

# Materials Science and Engineering/Mechanical 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. These curricula include the core courses in each of the major fields. While they require slightly increased course loads, they can be completed in four years.

Students interested in the mechanical behavior of materials have the option of pursuing a joint major in Materials Science and Engineering and Mechanical Engineering. The curriculum addresses key fundamentals of both disciplines, preparing students in materials selection and design for structural and functional applications. Students completing this joint major enter professional positions in the aerospace, automotive, energy, manufacturing industries, and much more or top graduate programs.

## Admission to the Joint Major

Admission directly to a joint major is closed to freshmen and junior transfer applicants. Students interested in a joint program may apply to change majors during specific times in their academic progress. Please see the College of Engineering joint majors website (<http://engineering.berkeley.edu/academics/majors-minors/joint-majors/>) for complete details.

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
MATH 54	Linear Algebra and Differential Equations	4
CHEM 1A	General Chemistry <sup>1</sup>	3-5

or CHEM 4A	General Chemistry and Quantitative Analysis	
PHYSICS 7A	Physics for Scientists and Engineers	4
PHYSICS 7B	Physics for Scientists and Engineers	4
ENGIN 7	Introduction to Computer Programming and Numerical Methods	4
ENGIN 26	Three-Dimensional Modeling for Design	2
ENGIN 29	Manufacturing and Design Communication	4
MAT SCI 45	Properties of Materials	3
MAT SCI 45L	Properties of Materials Laboratory	1
MEC ENG 40	Thermodynamics	3
MEC ENG C85	Introduction to Solid Mechanics	3

<sup>1</sup> CHEM 4A is intended for students majoring in chemistry or a closely related field.

## Upper Division Requirements

ENGIN 178	Statistics and Data Science for Engineers	4
MEC ENG 100	Electronics for the Internet of Things or PHYSICS 11 Instrumentation Laboratory	4
MEC ENG 102B	Mechatronics Design	4
MEC ENG 103	Experimentation and Measurements	4
MEC ENG 104	Engineering Mechanics II	3
MEC ENG 106	Fluid Mechanics	3
MEC ENG 108	Mechanical Behavior of Engineering Materials or MAT SCI 113 Mechanical Behavior of Engineering Materials	3-4
MEC ENG 109	Heat Transfer	3
MEC ENG 132	Dynamic Systems and Feedback <sup>3</sup>	3
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 112	Corrosion (Chemical Properties)	3
MAT SCI 131	Additive Manufacturing Processes and Systems for Advanced Materials	3

Upper division technical electives: minimum 9 units to include: <sup>1,2</sup> 9

At least 3 units of MAT SCI 12x (from the 120 series)

At least 6 units of upper division MEC ENG courses, one of which must be a design elective chosen from: MEC ENG 101, MEC ENG 110, MEC ENG C117, MEC ENG 118, MEC ENG 119, MEC ENG 130, MEC ENG 133, MEC ENG C134, MEC ENG 135, MEC ENG 139, MEC ENG 146, MEC ENG 151, MEC ENG 165, MEC ENG C176, MEC ENG C178, MEC ENG 179, ENGIN 128

<sup>1</sup> Students may receive up to three units of technical elective credit for work on a research project in MEC ENG H194 or MEC ENG 196. Other letter-graded research courses may be approved by petition.

<sup>2</sup> Technical electives cannot include any course taken on a Pass/No Pass basis; MEC ENG 191AC, MEC ENG 190K, MEC ENG 191K.

<sup>3</sup> MEC ENG 132 is only offered in the fall semester.

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

### American History and American Institutions (<https://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 (<https://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 College Requirements and Major Requirements tabs.

Freshman			
	Fall Units	Spring Units	
CHEM 4A or 1A <i>and</i> 1AL <sup>1</sup>		5 MATH 1B	4
MATH 1A		4 PHYSICS 7A	4
ENGIN 26		2 ENGIN 7	4
Reading & Composition Part A Course <sup>4</sup>		4 Reading & Composition Part B Course <sup>4</sup>	4
Optional Freshman Seminar or ENGIN 92		0-1 Optional Freshman Seminar	0-1
	15-16	16-17	
Sophomore			
	Fall Units	Spring Units	
MATH 53		4 MATH 54	4
PHYSICS 7B		4 MEC ENG 40	3
ENGIN 29		4 MEC ENG C85	3
MAT SCI 45 <sup>5</sup>		3 Humanities/Social Sciences course <sup>4</sup>	3-4
MAT SCI 45L <sup>5</sup>		1 MEC ENG 100 or PHYSICS 111A	4
	16	17-18	
Junior			
	Fall Units	Spring Units	
MEC ENG 104		3 ENGIN 178	4
MEC ENG 106		3 MAT SCI 103	3
MEC ENG 108 or MAT SCI 113		3-4 MAT SCI 104 & 104L	4
MAT SCI 102		3 Technical Elective <sup>2,3</sup>	3

Senior			
	Fall Units	Spring Units	
MAT SCI 131		3 MEC ENG 102B	4
MEC ENG 109		3 MEC ENG 103	4
MEC ENG 132 <sup>6</sup>		3 MAT SCI 112	3
Technical Electives <sup>2,3</sup>		3 Technical Elective <sup>2,3</sup>	3
Humanities/Social Sciences course <sup>4</sup>		3-4 Humanities/Social Sciences course <sup>4</sup>	3-4
	15-16	17-18	
Total Units: 125-132			

- CHEM 4A is intended for students majoring in chemistry or a closely-related field.
- A total of 9 upper-division technical elective units are required. These must include 6 units of upper-division Mechanical Engineering courses, one of which must be from the following list: ENGIN 128, MEC ENG 101, MEC ENG 110, MEC ENG C117, MEC ENG 118, MEC ENG 119, MEC ENG 130, MEC ENG 133, MEC ENG C134, MEC ENG 135, MEC ENG 139, MEC ENG 146, MEC ENG 151, MEC ENG 165, MEC ENG C176, MEC ENG C178, MEC ENG 179. In addition, 3 units must be from the MAT SCI 120 series. Students may receive up to 3 units of technical elective credit for work on a research project in MEC ENG H194 or MEC ENG 196. Other letter-graded research courses may be approved by petition.
- Technical Electives cannot include any course taken on a *Pass/No Pass* basis; MEC ENG 191AC, MEC ENG 190K, MEC ENG 191K.
- 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/hss) (<https://engineering.berkeley.edu/academics/undergraduate-guide/degree-requirements/humanities-and-social-sciences/>) for complete details and a list of approved courses.
- 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).
- MEC ENG 132 is only offered in the fall semester.

## Materials Science

### MEASURED CURRICULAR OUTCOMES

The program is designed around a set of curricular outcomes.

