

Materials Science and Engineering

Bachelor of Science (BS)

Materials Scientists and Engineers are involved in every aspect of technology, ranging from the design of materials appropriate for use in integrated circuits and biological applications to those materials needed for energy generation (both conventional energy sources and green sources) and for building bridges, roads, and buildings.

Upon graduation, students are prepared for a number of different careers paths. Many go on to graduate studies at prestigious universities. Others head directly into the workforce as engineers in Silicon Valley (e.g. Agilent and Applied Materials), the biotechnology sector (e.g. Genentech), and engineers in the Aerospace field (e.g. Boeing).

The objectives of the undergraduate program in Materials Science and Engineering (MSE) are to educate graduates who have the following skills:

- Knowledge of the fundamental science and engineering principles relevant to materials design, development and engineering application
- Understanding of the relationship between nano/microstructure, characterization, properties and processing and design of materials
- Have the experimental and computational skills for a professional career or graduate study in materials
- Possess a knowledge of the significance of research, the value of continued learning, and environmental/social issues surrounding materials
- Ability to communicate effectively, to work in teams, and to assume positions as leaders

This major program leads to a Bachelor of Science (BS) degree.

Admission to the Major

Prospective undergraduates to the College of Engineering will apply for admission to a specific program in the College. For further information, please see the College of Engineering's website (<https://engineering.berkeley.edu/admissions/undergraduate-admissions/>).

Admission to Engineering via a Change of College application for current UC Berkeley students is highly unlikely and very competitive as there few, if any, spaces that open in the College each year to students admitted to other colleges at UC Berkeley. For further information regarding a Change of College to Engineering, please see the College's website (<https://engineering.berkeley.edu/admissions/undergraduate-admissions/change-of-college/>).

Five-Year BS/MS Program

The five-year combined Bachelor of Science/Master of Science program augments the existing four-year undergraduate program with a fifth year of graduate study that provides a professionally oriented component, preparing students for careers in engineering or engineering management within the business, government, and/or industrial sectors. In this program, students earn a bachelor's degree and subsequently, a Master of Science degree under Plan II (without thesis) of the Academic Senate. This five-year program emphasizes interdisciplinary study

through an independent project coupled to coursework. The program is open to undergraduate materials science and engineering majors (both single or joint majors) only. For further information regarding this program, please see the department's website (<https://mse.berkeley.edu/five-year-bs-ms/>).

Minor Program

The department offers a minor in Materials Science and Engineering that is open to all students who are not majoring in MSE and who have completed the necessary prerequisites. To be eligible for the program, students are required to have a minimum overall grade point average (GPA) of 2.5 and a minimum GPA of 2.5 in the prerequisite courses. For information regarding the prerequisites, please see the Minor Requirements tab on this page.

To apply for the minor, submit the Petition for Admission to the Undergraduate Minor (<https://mse.berkeley.edu/wp-content/uploads/2020/02/mse-minor-2.4.20.pdf>) to the undergraduate adviser after completion of the prerequisite courses. Upon completion of the minor requirements, submit a Petition for Completion of the Undergraduate Minor (<https://mse.berkeley.edu/wp-content/uploads/2020/02/confirmation-of-completion-mse-minor-2.4.20.pdf>) to the undergraduate adviser.

Joint Majors

The Department of Materials Science and Engineering also offers four joint majors, with other departments in the College of Engineering, and one joint major with a department in the College of Chemistry. For further information on these programs, please see the links below:

Chemical Engineering/Materials Science and Engineering (<https://guide.berkeley.edu/undergraduate/degree-programs/chemical-engineering-materials-science-joint-major/>) (Department of Chemical and Biomolecular Engineering, College of Chemistry)

Bioengineering/Materials Science and Engineering (<https://guide.berkeley.edu/undergraduate/degree-programs/bioengineering-materials-science-engineering-joint-major/>) (Department of Bioengineering)

Electrical Engineering and Computer Sciences/Materials Science and Engineering (<https://guide.berkeley.edu/undergraduate/degree-programs/electrical-engineering-computer-sciences-materials/>) (Department of Electrical Engineering and Computer Sciences)

Materials Science and Engineering/Mechanical Engineering (<https://guide.berkeley.edu/undergraduate/degree-programs/materials-science-engineering-mechanical-joint-major/>) (Department of Mechanical Engineering)

Materials Science and Engineering/Nuclear Engineering (<https://guide.berkeley.edu/undergraduate/degree-programs/materials-science-engineering-nuclear-joint-major/>) (Department of Nuclear Engineering)

In addition to the University, campus, and college requirements, students must fulfill the below requirements specific to their major program.

