure-property relationships of biomedical materials and their interaction with biological systems will be addressed. Applications of the concepts developed include blood-materials compatibility, biomimetic materials, hard and soft tissue-materials interactions, drug delivery, tissue engineering, and biotechnology.
Biological Performance of Materials: Read More [+]
Objectives & Outcomes

Course Objectives: The course is separated into four parts spanning the principles of synthetic materials and surfaces, principles of biological materials, biological performance of materials and devices, and state-of-the-art materials design. Students are required to attend class and master the material therein. In addition, readings from the clinical, life and materials science literature are assigned. Students are encouraged to seek out additional reference material to complement the readings assigned. A mid-term examination is given on basic principles (parts 1 and 2 of the outline). A comprehensive final examination is given as well. The purpose of this course is to introduce students to problems associated with the selection and function of biomaterials. Through class lectures and readings in both the physical and life science literature, students will gain broad knowledge of the criteria used to select biomaterials, especially in devices where the material-tissue or material-solution interface dominates performance. Materials used in devices for medicine, dentistry, tissue engineering, drug delivery, and the biotechnology industry will be addressed.

This course also has a significant design component (~35%). Students will form small teams (five or less) and undertake a semester-long design project related to the subject matter of the course. The project includes the preparation of a paper and a 20 minute oral presentation critically analyzing a current material-tissue or material-solution problem. Students will be expected to design improvements to materials and devices to overcome the problems identified in class with existing materials.

Student Learning Outcomes:
Apply math, science & engineering principles to the understanding of soft materials, surface chemistry, DLVO theory, protein adsorption kinetics, viscoelasticity, mass diffusion, and molecular (i.e., drug) delivery kinetics.

•
Design experiments and analyze data from the literature in the context of the class design project.
Apply core concepts in materials science to solve engineering problems related to the selection biomaterials, especially in devices where the material-tissue or material-solution interface dominates performance.
Develop an understanding of the social, safety and medical consequences of biomaterial use and regulatory issues associated with the selection of biomaterials in the context of the silicone breast implant controversy and subsequent biomaterials crisis.
Work independently and function on a team, and develop solid communication skills (oral, graphic & written) through the class design project.
•
Understanding of the origin of surface forces and interfacial free energy, and how they contribute to the development of the biomaterial interface and ultimately biomaterial performance.

Rules & Requirements

Prerequisites: MAT SCI 45 and BIO ENG 103 are required.
BIO ENG 102 and BIO ENG 104 are strongly recommended

MAT SCI 120 Materials Production 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
Economic and technological significance of metals and other materials. Elementary geology (composition of lithosphere, mineralization). Short survey of mining and mineral processing techniques. Review of chemical thermodynamics and reaction kinetics. Principles of process engineering including material, heat, and mechanical energy balances. Elementary heat transfer, fluid flow, and mass transfer. Electrolytic production and refining of metals. Vapor techniques for production of metals and coatings.
Materials Production: Read More [+]
Rules & Requirements

Prerequisites: ENGIN 40, MEC ENG 40, CHM ENG 141, CHEM 120B, or equivalent thermodynamics course

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Materials Production: Read Less [-]

MAT SCI 121 Metals Processing 3 Units

Terms offered: Spring 2019, Spring 2015, Spring 2014
The principles of metals processing with emphasis on the use of processing to establish microstructures which impart desirable engineering properties. The techniques discussed include solidification, thermal and mechanical processing, powder processing, welding and joining, and surface treatments.
Metals Processing: Read More [+]
Rules & Requirements

Prerequisites: MAT SCI 45

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Gronsky

Metals Processing: Read Less [-]

MAT SCI 122 Ceramic Processing 3 Units

Terms offered: Fall 2012, Fall 2011, Fall 2010
Powder fabrication by grinding and chemical methods, rheological behavior of powder-fluid suspensions, forming methods, drying, sintering, and grain growth. Relation of processing steps to microstructure development.
Ceramic Processing: Read More [+]
Rules & Requirements