- Be able to apply general math, science and engineering skills to the solution of engineering problems.
- Be aware of the social, safety and environmental consequences of their work, and be able to engage in public debate regarding these issues.
- 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.
1. Be able to communicate effectively, to work in teams and to assume positions as leaders.

## Mechanical Engineering

### Learning Goals

The objectives of the Mechanical Engineering undergraduate program are to produce graduates who do the following:

1. Vigorously engage in post-baccalaureate endeavors, whether in engineering graduate study, in engineering practice, or in the pursuit of other fields such as science, law, medicine, business or public policy.
2. Apply their mechanical engineering education to address the full range of technical and societal problems with creativity, imagination, confidence and responsibility.
3. Actively seek out positions of leadership within their profession and their community.
4. Serve as ambassadors for engineering by exhibiting the highest ethical and professional standards, and by communicating the importance and excitement of this dynamic field.
5. Retain the intellectual curiosity that motivates lifelong learning and allows for a flexible response to the rapidly evolving challenges of the 21st century.

### Skills

Mechanical Engineering graduates have the following:

1. An ability to apply knowledge of mathematics, science, and engineering.

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

- Materials Science and Engineering (p. 4)
- Mechanical Engineering (p. 14)

## 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:** Gronsky



## 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 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.

## **Mechanical Engineering Courses**

### **MEC ENG 24 Freshman Seminars 1 Unit**

Terms offered: Fall 2025, Fall 2024, Fall 2023

The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley Seminars are offered in all campus departments, and topics vary from department to department and semester to semester.

### **Rules & Requirements**

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

### **Hours & Format**

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

### **Additional Details**

**Subject/Course Level:** Mechanical 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.

## MEC ENG 40 Thermodynamics 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

This course introduces the scientific principles that deal with energy conversion among different forms, such as heat, work, internal, electrical, and chemical energy. The physical science of heat and temperature, and their relations to energy and work, are analyzed on the basis of the four fundamental thermodynamic laws (zeroth, first, second, and third). These principles are applied to various practical systems, including heat engines, refrigeration cycles, air conditioning, and chemical reacting systems.

### Objectives & Outcomes

**Course Objectives:** 2) to develop analytic ability in real-world engineering applications using thermodynamics principles.

The objectives of this course are:

1) to provide the fundamental background of thermodynamics principles, and

**Student Learning Outcomes:** (a) an ability to apply knowledge of mathematics, science, and engineering  
(e) an ability to identify, formulate, and solve engineering problems  
(f) an understanding of professional and ethical responsibility  
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context  
(i) a recognition of the need for, and an ability to engage in life-long learning  
(j) a knowledge of contemporary issues  
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** CHEM 1A, ENGIN 7, MATH 52, and PHYSICS 7B

### Hours & Format

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

**Summer:** 10 weeks - 4.5 hours of lecture and 1.5 hours of discussion per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG C85 Introduction to Solid Mechanics 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

A review of equilibrium for particles and rigid bodies. Application to truss structures. The concepts of deformation, strain, and stress. Equilibrium equations for a continuum. Elements of the theory of linear elasticity. The states of plane stress and plane strain. Solution of elementary elasticity problems (beam bending, torsion of circular bars). Euler buckling in elastic beams.

### Rules & Requirements

**Prerequisites:** Mathematics 53 and 54 (may be taken concurrently); Physics 7A

**Credit Restrictions:** Students will receive no credit for Mechanical Engineering C85/Civil and Environmental Engineering C30 after completing Mechanical Engineering W85. A deficient grade in Mechanical Engineering W85 may be removed by taking Mechanical Engineering C85/Civil and Environmental Engineering C30.

### Hours & Format

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

### Summer:

6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week  
10 weeks - 4.5 hours of lecture and 1.5 hours of discussion per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Armero, Papadopoulos, Zohdi, Johnson

**Also listed as:** CIV ENG C30

## MEC ENG W85 Introduction to Solid Mechanics 3 Units

Terms offered: Summer 2021 8 Week Session, Summer 2020 8 Week Session, Summer 2019 8 Week Session

A review of equilibrium for particles and rigid bodies. Application to truss structures. The concepts of deformation, strain, and stress. Equilibrium equations for a continuum. Elements of the theory of linear elasticity. The states of plane stress and plane strain. Solution of elementary elasticity problems (beam bending, torsion of circular bars). Euler buckling in elastic beams.

### Objectives & Outcomes

**Course Objectives:** To learn statics and mechanics of materials

### Student Learning Outcomes: -

Correctly draw free-body

-

Apply the equations of equilibrium to two and three-dimensional solids

-

Understand the concepts of stress and strain

-

Ability to calculate deflections in engineered systems

-

Solve simple boundary value problems in linear elastostatics (tension, torsion, beam bending)

### Rules & Requirements

**Prerequisites:** MATH 53 and MATH 54 (may be taken concurrently); PHYSICS 7A

**Credit Restrictions:** Students will receive no credit for MEC ENG W85 after completing MEC ENG C85. A deficient grade in MEC ENG W85 may be removed by taking MEC ENG C85.

### Hours & Format

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

### Summer:

6 weeks - 7.5 hours of web-based lecture and 2.5 hours of web-based discussion per week

8 weeks - 6 hours of web-based lecture and 2 hours of web-based discussion per week

10 weeks - 4.5 hours of web-based lecture and 1.5 hours of web-based discussion per week

**Online:** This is an online course.

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Govindjee

**Also listed as:** CIV ENG W30

## MEC ENG 98 Supervised Independent Group Studies 1 - 4 Units

Terms offered: Fall 2024, Spring 2024, Fall 2023

Organized group study on various topics under the sponsorship and direction of a member of the Mechanical Engineering faculty.

### Rules & Requirements

**Prerequisites:** 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 directed group study per week

**Summer:** 10 weeks - 1.5-6 hours of directed group study per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 100 Electronics for the Internet of Things 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Electronics and Electrical Engineering has become pervasive in our lives as a powerful technology with applications in a wide range of fields including healthcare, environmental monitoring, robotics, or entertainment. This course offers a broad survey of Electrical Engineering ideas to non-majors. In the laboratory students will learn in-depth how to design and build systems that exchange information with or are controlled from the cloud. Examples include solar harvesters, robots, and smart home devices. In the course project, the students will integrate what they have learned and build an Internet-of-Things application of their choice. The course has a mandatory lab fee.

### Objectives & Outcomes

**Course Objectives:** Electronics has become a powerful and ubiquitous technology supporting solutions to a wide range of applications in fields ranging from science, engineering, healthcare, environmental monitoring, transportation, to entertainment. This course teaches students majoring in these and related subjects how to use electronic devices to solve problems in their areas of expertise. Through the lecture and laboratory, students gain insight into the possibilities and limitations of the technology and how to use electronics to help solve problems. Students learn to use electronics to interact with the environment through sound, light, temperature, motion using sensors and actuators, and how to use electronic computation to orchestrate the interactions and exchange information wirelessly over the internet.