General Guidelines

1. All technical courses taken in satisfaction of major requirements must be taken for a letter grade.
2. No more than one upper division course may be used to simultaneously fulfill requirements for a student's major and minor programs.

3. A minimum overall grade point average (GPA) of 2.0 is required for all work undertaken at UC Berkeley.
4. A minimum GPA of 2.0 is required for all technical courses taken in satisfaction of major requirements.

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

For a detailed plan of study by year and semester, please see the Plan of Study tab.

Lower Division Requirements

| | | |
|-----------------------------|---|---|
| MATH 51/1A | Calculus I (MATH 51 as of Fall 2025) | 4 |
| MATH 52/1B | Calculus II (MATH 52 as of Fall 2025) | 4 |
| MATH 53 | Multivariable Calculus | 4 |
| PHYSICS 89 | Introduction to Mathematical Physics | 4 |
| CHEM 1A & 1AL | General Chemistry and General Chemistry Laboratory ¹ | 5 |
| or CHEM 4A | General Chemistry and Quantitative Analysis | |
| CHEM 1B or CHEM 4B | General Chemistry ¹ General Chemistry and Quantitative Analysis | 4 |
| 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 and Numerical Methods | 4 |
| ENGIN 40 | Engineering Thermodynamics | 4 |
| MAT SCI 45 & 45L | Properties of Materials and Properties of Materials Laboratory | 4 |
| MEC ENG C85/ CIV ENG C30 | Introduction to Solid Mechanics | 3 |

¹ CHEM 4A and CHEM 4B are designed for students majoring in chemistry or a closely-related field.

Upper Division Requirements

| | | |
|--|---|-----|
| Math/Stat/Data Elective ¹ | | 3-4 |
| MAT SCI 102 | Bonding, Crystallography, and Crystal Defects | 3 |
| MAT SCI 103 | Phase Transformations and Kinetics | 3 |
| MAT SCI 104 & 104L | Materials Characterization and Materials Characterization Laboratory | 4 |
| MAT SCI 111 | Properties of Electronic Materials | 4 |
| MAT SCI 112 | Corrosion (Chemical Properties) | 3 |
| MAT SCI 113 | Mechanical Behavior of Engineering Materials | 3 |
| MAT SCI 151 | Polymeric Materials | 3 |
| MAT SCI 131 | Additive Manufacturing Processes and Systems for Advanced Materials | 3 |
| MAT SCI 120 series course | | 3-4 |
| Upper Division Engineering Elective ² | | 3-4 |

¹ Math/Stat/Data Elective - Choose one of the following:

- any upper division MATH course (except C103, 151, 152, 153, 160, and any course numbered 190 or higher)
- any upper division STAT course (except 157, or any course numbered 190 or higher)

- IND ENG 172 - Probability and Risk Analysis for Engineers
- COMPSI C100/DATA C100/STAT C100 - Principles & Techniques of Data Science
- ENGIN 117 - Methods of Engineering Analysis

² An upper division engineering elective, of at least 3 units, is chosen in consultation with the student's faculty adviser. Students may use three units of credit for work on a research project in MAT SCI H194 (Honors Undergraduate Research). Other letter-graded research courses may be approved by petition. Typically, this elective should be offered by a department within the College of Engineering or from the Department of Chemical & Biomolecular Engineering.

Upper division engineering electives cannot include:

- Any course taken on a *Pass/No Pass* basis
- Any course that counts as H/SS
- Any of the following courses: BIOENG 100; DESINV courses (except DES INV 190E); ENGIN 125, 157AC, 180, 183 series, 185, 187, 195 series; INDENG 172, 185, 186, 190 series, 191, 192, 195; MECENG 190K, 191AC, 191K.