Prerequisites: MAT SCI 45 and ENGIN 40

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Ceramic Processing: Read Less [-]

MAT SCI 123 ELECTRONIC MATERIALS PROCESSING 4 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
This 4-unit course starts with a brief review of the fundamentals of solid-state physics including bands and defects in semiconductors and oxides, and then moves to bulk semiconductor crystals growth and processing including doping, diffusion and implantation, and then to thin film deposition and processing methods, and finishes with a discussion of materials analysis and characterization. Recent advances in nanomaterials research will also be introduced.
ELECTRONIC MATERIALS PROCESSING: Read More [+]
Objectives & Outcomes

Course Objectives: To prepare students a) for work in semiconductor processing facilities and b) for graduate studies related to thin film processing and relevant materials science topics.
To present the relevant materials science issues in semiconductor and oxide processing.
To provide an introduction into the principles of thin film processing and related technologies.

Student Learning Outcomes: Basic knowledge of gas kinetics and vacuum technology, including ideal gas, gas transport theory, definition, creation and measurement of vacuum.
Knowledge of electrical and optical properties of thin films.
Knowledge of the formation of p-n junction to explain the diode operation and its I-V characteristics. Understanding of the mechanisms of Hall Effect, transport, and C-V measurements, so that can calculate carrier concentration, mobility and conductivity given raw experimental data.
The ability to describe major growth techniques of bulk, thin film, and nanostructured semiconductors, with particular emphasis on thin film deposition technologies, including evaporation, sputtering, chemical vapor deposition and epitaxial growths.
To have basic knowledge of doping, purification, oxidation, gettering, diffusion, implantation, metallization, lithography and etching in semiconductor processing.
To have basic knowledge of electronic material characterization methods: x-ray diffraction, SEM and TEM, EDX, Auger, STM and AFM, Rutherford Back Scattering and SIMS, as well as optical methods including photoluminescence, absorption and Raman scattering.
To understand the concepts of bands, bandgap, to distinguish direct and indirect bandgap semiconductors. Understanding of free electron and hole doping of semiconductors to determine Fermi level position.
To understand the effect of defects in semiconductors, so that can describe their electronic and optical behaviors, and the methods to eliminate and control them in semiconductors.

Rules & Requirements

Prerequisites: MAT SCI 111, PHYSICS 7C, or consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructors: Wu, Yao

ELECTRONIC MATERIALS PROCESSING: Read Less [-]

MAT SCI 125 Thin-Film Materials Science 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
Deposition, processing, and characterization of thin films and their technological applications. Physical and chemical vapor deposition methods. Thin-film nucleation and growth. Thermal and ion processing. Microstructural development in epitaxial, polycrystalline, and amorphous films. Thin-film characterization techniques. Applications in information storage, integrated circuits, and optoelectronic devices. Laboratory demonstrations.
Thin-Film Materials Science: Read More [+]
Rules & Requirements

Prerequisites: Upper division or graduate standing in Engineering, Physics, Chemistry, or Chemical Engineering; and MAT SCI 45. PHYSICS 111A or PHYSICS 141A recommended

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Dubon

Thin-Film Materials Science: Read Less [-]

MAT SCI 129 Experimental Materials Science of Thin Films and Coatings 3 Units

Terms offered: Spring 2022
This course covers the fundamental experimental materials science and processing
of thin film and coatings that incorporates fundamental knowledge of materials transport,
accumulation, defects and epitaxy. Through this course, an understanding of the fundamental
physical and chemical processes which are involved in crystal growth and thin film fabrication
will be gained. Important synthesis and processing techniques used for the fabrication of
electronic and photonic devices will be discussed. Finally, it will provide an
understanding of how material characteristics are influenced by processing and deposition
conditions. This course addresses current challenges and future needs of the semiconductor and coating industries.
Experimental Materials Science of Thin Films and Coatings: Read More [+]
Objectives & Outcomes

Student Learning Outcomes: The development of proper protocols for data collection, analysis, and dissemination.
To apply this knowledge to scholarly report writing and the hypothesis driven insights and conclusions.
To familiarize students with some of the important experimental methods growth of materials.
To gain an understanding of how material characteristics are influenced by processing and deposition
conditions of thin films and coatings.
To gain an understanding of the fundamental physical and chemical processes which are involved in
crystal growth and thin film fabrication.