The course has two objectives: (a) to teach students how to build electronic circuits that interact with the environment through sensors and actuators and how to communicate wirelessly with the internet to cooperate with other devices and with humans, and (b) to offer a broad survey of modern Electrical Engineering including analog electronics: analysis of RLC circuits, filtering, diodes and rectifiers, op-amps, A2D and D2A converters; digital electronics: combinatorial and sequential logic, flip-flops, counters, memory; applications: communication systems, signal processing, computer architecture; basics of manufacturing of integrated circuits.

**Student Learning Outcomes:** an ability to communicate effectively an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability an ability to identify, formulate, and solve engineering problems an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** ENGIN 7, COMPSCI 10, COMPSCI 61A, COMPSCI C8, or equivalent background in computer programming; MATH 51 or equivalent background in calculus; PHYSICS 7A or equivalent background in physics

**Credit Restrictions:** Student will not receive credit for this course if they have taken EE49

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 101 Introduction to Lean Manufacturing Systems 3 Units

Terms offered: Spring 2025, Spring 2023, Spring 2021

Fundamentals of lean manufacturing systems including manufacturing fundamentals, unit operations and manufacturing line considerations for work in process (WIP), manufacturing lead time (MLT), economics, quality monitoring; high mix/low volume (HMLV) systems fundamentals including just in time (JIT), kanban, buffers and line balancing; class project/case studies for design and analysis of competitive manufacturing systems.

### Objectives & Outcomes

**Course Objectives:** This course will enable students to analyze manufacturing lines in order to understand the production process and improve production efficiency. The course provides practical knowledge and skills that can be applied in industry, covering the complete manufacturing system from production planning to quality control. Students are given a chance to practice and implement what they learn during lectures by conducting projects with local or global manufacturing companies.

**Student Learning Outcomes:** Students will understand the whole scope of manufacturing systems from production planning to quality control, which can be helpful to set up manufacturing lines for various products. Students will be capable of identifying sources of manufacturing problems by analyzing the production line and produce multi-level solutions to optimize manufacturing efficiency.

### Rules & Requirements

**Prerequisites:** Completion of all lower division requirements for an engineering major, or consent of instructor

### Hours & Format

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

**Summer:** 6 weeks - 7.5 hours of lecture and 3 hours of discussion per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Dornfeld, McMains

## MEC ENG 102B Mechatronics Design 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

Introduction to design and realization of mechatronics systems.

Micro computer architectures. Basic computer IO devices. Embedded microprocessor systems and control, IO programming such as analogue to digital converters, PWM, serial and parallel outputs. Electrical components such as power supplies, operational amplifiers, transformers and filters. Shielding and grounding. Design of electric, hydraulic and pneumatic actuators. Design of sensors. Design of power transmission systems. Kinematics and dynamics of robotics devices. Basic feedback design to create robustness and performance.

### Objectives & Outcomes

**Course Objectives:** Introduce students to design and design techniques of mechatronics systems; provide guidelines to and experience with design of variety of sensors and actuators; design experience in programming microcomputers and various IO devices; exposure to and design experience in synthesis of mechanical power transfer components; understanding the role of dynamics and kinematics of robotic devices in design of mechatronics systems; exposure to and design experience in synthesis of feedback systems; provide experience in working in a team to design a prototype mechatronics device.

**Student Learning Outcomes:** By the end of this course, students should: Know how to set up micro computers and interface them with various devices; know how to understand the microcomputers architectures, IO devices and be able to program them effectively; understand the design of actuators and sensors; know how to do shielding and grounding for various mechatronics projects, know how to create feedback systems, know the role of dynamics and kinematics of robotic devices in design and control of mechatronics systems; know how to design mechanical components such as transmissions, bearings, shafts, and fasteners.

### Rules & Requirements

**Prerequisites:** ENGIN 26, ENGIN 29; and EECS 16A or MEC ENG 100. Please note that junior transfer admits are exempt from ENGIN 26

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Kazerooni, Stuart

## MEC ENG 103 Experimentation and Measurements 4 Units

Terms offered: Fall 2025, Fall 2024, Spring 2024

This course introduces students to modern experimental techniques for mechanical engineering, and improves students' teamwork and communication skills. Students will work in a laboratory setting on systems ranging in complexity from desktop experiments with only a few instruments up to systems such as an internal combustion engine with a wide variety of sensors. State-of-the-art software for data acquisition and analysis will be introduced and used throughout the course. The role of error and uncertainty, and uncertainty propagation, in measurements and analysis will be examined. Design of experiments will be addressed through examples and homework. The role and limitations of spectral analysis of digital data will be discussed.

### Objectives & Outcomes

**Course Objectives:** Introduce students to modern experimental techniques for mechanical engineering; provide exposure to and experience with a variety of sensors, including those to measure temperature, displacement, velocity, acceleration and strain; examine the role of error and uncertainty in measurements and analysis; exposure to and experience in using commercial software for data acquisition and analysis; discuss the role and limitations of spectral analysis of digital data; provide experience in working in a team in all aspects of the laboratory exercises, including set-up, data collection, analysis, technical report writing and oral presentation.

**Student Learning Outcomes:** (a) an ability to apply knowledge of mathematics, science, and engineering  
(b) an ability to design and conduct experiments, as well as to analyze and interpret data  
(c) an ability to function on multi-disciplinary teams  
(d) an ability to identify, formulate, and solve engineering problems  
(e) an understanding of professional and ethical responsibility  
(f) an ability to communicate effectively  
(g) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context  
(h) a recognition of the need for, and an ability to engage in life-long learning  
(i) a knowledge of contemporary issues  
(j) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** MEC ENG 40; MEC ENG C85 / CIV ENG C30; MEC ENG 100; MEC ENG 106 (can be taken concurrently), and MEC ENG 109 (can be taken concurrently)

**Credit Restrictions:** Students will not receive credit for this course if they have taken both ME 102A and ME 107.

### Hours & Format

**Fall and/or spring:** 15 weeks - 2 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Johnson, Makiharju, Chen



## MEC ENG 104 Engineering Mechanics II 3 Units

Terms offered: Fall 2025, Summer 2025 10 Week Session, Spring 2025

This course is an introduction to the dynamics of particles and rigid bodies. The material, based on a Newtonian formulation of the governing equations, is illustrated with numerous examples ranging from one-dimensional motion of a single particle to planar motions of rigid bodies and systems of rigid bodies.