Minor programs are areas of concentration requiring fewer courses than an undergraduate major. These programs are optional but can provide depth and breadth to a UC Berkeley education. The College of Engineering does not offer additional time to complete a minor, but it is usually possible to finish within the allotted time with careful course planning. Students are encouraged to meet with their ESS adviser to discuss the feasibility of completing a minor program.

All the engineering departments offer minors. Students may also consider pursuing a minor in another school or college.

General Guidelines

1. All minors must be declared no later than one semester before a student's Expected Graduation Term (EGT). If the semester before EGT is fall or spring, the deadline is the last day of RRR week. If the semester before EGT is summer, the deadline is the final Friday of Summer Sessions. To declare a minor, contact the department advisor for information on requirements, and the declaration process.
2. All courses taken to fulfill the minor requirements must be taken for graded credit, unless course is only offered on a Pass/No Pass basis
3. A minimum overall grade point average (GPA) of 2.5 and a minimum GPA of 2.5 in the prerequisite courses is required for acceptance into the minor program.
4. A minimum grade point average (GPA) of 2.5 is required for courses used to fulfill the minor requirements.
5. No more than one upper division course may be used to simultaneously fulfill requirements for a student's major and minor programs.
6. Completion of the minor program cannot delay a student's graduation.

*For Bioengineering majors, ENGIN 40 can be substituted with CHEM 120B or CHEM C130/MCB C100A.

*For Chemical Engineering majors, ENGIN 40 can be substituted with CHM ENG 141.

*Chemical Engineering majors must also take two courses from MAT SCI 104, MAT SCI 111-113, and MAT SCI 117-125.

*For Mechanical Engineering majors, ENGIN 40 can be substituted with MEC ENG 40.

Requirements

Prerequisites

| | | |
|-------------|------------------------------------|---|
| MAT SCI 45 | Properties of Materials | 3 |
| MAT SCI 45L | Properties of Materials Laboratory | 1 |
| ENGIN 40 | Engineering Thermodynamics | 4 |

Upper Division Requirements

| | | |
|-------------|---|---|
| MAT SCI 102 | Bonding, Crystallography, and Crystal Defects | 3 |
| MAT SCI 103 | Phase Transformations and Kinetics | 3 |

Select one of the following:

| | | |
|--------------------|--|--|
| MAT SCI 104 & 104L | Materials Characterization and Materials Characterization Laboratory | |
| MAT SCI 111 | Properties of Electronic Materials [4] | |
| MAT SCI 112 | Corrosion (Chemical Properties) [3] | |
| MAT SCI 113 | Mechanical Behavior of Engineering Materials [3] | |
| MAT SCI 117 | Properties of Dielectric and Magnetic Materials [3] | |
| MAT SCI C118 | Biological Performance of Materials [4] | |
| MAT SCI 120 | Materials Production [3] | |
| MAT SCI 121 | Metals Processing [3] | |
| MAT SCI 122 | Ceramic Processing [3] | |
| MAT SCI 125 | Thin-Film Materials Science [3] | |
| MAT SCI 123 | ELECTRONIC MATERIALS PROCESSING [4] | |
| MAT SCI 151 | Polymeric Materials [3] | |

Students in the College of Engineering must complete no fewer than 120 semester units with the following provisions:

1. Completion of the requirements of one engineering major program (<https://engineering.berkeley.edu/students/undergraduate-guide/degree-requirements/major-programs/>) of study.
2. A minimum overall grade point average of 2.00 (C average) and a minimum 2.00 grade point average in upper division technical coursework required of the major.
3. The final 30 units and two semesters must be completed in residence in the College of Engineering on the Berkeley campus.
4. All technical courses (math, science, and engineering) that can fulfill requirements for the student's major must be taken on a letter graded basis (unless they are only offered P/NP).
5. Entering freshmen are allowed a maximum of eight semesters to complete their degree requirements. Entering junior transfers are allowed five semesters to complete their degree requirements. Summer terms are optional and do not count toward the maximum. Students are responsible for planning and satisfactorily completing all graduation requirements within the maximum allowable semesters.
6. Adhere to all college policies and procedures (<https://engineering.berkeley.edu/students/undergraduate-guide/policies-procedures/>) as they complete degree requirements.
7. Complete lower division technical courses before enrolling in upper division technical courses.