Rules & Requirements

Prerequisites: MAT SCI 45, MAT SCI 104, and MAT SCI 125; or consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Al Balushi

Experimental Materials Science of Thin Films and Coatings: Read Less [-]

MAT SCI 130 Experimental Materials Science and Design 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
This course provides a culminating experience for students approaching completion of the materials science and engineering curriculum. Laboratory experiments are undertaken in a variety of areas from the investigations on semiconductor materials to corrosion science and elucidate the relationships among structure, processing, properties, and performance. The principles of materials selection in engineering design are reviewed.
Experimental Materials Science and Design: Read More [+]
Rules & Requirements

Prerequisites: Senior standing or consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Experimental Materials Science and Design: Read Less [-]

MAT SCI 136 Materials in Energy Technologies 4 Units

Terms offered: Fall 2021, Fall 2019, Fall 2017
In many, if not all, technologies, it is materials that play a crucial, enabling role. This course examines potentially sustainable technologies, and the materials properties that enable them. The science at the basis of selected energy technologies are examined and considered in case studies.
Materials in Energy Technologies: Read More [+]
Rules & Requirements

Prerequisites: Junior or above standing in Materials Science and Engineering or related field

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Formerly known as: Materials Science and Engineering 126

Materials in Energy Technologies: Read Less [-]

MAT SCI 140 Nanomaterials for Scientists and Engineers 3 Units

Terms offered: Spring 2022, Spring 2020, Spring 2015
This course introduces the fundamental principles needed to understand the behavior of materials at the nanometer length scale and the different classes of nanomaterials with applications ranging from information technology to biotechnology. Topics include introduction to different classes of nanomaterials, synthesis and characterization of nanomaterials, and the electronic, magnetic, optical, and mechanical properties of nanomaterials.
Nanomaterials for Scientists and Engineers: Read More [+]
Rules & Requirements

Prerequisites: PHYSICS 7C and MAT SCI 45. MAT SCI 102 recommended

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Zheng

Nanomaterials for Scientists and Engineers: Read Less [-]

MAT SCI C150 Introduction to Materials Chemistry 3 Units

Terms offered: Fall 2022, Fall 2021, Spring 2021, Spring 2020
The application of basic chemical principles to problems in materials discovery, design, and characterization will be discussed. Topics covered will include inorganic solids, nanoscale materials, polymers, and biological materials, with specific focus on the ways in which atomic-level interactions dictate the bulk properties of matter.
Introduction to Materials Chemistry: Read More [+]
Rules & Requirements

Prerequisites: CHEM 104A. CHEM 104B recommended

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Also listed as: CHEM C150

Introduction to Materials Chemistry: Read Less [-]

MAT SCI 151 Polymeric Materials 3 Units

Terms offered: Spring 2022, Spring 2021, Spring 2020
This course is designed for upper division undergraduate and graduate students to gain a fundamental understanding of the science of polymeric materials. Beginning with a treatment of ideal polymeric chain conformations, it develops the thermodynamics of polmyer blends and solutions, the modeling of polymer networks and gelations, the dynamics of polymer chains, and the morphologies of thin films and other dimensionally-restricted structures relevant to nanotechnology.
Polymeric Materials: Read More [+]
Rules & Requirements

Prerequisites: CHEM 1A or MAT SCI 45. MAT SCI 103 is recommended

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Xu

Polymeric Materials: Read Less [-]