### Rules & Requirements

**Prerequisites:** MEC ENG C85, and one of ENGIN 7 or COMPSCI 61A

### Hours & Format

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

**Summer:** 10 weeks - 4.5 hours of lecture and 1.5 hours of discussion per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Ma, Casey, O'Reilly

## MEC ENG 106 Fluid Mechanics 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

This course introduces the fundamentals and techniques of fluid mechanics with the aim of describing and controlling engineering flows.

### Rules & Requirements

**Prerequisites:** MEC ENG C85 / CIV ENG C30 and MEC ENG 104 (104 may be taken concurrently)

### Hours & Format

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

**Summer:** 10 weeks - 4.5 hours of lecture and 1.5 hours of discussion per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG C106A Introduction to Robotics 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023, Fall 2021, Fall 2020, Fall 2019

This course is an introduction to the field of robotics. It covers the fundamentals of kinematics, dynamics, control of robot manipulators, robotic vision, sensing, forward & inverse kinematics of serial chain manipulators, the manipulator Jacobian, force relations, dynamics, & control. We will present techniques for geometric motion planning & obstacle avoidance. Open problems in trajectory generation with dynamic constraints will also be discussed. The course also presents the use of the same analytical techniques as manipulation for the analysis of images & computer vision. Low level vision, structure from motion, & an introduction to vision & learning will be covered. The course concludes with current applications of robotics.

### Rules & Requirements

**Prerequisites:** Familiarity with linear algebra at the level of EECS 16A/EECS 16B or MATH 54. Experience coding in python at the level of COMPSCI 61A. Preferred: experience developing software at the level of COMPSCI 61B and experience using Linux

**Credit Restrictions:** Students will receive no credit for Electrical Engineering and Computer Science C106A/Bioengineering C106A after completing EE C106A/BioE C125, Electrical Engineering 206A, or Electrical Engineering and Computer Science 206A.

### Hours & Format

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

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Sastry

**Also listed as:** BIO ENG C106A/EECS C106A

## MEC ENG C106B Robotic Manipulation and Interaction 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023, Spring 2021, Spring 2020, Spring 2019

The course is a sequel to EECS/BIOE/MEC106A/EECS206A, which covers the mathematical fundamentals of robotics including kinematics, dynamics and control as well as an introduction to path planning, obstacle avoidance, and computer vision. This course will present several areas of robotics and active vision, at a deeper level and informed by current research. Concepts will include the review at an advanced level of robot control, the kinematics, dynamics and control of multi-fingered hands, grasping and manipulation of objects, mobile robots: including non-holonomic motion planning and control, path planning, Simultaneous Localization And Mapping (SLAM), and active vision. Additional research topics covered at the instructor's discretion.

### Rules & Requirements

**Prerequisites:** EECS C106A / BIO ENG C106A / MEC ENG C106A / EECS C206A or an equivalent course. A strong programming background, knowledge of Python and Matlab, and some coursework in feedback controls (such as EL ENG C128 / MEC ENG C134) are also useful. Students who have not taken the prerequisite course should have a strong programming background, knowledge of Python and Matlab, and exposure to linear algebra, Lagrangian dynamics, and feedback controls at the intermediate level. EECS C106A

**Credit Restrictions:** Students will receive no credit for Electrical Engineering and Computer Science C106B/Bioengineering C106B after completing Electrical Engineering C106B/Bioengineering C125B, Electrical Engineering 206B, or Electrical Engineering and Computer Science 206B.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Sastry

**Also listed as:** BIO ENG C106B/EECS C106B

## MEC ENG 108 Mechanical Behavior of Engineering Materials 4 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

This course covers elastic and plastic deformation under static and dynamic loads. Failure by yielding, fracture, fatigue, wear, and environmental factors are also examined. Topics include engineering materials, heat treatment, structure-property relationships, elastic deformation and multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, fracture, fatigue, and contact deformation.

### Objectives & Outcomes

**Course Objectives:** The central theme of this course is the mechanical behavior of engineering materials, such as metals, ceramics, polymers, and composites, subjected to different types of loading. The main objectives are to provide students with basic understanding of phase transformation by heat treating and stress-induced hardening, linear and nonlinear elastic behavior, deformation under multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, brittle versus ductile fracture, fracture mechanisms at different scales, fatigue, contact deformation, and wear.

**Student Learning Outcomes:** (a) an ability to apply knowledge of mathematics, science, and engineering  
(b) an ability to design and conduct experiments, as well as to analyze and interpret data  
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability  
(e) an ability to identify, formulate, and solve engineering problems  
(i) a recognition of the need for, and an ability to engage in life-long learning  
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** MEC ENG C85 / CIV ENG C30

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Komvopoulos, Grace O'Connell

## MEC ENG 109 Heat Transfer 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024

This course covers transport processes of mass, momentum, and energy from a macroscopic view with emphasis both on understanding why matter behaves as it does and on developing practical problem solving skills. The course is divided into four parts: introduction, conduction, convection, and radiation.

### Rules & Requirements

**Prerequisites:** MEC ENG 40 and MEC ENG 106

### Hours & Format

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

### Summer:

8 weeks - 5.5 hours of lecture and 1.5 hours of discussion per week

10 weeks - 4.5 hours of lecture and 1.5 hours of discussion per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 110 Introduction to Product Development 3 Units

Terms offered: Summer 2025 10 Week Session, Spring 2025, Summer 2024 10 Week Session

The course provides project-based learning experience in innovative new product development, with a focus on mechanical engineering systems. Design concepts and techniques are introduced, and the student's design ability is developed in a design or feasibility study chosen to emphasize ingenuity and provide wide coverage of engineering topics. Relevant software will be integrated into studio sessions, including solid modeling and environmental life cycle analysis. Design optimization and social, economic, and political implications are included.

### Rules & Requirements

**Prerequisites:** Junior or higher standing

### Hours & Format

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

**Summer:** 10 weeks - 5 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG C115 Molecular Biomechanics and Mechanobiology of the Cell 4 Units

Terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020

This course applies methods of statistical continuum mechanics to subcellular biomechanical phenomena ranging from nanoscale (molecular) to microscale (whole cell and cell population) biological processes at the interface of mechanics, biology, and chemistry.

### Objectives & Outcomes

**Course Objectives:** This course, which is open to senior undergraduate students or graduate students in diverse disciplines ranging from engineering to biology to chemistry and physics, is aimed at exposing students to subcellular biomechanical phenomena spanning scales from molecules to the whole cell.

**Student Learning Outcomes:** The students will develop tools and skills to (1) understand and analyze subcellular biomechanics and transport phenomena, and (2) ultimately apply these skills to novel biological and biomedical applications

### Rules & Requirements

**Prerequisites:** BIO ENG 102; or MEC ENG C85 / CIV ENG C30; or 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:** Mechanical Engineering/Undergraduate

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

**Instructor:** Mofrad

**Also listed as:** BIO ENG C112

## MEC ENG C117 Structural Aspects of Biomaterials 4 Units

Terms offered: Fall 2024, Spring 2023, Fall 2020

This course covers the basic design, materials selection, stress analysis and clinical case studies for load-bearing medical devices. Implant applications include orthopedics, dentistry and cardiology reconstructive surgery. FDA regulatory requirements and intellectual property issues are discussed. Case studies of medical devices elucidating the trade-offs in structural function and clinical performance are presented. Ongoing challenges with personalized implantable devices are addressed. This is a project-based course.