Humanities and Social Sciences (H/SS) Requirement

To promote a rich and varied educational experience outside of the technical requirements for each major, the College of Engineering has a six-course Humanities and Social Sciences breadth requirement (<http://engineering.berkeley.edu/student-services/degree-requirements/humanities-and-social-sciences/>), which must be completed to graduate. This requirement, built into all the engineering programs of study, includes two Reading and Composition courses (R&C), and four additional courses within which a number of specific conditions must be satisfied. See the humanities and social sciences (<https://engineering.berkeley.edu/students/undergraduate-guide/degree-requirements/humanities-and-social-sciences/>) section of our website for details.

Class Schedule Requirements

- Minimum units per semester: 12.0
- Maximum units per semester: 20.5
- Minimum technical courses: College of Engineering undergraduates must include at least two letter graded technical courses (of at least 3 units each) in their semester program. Every semester students are expected to make normal progress in their declared major. Normal progress is determined by the student's Engineering Student Services Advisor. (Note: For most majors, normal progress (<https://engineering.berkeley.edu/academics/undergraduate-guide/policies-procedures/scholarship-progress/#ac12282>) will require enrolling in 3-4 technical courses required of your current major each semester.) Students who are not in compliance with this policy by the end of the fifth week of the semester are subject to a registration block that will delay enrollment for the following semester.
- All technical courses (math, science, engineering) that satisfy requirements for the major must be taken on a letter-graded basis (unless only offered as P/NP).

Minimum Academic Requirements

- Students must have a minimum overall and semester grade point average of 2.00 (C average). Students will be subject to suspension or dismissal from the University if during any fall or spring semester their overall UC GPA falls below a 2.00, or their semester GPA is less than 2.00.
- Students must achieve a minimum grade point average of 2.00 (C average) in upper division technical courses required for the major curriculum each semester.
- A minimum overall grade point average of 2.00 and a minimum 2.00 grade point average in upper division technical course work required for the major are required to earn a Bachelor of Science in the College of Engineering.
- Students must make normal degree progress toward the Bachelor of Science degree and their officially declared major.

Unit Requirements

To earn a Bachelor of Science in Engineering, students must complete at least 120 semester units of courses subject to certain guidelines:

- Completion of the requirements of one engineering major program (<https://engineering.berkeley.edu/students/undergraduate-guide/degree-requirements/major-programs/>) of study.
- A maximum of 16 units of special studies coursework (courses numbered 97, 98, 99, 197, 198, or 199) is allowed to count towards

the B.S. degree, and no more than 4 units in any single term can be counted.

- A maximum of 4 units of physical education from any school attended will count towards the 120 units.
- Passed (P) grades may account for no more than one third of the total units completed at UC Berkeley, Fall Program for First Semester (FPF), UC Education Abroad Program (UCEAP), or UC Berkeley Washington Program (UCDC) toward the 120 overall minimum unit requirement. Transfer credit is not factored into the limit. This includes transfer units from outside of the UC system, other UC campuses, credit-bearing exams, as well as UC Berkeley Extension XB units.

Normal Progress

Students in the College of Engineering must enroll in a full-time program and make normal progress (<https://engineering.berkeley.edu/students/undergraduate-guide/policies-procedures/scholarship-progress/#ac12282>) each semester toward their declared major. Students who fail to achieve normal academic progress shall be subject to suspension or dismissal. (Note: Students with official accommodations established by the Disabled Students' Program, with health or family issues, or with other reasons deemed appropriate by the dean may petition for an exception to normal progress rules.)

University of California Requirements

Entry Level Writing (<https://guide.berkeley.edu/undergraduate/education/#earningyourdegreertext>)

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/>) provides information on how to satisfy the requirement.