MAT SCI C157 Nanomaterials in Medicine 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
Nanomedicine is an emerging field involving the use of nanoscale materials for therapeutic and diagnostic purposes. Nanomedicine is a highly interdisciplinary field involving chemistry, materials science, biology and medicine, and has the potential to make major impacts on healthcare in the future. This upper division course is designed for students interested in learning about current developments and future trends in nanomedicine. The overall objective of the course is to introduce major aspects of nanomedicine including the selection, design and testing of suitable nanomaterials, and key determinants of therapeutic and diagnostic efficacy. Organic, inorganic and hybrid nanomaterials will be discussed in this course.
Nanomaterials in Medicine: Read More [+]
Objectives & Outcomes

Course Objectives: To identify an existing or unmet clinical need and identify a nanomedicine that can provide a solution
To learn about chemical approaches used in nanomaterial synthesis and surface modification.
To learn how to read and critique the academic literature.
To understand the interaction of nanomaterials with proteins, cells, and biological systems.

Rules & Requirements

Prerequisites: MAT SCI 45 or consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Messersmith

Also listed as: BIO ENG C157

Nanomaterials in Medicine: Read Less [-]

MAT SCI 159 Introduction to Soft Matter 3 Units

Terms offered: Fall 2022
Soft matter is ubiquitous in synthetic materials and plays a central role in living systems. This
course aims to provide students with an introduction to the physics that govern the structure and
dynamics of soft mater systems, including polymers, colloids, surfactants, membranes, and active
matter. A particular emphasis will be placed on connecting a microscopic physical picture to the
emergent phenomena and properties of interest using scaling theory and statistical mechanics.
Specific topics will include Brownian motion and colloidal dynamics, the depletion force, polymer
chain conformation, rubber elasticity; and surfactant and liquid crystal thermodynamics.
Introduction to Soft Matter: Read More [+]
Rules & Requirements

Prerequisites: ENGIN 40, MAT SCI 103 or equivalent

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Instructor: Omar

Introduction to Soft Matter: Read Less [-]

MAT SCI H194 Honors Undergraduate Research 1 - 4 Units

Terms offered: Fall 2016, Spring 2016, Fall 2015
Students who have completed a satisfactory number of advanced courses with a grade-point average of 3.3 or higher may pursue original research under the direction of one of the members of the staff. A maximum of 3 units of H194 may be used to fulfill technical elective requirements in the Materials Science and Engineering program or double majors (unlike 198 or 199, which do not satisfy technical elective requirements). Final report required.
Honors Undergraduate Research: Read More [+]
Rules & Requirements

Prerequisites: Upper division technical GPA of 3.3 or higher and consent of instructor and adviser

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

Hours & Format

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

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Honors Undergraduate Research: Read Less [-]

MAT SCI 195 Special Topics for Advanced Undergraduates 1 Unit

Terms offered: Spring 2012, Spring 2011, Spring 2010
Group study of special topics in materials science and engineering. Selection of topics for further study of underlying concepts and relevent literature, in consultion with appropriate faculty members.
Special Topics for Advanced Undergraduates: Read More [+]
Rules & Requirements

Prerequisites: Upper division standing and good academic standing. (2.0 gpa and above)

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Special Topics for Advanced Undergraduates: Read Less [-]

MAT SCI 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units

Terms offered: Spring 2019, Fall 2018, Spring 2016
Group studies of selected topics.
Directed Group Studies for Advanced Undergraduates: Read More [+]
Rules & Requirements

Prerequisites: Upper division standing in Engineering

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Directed Group Studies for Advanced Undergraduates: Read Less [-]

MAT SCI 199 Supervised Independent Study 1 - 4 Units

Terms offered: Fall 2022, Spring 2022, Fall 2021
Supervised independent study. Enrollment restrictions apply; see the Introduction to Courses and Curricula section of this catalog.
Supervised Independent Study: Read More [+]
Rules & Requirements

Prerequisites: Consent of instructor and major adviser

Credit Restrictions: Course may be repeated for a maximum of four units per semester.

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

Hours & Format

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

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

Additional Details

Subject/Course Level: Materials Science and Engineering/ Undergraduate

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

Supervised Independent Study: Read Less [-]