### Rules & Requirements

**Prerequisites:** MEC ENG 108, BIO ENG 102, MAT SCI 113 or equivalent

**Credit Restrictions:** Students will receive no credit for Mechanical Engineering C117 after completing Mechanical Engineering C215/ Bioengineering C222.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Pruitt

**Also listed as:** BIO ENG C117

## MEC ENG 118 Introduction to Nanotechnology and Nanoscience 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

This course introduces engineering students (juniors and seniors) to the field of nanotechnology and nanoscience. The course has two components: (1) Formal lectures. Students receive a set of formal lectures introducing them to the field of nanotechnology and nanoscience. The material covered includes nanofabrication technology (how one achieves the nanometer length scale, from "bottom up" to "top down" technologies), the interdisciplinary nature of nanotechnology and nanoscience (including areas of chemistry, material science, physics, and molecular biology), examples of nanoscience phenomena (the crossover from bulk to quantum mechanical properties), and applications (from integrated circuits, quantum computing, MEMS, and bioengineering). (2) Projects. Students are asked to read and present a variety of current journal papers to the class and lead a discussion on the various works.

### Rules & Requirements

**Prerequisites:** Chemistry 1A and Physics 7B. Physics 7C and Engineering 45 (or the equivalent) recommended

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Lin, Sohn

## MEC ENG 119 Introduction to MEMS (Microelectromechanical Systems) 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Fundamentals of microelectromechanical systems including design, fabrication of microstructures; surface-micromachining, bulk-micromachining, LIGA, and other micro machining processes; fabrication principles of integrated circuit device and their applications for making MEMS devices; high-aspect-ratio microstructures; scaling issues in the micro scale (heat transfer, fluid mechanics and solid mechanics); device design, analysis, and mask layout.

### Rules & Requirements

**Prerequisites:** PHYSICS 7B and MEC ENG 100

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 120 Computational Biomechanics Across Multiple Scales 3 Units

Terms offered: Spring 2025, Spring 2024, Fall 2016

This course applies the methods of computational modeling and continuum mechanics to biomedical phenomena spanning various length scales ranging from molecular to cellular to tissue and organ levels. The course is intended for upper level undergraduate students who have been exposed to undergraduate continuum mechanics (statics and strength of materials.)

### Rules & Requirements

**Prerequisites:** MEC ENG C85 / CIV ENG C30

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Mofrad

## MEC ENG 122 Processing of Materials in Manufacturing 3 Units

Terms offered: Spring 2020, Spring 2018, Spring 2017

Fundamentals of manufacturing processes (metal forming, forging, metal cutting, welding, joining, and casting); selection of metals, plastics, and other materials relative to the design and choice of manufacturing processes; geometric dimensioning and tolerancing of all processes.

### Rules & Requirements

**Prerequisites:** MEC ENG C85 / CIV ENG C30 and MEC ENG 108

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 125 Industry-Associated Capstones in Mechanical Engineering (iACME) 4 Units

Terms offered: Spring 2018

iACME provide opportunities for Mechanical Engineering undergraduates to tackle real-world engineering problems. Student teams, consisting of no more than four students, will apply to work on specific industry-initiated projects. Teams will be selected based on prior experience in research/internships, scholastic achievements in ME courses, and most importantly, proposed initial approaches toward tackling the specific project. ME faculty, alumni of the Mechanical Engineering Department, and industry participants will mentor selected teams. Projects fall within a wide range of mechanical engineering disciplines, e.g. biomedical, automotive/transportation, energy, design, etc.

### Objectives & Outcomes

**Course Objectives:** The purpose of this course is to:

- learn the fundamental concepts of approaching practical engineering problems;
- enhance skills in communication with clients and other engineers;
- enhance skills in design, prototyping, testing, and analysis.

**Student Learning Outcomes:** (a) an ability to apply knowledge of mathematics, science, and engineering  
 (b) an ability to design and conduct experiments, as well as to analyze and interpret data  
 (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability  
 (d) an ability to function on multi-disciplinary teams  
 (e) an ability to identify, formulate, and solve engineering problems  
 (f) an understanding of professional and ethical responsibility  
 (g) an ability to communicate effectively  
 (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context  
 (i) a recognition of the need for, and an ability to engage in life-long learning  
 (j) a knowledge of contemporary issues  
 (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** Senior standing and a minimum GPA of 3.0

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical 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.).

**Instructors:** O'Connell , Sohn



## MEC ENG 126 The Science and Engineering of Cooking 4 Units

Terms offered: Fall 2024, Fall 2022, Spring 2022

This course will discuss concepts from the physical sciences and engineering (e.g. heat and mass transfer, phase transitions, fluid mechanics, etc.) that serve as a foundation for everyday cooking and haute cuisine. The course will integrate the expertise of visiting chefs from the Bay Area (and beyond) who will serve as guest lecturers and present their cooking techniques. These unique opportunities will be complemented by lectures that investigate in-depth the science and engineering that underlie these techniques.

### Rules & Requirements

**Prerequisites:** PHYSICS 7A, CHEM 1A, or consent of instructor. MEC ENG 109 and MEC ENG 108 recommended

### Hours & Format

**Fall and/or spring:** 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Sohn

## MEC ENG 127 Introduction to Composite Materials 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

Imagine a material that offers mechanical properties that are competitive with aluminum and steel but are at fractions of their weight – these materials are termed as composites. Composite materials are used for many applications such as aircraft structures, biomedical devices, racing car bodies, and many others for their capability to be stronger, lighter, and cheaper when compared to traditional materials. In this class, students will delve into the theory to design composite structures, processing techniques to manufacture them, and structural testing methods for validation. Starting from traditional fiber-reinforced composite materials, this course will also bring in new concepts such as nanocomposites and bioinspired composites.

### Objectives & Outcomes

**Course Objectives:** The course objectives are to train students to be able to design composite structures, select composite materials, conduct stress analyses of selected practical applications using laminated plate theories and appropriate strength criteria, and be familiar with the properties and response of composite structures subjected to mechanical loading under static and cyclic conditions.

**Student Learning Outcomes:** A knowledge of contemporary issues.

An ability to design and conduct experiments, as well as to analyze and interpret data.

An understanding of professional and ethical responsibility.

The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

A recognition of the need for, and an ability to engage in life-long learning.