American History and American Institutions (<https://guide.berkeley.edu/undergraduate/education/#earningyourdegreertext>)

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 (<https://guide.berkeley.edu/undergraduate/education/#earningyourdegreertext>)

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 College Requirements and Major Requirements tabs.

| Freshman | | |
|--|---|-----|
| Fall Units | Spring Units | |
| CHEM 4A or 1A and 1AL ¹ | 5 MATH 1B | 4 |
| MATH 1A | 4 PHYSICS 7A | 4 |
| MAT SCI 45 ² | 3 CHEM 1B or 4B ¹ | 4-5 |
| MAT SCI 45L ² | 1 Humanities/ Social Sciences course ³ | 3-4 |
| Reading & Composition Part A Course ³ | 4 | |
| 17 | 15-17 | |
| Sophomore | | |
| Fall Units | Spring Units | |
| MATH 53 | 4 PHYSICS 89 ⁴ | 4 |
| PHYSICS 7B | 4 PHYSICS 7C | 4 |
| ENGIN 7 | 4 MAT SCI 151 | 3 |
| Reading & Composition Part B Course ³ | 4 Humanities/ Social Sciences course ³ | 3-4 |
| 16 | 14-15 | |
| Junior | | |
| Fall Units | Spring Units | |
| ENGIN 40 | 4 MAT SCI 103 | 3 |
| MEC ENG C85 | 3 MAT SCI 104 & 104L | 4 |
| MAT SCI 102 | 3 MAT SCI 111 | 4 |
| Math/Stat/Data Elective ⁵ | 3-4 MAT SCI 112 | 3 |
| Free Elective ⁶ | 4 | |
| 17-18 | 14 | |
| Senior | | |
| Fall Units | Spring Units | |
| MAT SCI 113 | 3 Upper Division Engineering Elective ⁷ | 3-4 |
| MAT SCI 120 Series Course | 3-4 Humanities/ Social Science Course ⁴ | 3-4 |
| MAT SCI 131 | 3 Free Electives ⁶ | 6-8 |
| Humanities/Social Science Course ⁴ | 3-4 | |
| Free Elective ⁶ | 3 | |
| 15-17 | 12-16 | |
| Total Units: 120-130 | | |

¹ CHEM 4A and CHEM 4B are intended for students majoring in chemistry or a closely-related field.

² MAT SCI 45/MAT SCI 45L can be taken in either the fall or spring semesters of the first year. 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).

³ The Humanities/Social Sciences (H/SS) requirement includes two approved Reading & Composition (R&C) courses and four additional approved courses, with which a number of specific conditions must be satisfied. R&C courses must be taken for a letter grade (C- or better required). The first half (R&C Part A) must be completed by the end of the freshman year; the second half (R&C Part B) must be completed by no later than the end of the sophomore year. The

remaining courses may be taken at any time during the program. See engineering.berkeley.edu/hss (<https://engineering.berkeley.edu/academics/undergraduate-guide/degree-requirements/humanities-and-social-sciences/>) for complete details and a list of approved courses.

⁴ Please note that PHYSICS 89 is meant to replace MATH 54. As such, students should be well prepared for any class listing MATH 54 as a prerequisite and often the departments offering those courses do not officially enforce their prerequisites in the system so there should not be an issue with enrollment.

⁵ Math/Stat/Data Elective - Choose one of the following:

- any upper division MATH course (except C103, 151, 152, 153, 160, and any course numbered 190 or higher)
- any upper division STAT course (except 157, or any course numbered 190 or higher)
- ENGIN 117 - Methods of Engineering Analysis
- IND ENG 172 - Probability and Risk Analysis for Engineers
- COMPSI C100/DATA C100/STAT C100 - Principles & Techniques of Data Science

⁶ Free electives can be any technical or non-technical course, any course of your interest offered by any department. There are no restrictions.

⁷ Students must complete an upper division engineering elective, of at least 3 units, chosen in consultation with the student's faculty adviser. The engineering elective cannot be: any course taken on a P/NP basis; BIO ENG 100; DESINV courses (except DES INV 190E); ENGIN 125, 157AC, 180, 183 series, 185, 187, 195 series; INDENG 172, 185, 186, 190 series, 191, 192, 195; MECENG 190K, 191AC, 191K. Students may use three units of credit for work on a research project in MATSCI H194 (Honors Undergraduate Research) for the engineering elective. Other letter graded research courses may be approved by petition. Typically, this elective should be offered by a department within the College of Engineering or from the Department of Chemical & Biomolecular Engineering.