An ability to apply knowledge of mathematics, science, and engineering.

An ability to communicate effectively.

An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

An ability to function on multi-disciplinary teams.

An ability to identify, formulate, and solve engineering problems.

An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Students completing this course will have the facility for designing robust composite structures subjected to various types of loads.

Students will also be able to assess the effects of long-term loading, including damage generation, delamination fracture and fatigue failure.

Additionally, students will be exposed to how composites are used in various applications in aerospace, biomedical, sports, among other fields.

### Rules & Requirements

**Prerequisites:** MEC ENG C85 / CIV ENG C30

**Credit Restrictions:** Students will receive no credit for MEC ENG 127 after completing MEC ENG 127. A deficient grade in MEC ENG 127 may be removed by taking MEC ENG 127.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 130 Design of Planar Machinery 3 Units

Terms offered: Spring 2025, Fall 2023, Fall 2022

Synthesis, analysis, and design of planar machines. Kinematic structure, graphical, analytical, and numerical analysis and synthesis. Linkages, cams, reciprocating engines, gear trains, and flywheels.

### Rules & Requirements

**Prerequisites:** MEC ENG 104

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Youssefi

## MEC ENG 131 Vehicle Dynamics and Control 4 Units

Terms offered: Spring 2025, Spring 2023, Spring 2021

Physical understanding of automotive vehicle dynamics including simple lateral, longitudinal and ride quality models. An overview of active safety systems will be introduced including the basic concepts and terminology, the state-of-the-art development, and basic principles of systems such as ABS, traction control, dynamic stability control, and roll stability control. Passive, semi-active and active suspension systems will be analyzed. Concepts of autonomous vehicle technology including drive-by-wire and steer-by-wire systems, adaptive cruise control and lane keeping systems. Design of software control systems for an actual 1/10 scale race vehicle.

### Objectives & Outcomes

**Course Objectives:** At the end of the course the students should be able to:

- Formulate simple but accurate dynamic models for automotive longitudinal, lateral and ride quality analysis.
- Assess the stability of dynamic systems using differential equation theory, apply frequency-response methods to assess system response to external disturbances, sensor noise and parameter variations.
- Have a basic understanding of modern automotive safety systems including ABS, traction control, dynamic stability control and roll control.
- Follow the literature on these subjects and perform independent design, research and development work in this field.
- Expected to design feedback control systems for an actual 1/10 scaled vehicle platform which will be distributed to every group of two students in the class

**Student Learning Outcomes:** (a) an ability to apply knowledge of mathematics, science, and engineering  
 (b) an ability to design and conduct experiments, as well as to analyze and interpret data  
 (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability  
 (d) an ability to function on multi-disciplinary teams  
 (e) an ability to identify, formulate, and solve engineering problems  
 (g) an ability to communicate effectively  
 (j) a knowledge of contemporary issues  
 (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** MATH 52, MATH 53, MATH 54, PHYSICS 7A, PHYSICS 7B, ENGIN 7 (or alternate programming course), and MEC ENG 132

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Borrelli

## MEC ENG 132 Dynamic Systems and Feedback 3 Units

Terms offered: Fall 2025, Summer 2025 10 Week Session, Fall 2024

Physical understanding of dynamics and feedback. Linear feedback control of dynamic systems. Mathematical tools for analysis and design. Stability. Modeling systems with differential equations. Linearization. Solution to linear, time-invariant differential equations.

### Rules & Requirements

**Prerequisites:** MATH 53, MATH 54, PHYSICS 7A, and PHYSICS 7B

### Hours & Format

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

**Summer:** 10 weeks - 4.5 hours of lecture and 1.5 hours of laboratory per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 133 Mechanical Vibrations 3 Units

Terms offered: Spring 2025, Spring 2023, Spring 2022

An introduction to the theory of mechanical vibrations including topics of harmonic motion, resonance, transient and random excitation, applications of Fourier analysis and convolution methods. Multidegree of freedom discrete systems including principal mode, principal coordinates and Rayleigh's principle.

### Objectives & Outcomes

**Course Objectives:** Introduce basic aspects of vibrational analysis, considering both single and multi-degree-of-freedom systems. Discuss the use of exact and approximate methods in the analysis of complex systems. Familiarize students with the use of MATLAB as directed toward vibration problems.

**Student Learning Outcomes:**

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Upon completion of the course students shall be able to: Derive the equations of motion for vibratory systems. Linearize nonlinear systems so as to allow a linear vibrational analysis. Compute the natural frequency (or frequencies) of vibratory systems and determine the system's modal response. Determine the overall response based upon the initial conditions and/or steady forcing input. Design a passive vibration absorber to ameliorate vibrations in a forced system.

### Rules & Requirements

**Prerequisites:** MEC ENG 104

### Hours & Format

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

**Summer:** 10 weeks - 5 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG C134 Feedback Control Systems 4 Units

Terms offered: Fall 2025, Spring 2025, Spring 2024, Spring 2023

Analysis and synthesis of linear feedback control systems in transform and time domains. Control system design by root locus, frequency response, and state space methods. Applications to electro-mechanical and mechatronics systems.

### Rules & Requirements

**Prerequisites:** EECS 16A or MEC ENG 100; MEC ENG 132 or EL ENG 120

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Also listed as:** EL ENG C128

## MEC ENG 135 Design of Microprocessor-Based Mechanical Systems 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

This course provides preparation for the conceptual design and prototyping of mechanical systems that use microprocessors to control machine activities, acquire and analyze data, and interact with operators. The architecture of microprocessors is related to problems in mechanical systems through study of systems, including electro-mechanical components, thermal components and a variety of instruments. Laboratory exercises lead through studies of different levels of software.

### Rules & Requirements

**Prerequisites:** ENGIN 7

### Hours & Format

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

**Summer:** 10 weeks - 4.5 hours of lecture and 4.5 hours of laboratory per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Kazerooni

## MEC ENG 136 Dynamics and Control of Autonomous Flight 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

This course introduces students to the dynamics and control of autonomous flight, with focus on uninhabited aerial vehicles (UAVs). The course will cover modeling and dynamics of aerial vehicles, and common control strategies.

### Objectives & Outcomes

**Course Objectives:** Introduce students to analysis, modeling, and control of unmanned aerial vehicles.

**Student Learning Outcomes:** - ability to reason about the dominant effects acting on uninhabited aerial vehicle (UAV)

- explain and derive dynamic relationships governing UAV flight

- explain different sensors available on a UAV

### Rules & Requirements

**Prerequisites:** MEC ENG 104 is recommended. Corequisite: MEC ENG 132

**Credit Restrictions:** Student will not receive credit for this course if they have taken Mechanical Engineering 236U.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Mueller

## **MEC ENG 136HL Hardware Laboratory: Dynamics and Control of Autonomous Flight 1 Unit**

Terms offered: Fall 2022

This course complements ME136, Dynamics and Control of Autonomous Flight. The aim is to provide hardware experiments corresponding to the theory section of ME136. Students will work in teams.

### **Objectives & Outcomes**

#### **Course Objectives:**

Evaluating data from real experiments, with corresponding issues.

- Experimental flight hardware.
- 

Real noisy sensors.

- Embedded programming and constraints following there from

**Student Learning Outcomes:** data evaluation  
non-idealities in real sensors and actuators  
programming embedded computers

### **Rules & Requirements**

**Prerequisites:** MECENG 136 (corequisite)

**Credit Restrictions:** Students will receive no credit for MEC ENG 136HL after completing MEC ENG 136SL.

### **Hours & Format**

**Fall and/or spring:** 6 weeks - 3 hours of laboratory per week

### **Additional Details**

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Mueller

## **MEC ENG 136SL Software Laboratory: Dynamics and Control of Autonomous Flight 1 Unit**

Terms offered: Fall 2024

This course complements MEC ENG 136, Introduction to Control of Unmanned Aerial Vehicles. The aim is to provide (virtual) laboratory experiments corresponding to the theory provided in MEC ENG 136. Students may work alone or in teams.

### **Objectives & Outcomes**

**Course Objectives:** embedded programming and constraints following therefrom

evaluating data from experiments with corresponding issues

real (i.e., noisy) sensors

simulated flight hardware

**Student Learning Outcomes:** evaluate experimental data  
explain the utility of simulations and hardware experiments for development  
program an embedded flight controller

### **Rules & Requirements**

**Prerequisites:** MEC ENG 136 (co-requisite)

**Credit Restrictions:** Students will receive no credit for MEC ENG 136SL after completing MEC ENG 136HL.

### **Hours & Format**

**Fall and/or spring:** 6 weeks - 3 hours of laboratory per week

### **Additional Details**

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Mueller



## MEC ENG 138 Introduction to Micro/Nano Mechanical Systems Laboratory 3 Units

Terms offered: Spring 2018, Spring 2015, Spring 2013

This hands-on laboratory course focuses on the mechanical engineering principles that underlie the design, fabrication, and operation of micro/nanoscale mechanical systems, including devices made by nanowire/nanotube syntheses; photolithography/soft lithography; and molding processes. Each laboratory will have different focuses for basic understanding of MEMS/NEMS systems from prototype constructions to experimental testings using mechanical, electrical, or optical techniques.

### Rules & Requirements

**Prerequisites:** PHYSICS 7B and MEC ENG 106; EECS 16A or MEC ENG 100. MEC ENG 118 or MEC ENG 119 are highly recommended but not mandatory

**Credit Restrictions:** Students will receive no credit for Mechanical Engineering 238 after taking Mechanical Engineering 138.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 139 Robotic Locomotion 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This course provides students with a basic understanding of robotic locomotion and the use of kinematics, dynamics, control algorithms, embedded microcomputers and mechanical components in designing artificial legs such as prosthetics, orthotics and exoskeletons.

### Objectives & Outcomes

**Course Objectives:** Conduct various analyses on the legs' performance, propose and study practical applications such as orthotics and prosthetics in medical field, back support, knee support and shoulder support exoskeletons in industrial field and recreational exoskeletons. The course objectives are to train students to be able to design artificial legs, select and design components of the robotic legs.

**Student Learning Outcomes:**

- (a) An ability to apply knowledge of mathematics, science, and engineering.
- (b) An ability to design and conduct experiments, as well as to analyze and interpret data.
- (c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- (d) An ability to function on multi-disciplinary teams.
- (e) An ability to identify, formulate, and solve engineering problems.
- (f) An understanding of professional and ethical responsibility.
- (g) An ability to communicate effectively.
- (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- (i) A recognition of the need for, and an ability to engage in life-long learning.
- (j) A knowledge of contemporary issues.
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** A preliminary course in the design and control of mechanical systems

**Credit Restrictions:** Students will receive no credit for MEC ENG 139 after completing MEC ENG 239. A deficient grade in MEC ENG 139 may be removed by taking MEC ENG 239.

### Hours & Format

**Fall and/or spring:**

15 weeks - 3 hours of lecture and 3 hours of laboratory per week

15 weeks - 3 hours of lecture and 3 hours of laboratory per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Kazerooni

## MEC ENG 140 Combustion Processes 3 Units

Terms offered: Spring 2023, Fall 2020, Fall 2019

Fundamentals of combustion, flame structure, flame speed, flammability, ignition, stirred reaction, kinetics and nonequilibrium processes, pollutant formation. Application to engines, energy production and fire safety.

### Rules & Requirements

**Prerequisites:** MEC ENG 40, MEC ENG 106, and MEC ENG 109 (106 and 109 may be taken concurrently)

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Fernandez-Pello, Chen

## MEC ENG 146 Energy Conversion Principles 3 Units

Terms offered: Spring 2025, Fall 2018, Spring 2018

This course covers the fundamental principles of energy conversion processes, followed by development of theoretical and computational tools that can be used to analyze energy conversion processes. The course also introduces the use of modern computational methods to model energy conversion performance characteristics of devices and systems. Performance features, sources of inefficiencies, and optimal design strategies are explored for a variety of applications, which may include conventional combustion based and Rankine power systems, energy systems for space applications, solar, wind, wave, thermoelectric, and geothermal energy systems.

### Rules & Requirements

**Prerequisites:** MEC ENG 40, MEC ENG 106, and MEC ENG 109 (106 and 109 may be taken concurrently)

### Hours & Format

**Fall and/or spring:** 15 weeks - 3-3 hours of lecture and 0-1 hours of discussion per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Carey

## MEC ENG 150 Modeling and Simulation of Advanced Manufacturing Processes 3 Units

Terms offered: Fall 2025, Fall 2024

This course teaches students modern modeling and simulation methods that are geared towards the analysis and optimization of advanced manufacturing processes, in a systematic and scientific manner, with special emphasis on physical modeling, simulation and machine-learning. Examples are motivated by real-world phenomena that students are likely to encounter in their careers, involving a number of topics in advanced manufacturing, including dynamics, controls, structural analysis, materials engineering, robotics, heat-transfer, etc. There are several major applications, which are selected for their current societal and industrial relevance.

### Objectives & Outcomes

**Course Objectives:** To enable students to model and simulate modern advanced manufacturing processes.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Zohdi

## MEC ENG 150A Solar-Powered Vehicles: Analysis, Design and Fabrication 3 Units

Terms offered: Summer 2015 10 Week Session, Summer 2014 10 Week Session, Spring 2014

This course addresses all aspects of design, analysis, construction and economics of solar-powered vehicles. It begins with an examination of the fundamentals of photovoltaic solar power generation, and the capabilities and limitations that exist when using this form of renewable energy. The efficiency of energy conversion and storage will be evaluated across an entire system, from the solar energy that is available to the mechanical power that is ultimately produced. The structural and dynamic stability, as well as the aerodynamics, of vehicles will be studied. Safety and economic concerns will also be considered. Students will work in teams to design, build and test a functioning single-person vehicle capable of street use.