Learning Goals of the Major

Measured Curricular Outcomes

The program is designed around a set of curricular outcomes. Specifically, upon completion of our ABET accredited program in Materials Science and Engineering, the graduate will possess the following skills:

1. An ability to identify, formulate, and solve complex engineering problems by applying 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 global, economic, environmental, and societal contexts.

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.

Educational Objectives for Graduates

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

1. Use the fundamental science and engineering principles relevant to materials that include the relationships between nano/microstructure, characterization, properties, processing, performance and design of materials.
2. Use their knowledge of the significance of research, the value of continued learning and environmental/social issues surrounding materials.
3. Use the technical and communication skills developed in the program as a foundation for careers in engineering, research and development, the pursuit of advanced education and other professional careers.
4. Use lifelong learning skills to develop knowledge and skills, to pursue new areas of expertise and careers, and to take advantage of professional development opportunities.
5. Become leaders in their fields who will contribute to bettering society.

Major maps are experience maps that help undergraduates plan their Berkeley journey based on intended major or field of interest. Featuring student opportunities and resources from your college and department as well as across campus, each map includes curated suggestions for planning your studies, engaging outside the classroom, and pursuing your career goals in a timeline format.

Use the major map below to explore potential paths and design your own unique undergraduate experience:

View the Materials Science and Engineering Major Map (<https://discovery.berkeley.edu/getting-started/major-maps/materials-science-engineering/>)

Undergraduate Research

There is nothing more tangible in engineering products than the materials of which they are made, and this fact dominates the research agenda in materials science & engineering around the world. At Berkeley, research programs in new materials synthesis, processing, characterization, integration, and theoretical modeling dominate the laboratory space and multiple servers dedicated to basic and applied research programs in the department, including many that are conducted at the Lawrence Berkeley National Laboratory. Undergraduate students are strongly encouraged to meet with the many faculty members in the department who sponsor student research projects and learn about the many exciting options available to them. Sometimes a new student's research experience begins by shadowing a senior graduate student to learn the ropes, but sometimes the project is fully unique, and exclusively theirs! Undergraduate students can earn units for their research efforts by enrolling in MAT SCI 199, which is offered on a *Pass/No Pass* basis.

Another option is an honors thesis project, MAT SCI H194, offered to qualified students as a graded course, which can therefore be counted as an upper division technical elective. There are also a number of paid research positions, especially over the summer. Students should not be shy about asking and should consider adding materials research to their undergraduate experience at Berkeley.

Student Groups and Organizations

The Materials Science & Engineering Association (MSEA) serves a large number of students on the Berkeley campus, including many non-majors, who know that a future in the materials disciplines is an enticing career option. Officers in MSEA sponsor both scholarly and social events to broaden undergraduates' experiences here, and through a professional connection called Materials Advantage, students can join four national materials societies to launch their professional careers early.

Undergraduate students in the department are also highly respected members of several engineering student projects because of the materials issues involved. These include the Solar Car (CalSol) project, the Formula SAE race car team, the Human Powered Vehicle team, the Supermileage Vehicle team, and others offering deep immersion in actual engineering design and construction of a functional product. For students interested in shaping a carbon-fiber skin component or welding a 6061 aluminum alloy roll bar component, there are many opportunities to learn these and other valuable skills as a student in MSE.

Materials Science and Engineering

MAT SCI 24 Freshman Seminar 1 Unit

Terms offered: Spring 2025, Spring 2023, Spring 2022

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.

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.

MAT SCI 45 Properties of Materials 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

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.

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

MAT SCI 45L Properties of Materials Laboratory 1 Unit

Terms offered: Fall 2025, Spring 2025, Fall 2024

This course presents laboratory applications of the basic principles introduced in the lecture-based course MSE45 – Properties of Materials.

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

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

Terms offered: Fall 2025, Fall 2024, Fall 2023

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.

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

MAT SCI 103 Phase Transformations and Kinetics 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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.

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. Alternative to final exam.

MAT SCI 104 Materials Characterization 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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.

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

MAT SCI 104L Materials Characterization Laboratory 1 Unit

Terms offered: Spring 2025, Spring 2024, Spring 2023

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.

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

MAT SCI 111 Properties of Electronic Materials 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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.

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

MAT SCI 112 Corrosion (Chemical Properties) 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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.

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

MAT SCI 113 Mechanical Behavior of Engineering Materials 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

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.

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

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, pyroelectric, 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.

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.

MAT SCI C118 Biological Performance of Materials 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

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.

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 of 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.

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.

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.

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: Gronskey

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.

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.

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.

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

MAT SCI 125 Thin-Film Materials Science 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

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.

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

MAT SCI 127 Introduction to Additive Manufacturing: Process, Materials and Designs 3 Units

Terms offered: Spring 2024, Spring 2023

Additive manufacturing, the industrial name of 3D printing, pertains to the general class of technologies that, using computer-created (CAD) solid models as input, creates three-dimensional (3D) artifacts through the successive formation of materials. Students will learn the engineering principles and frontiers of additive manufacturing systems and their applications to transforming the rapid prototyping to the paradigm of Additive Manufacturing (AM) for creating functional parts, materials and assembly. Students will apply their learning through class projects wherein they will design novel products via AM, design new AM systems and manufacturing strategies for novel materials. Class will also explore advanced design topics enabled by AM

Rules & Requirements

Prerequisites: PHYSICS 7A (recommended), MAT SCI 45, MEC ENG C85/CIV ENG C30, 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. Alternative to final exam.

Instructor: Zheng

MAT SCI 128 Modern Structural Materials and Sustainability 3 Units

Terms offered: Not yet offered

The course offers a comprehensive overview of processing, characterization, and property testing methods, as well as recycling processes for structural materials, including metals, alloys, and structural ceramics. The objective of this course is to provide foundational knowledge of the relationships between the microstructures of the materials and their mechanical properties that make them suitable for structural applications. This course will also address sustainability challenges in structural materials and discuss how material selection, material design strategies, fabrication, and recycling methods have evolved to meet sustainability goals.

Rules & Requirements

Prerequisites: Mat Sci 45 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. Final exam required.

Instructor: Kang

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.

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

MAT SCI 130 Experimental Materials Science and Design 3 Units

Terms offered: Fall 2023, Fall 2022, Fall 2021

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.

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.

MAT SCI 131 Additive Manufacturing Processes and Systems for Advanced Materials 3 Units

Terms offered: Fall 2025, Fall 2024

In this course, students will learn the engineering principles, system designs, process dynamics and construction of advanced additive fabrication systems. Students will explore the process-structure-property relationships for various commercial and custom additive manufacturing processes for polymer, metal, ceramic, composites and beyond.

Additionally, students will explore the digital design and manufacturing of 3D topologies, cellular materials and metamaterials enabled by additive processes. In addition to gaining theoretical and hands-on access to AM technologies, students will apply their learning through design projects wherein they will create novel materials or engineering products via additive manufacturing processes.

Rules & Requirements

Prerequisites: ENGIN 29 (recommended); MAT SCI 45; MEC ENG C85; PHYSICS 7A (recommended); ENGIN 26 (optional); or instructor's permission

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 not required.

Instructor: Zheng

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.

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

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.

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

MAT SCI C150 Introduction to Materials Chemistry 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

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

Rules & Requirements

Prerequisites: CHEM 104A. CHEM 104B recommended

Hours & Format

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

Additional Details

Subject/Course Level: Materials Science and Engineering/
Undergraduate

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

Also listed as: CHEM C150

MAT SCI 151 Polymeric Materials 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

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 polymer 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.

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

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.

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

MAT SCI 159 Introduction to Soft Matter 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

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 matter 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.

Rules & Requirements

Prerequisites: ENGIN 40, PHYSICS 5C, CHEM 120B, CHEM ENG 141, or MECH ENG 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. Alternate method of final assessment during regularly scheduled final exam group (e.g., presentation, final project, etc.).

Instructor: Omar

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.

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.

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 relevant literature, in consultation with appropriate faculty members.

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.

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.

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.

MAT SCI 199 Supervised Independent Study 1 - 4 Units

Terms offered: Spring 2023, Fall 2022, Spring 2022

Supervised independent study. Enrollment restrictions apply; see the Introduction to Courses and Curricula section of this catalog.

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.