### Objectives & Outcomes

**Course Objectives:** This course provides a structured environment within which students can participate in a substantial engineering project from start to finish. It provides the opportunity for students to engage deeply in the analysis, design and construction of a functioning vehicle powered by a renewable source. Through participation in this course, students should strengthen their understanding of how their engineering education can be used to address the multidisciplinary problems with creativity, imagination, confidence and responsibility. Students will recognize the importance of effective communication in effectively addressing such problems.

**Student Learning Outcomes:** This course will strengthen students' abilities: to apply knowledge of mathematics, science, and engineering to real projects; to design a component or process that is part of a larger system; to function on multi-disciplinary teams; to identify, formulate, and solve engineering problems; to communicate effectively; to understand the impact of engineering solutions in a context beyond the classroom; to appreciate the importance of engaging in life-long learning and understanding contemporary issues; and to recognize and use the techniques, skills, and modern engineering tools necessary for successful project completion.

### Rules & Requirements

**Prerequisites:** MATH 54, PHYSICS 7A, and upper division status in engineering

### Hours & Format

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

**Summer:** 10 weeks - 3 hours of lecture and 4.5 hours of laboratory per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 151 Advanced Heat Transfer 3 Units

Terms offered: Spring 2017, Spring 2014, Spring 2008

Basic principles of heat transfer and their application. Subject areas include steady-state and transient system analyses for conduction, free and forced convection, boiling, condensation and thermal radiation.

### Rules & Requirements

**Prerequisites:** MEC ENG 40, MEC ENG 106, and MEC ENG 109 (106 and 109 may be taken concurrently)

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 151A Conductive and Radiative Transport 3 Units

Terms offered: Spring 2025, Fall 2023, Fall 2022

Fundamentals of conductive heat transfer. Analytical and numerical methods for heat conduction in rigid media. Fundamentals of radiative transfer. Radiative properties of solids, liquids and gas media. Radiative transport modeling in enclosures and participating media.

### Objectives & Outcomes

**Course Objectives:** The course will provide students with knowledge of the physics of conductive transport in solids, the analysis of steady and transient heat conduction by both analytical and numerical methods and the treatment of phase change problems. Furthermore, the course will provide students with knowledge of radiative properties, the mechanisms of radiative transfer and will present theory and methods of solution of radiative transfer problems in participating and nonparticipating media.

**Student Learning Outcomes:** Students will gain knowledge of the mechanisms of conductive transfer and will develop the ability to quantify steady and transient temperature in important engineering problems often encountered (e.g. manufacturing, materials processing, bio-thermal treatment and electronics cooling) by applying analytical methods and by constructing numerical algorithms. Students will also gain knowledge of the fundamental radiative properties and the mechanisms of radiative transport in enclosures, absorbing, emitting and scattering media as well as the interaction of thermal radiation with other modes of heat transfer.

### Rules & Requirements

**Prerequisites:** Undergraduate courses in engineering thermodynamics, fluid dynamics and heat transfer (MEC ENG 40, MEC ENG 106, and MEC ENG 109). Each student must have access to a PC, Macintosh or workstation machine with scientific programming capabilities for use in homework and projects

**Credit Restrictions:** Students who have taken ME 151 or ME 250A will not receive credit.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Grigoropoulos

## MEC ENG 151B Convective Transport and Computational Methods 3 Units

Terms offered: Spring 2025, Spring 2023, Spring 2020

The transport of heat and mass in fluids in motion; free and forced convection in laminar and turbulent flow over surfaces and within ducts. Fundamentals of computational methods used for solving the governing transport equations will also be covered.

### Objectives & Outcomes

**Course Objectives:** This course will provide students with knowledge of the physics of convective transport and an introduction to computational tools that can model convective processes in important applications such as electronics cooling, aerospace thermal management. The course also teaches students to construct computational models of natural and forced convection processes in boundary layers nears surfaces, in enclosures and in ducts or pipes that can be used to design heat exchangers and thermal management equipment for applications.

**Student Learning Outcomes:** (a) an ability to apply knowledge of mathematics, science, and engineering  
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability  
(d) an ability to function on multi-disciplinary teams  
(e) an ability to identify, formulate, and solve engineering problems  
(g) an ability to communicate effectively  
(j) a knowledge of contemporary issues  
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Students will gain a knowledge of the mechanisms of convective heat and mass transfer for flow over surfaces and within ducts, and will develop the ability to construct computer programs that implement computation methods that predict the flow and temperature fields and heat transfer performance for convective flows of interest in engineering applications.

### Rules & Requirements

**Prerequisites:** Undergraduate courses in engineering thermodynamics, fluid dynamics and heat transfer (MEC ENG 40, MEC ENG 106, and MEC ENG 109). Each student must have access to a PC, Macintosh or workstation machine with scientific programming capabilities for use in homework and projects

**Credit Restrictions:** Students should not receive credit for this course if they have taken ME 252 or ME 250B.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Carey

## MEC ENG 153 Applied Optics and Radiation 3 Units

Terms offered: Prior to 2007

Fundamentals of electromagnetic theory, principles of optics, waves, diffraction theory, interference, geometrical optics, scattering, theory of molecular spectra, optical and spectroscopic instrumentation. Lasers and laser materials processing, laser spectroscopy. Modern optics, plasmonics.

### Objectives & Outcomes

**Course Objectives:** The course will provide students with knowledge of the fundamental principles of optics to analyze optical phenomena and develop the background and skills to design optical instrumentation applied to engineering fields, including additive manufacturing, radiometry and spectroscopy.

### Student Learning Outcomes: ABET Outcomes

- (a) an ability to apply knowledge of mathematics, science, and engineering
  - (b) an ability to design and conduct experiments, as well as to analyze and interpret data
  - (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
  - (e) an ability to identify, formulate, and solve engineering problems
  - (g) an ability to communicate effectively
  - (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- Students will gain knowledge of the EM theory, optical properties of materials, principles of spectroscopy for gases, liquids and solids, principles and applications of lasers and optical diagnostics. Students will develop the ability to design optical instrumentation systems in the context of key industrial applications, including additive manufacturing, materials processing, bio-optics, semiconductor industry applications, reacting systems, forensics.

### Rules & Requirements

**Prerequisites:** Undergraduate courses in physics (e.g. 7A,B,C). Each student must have access to a PC, Macintosh or workstation machine with scientific programming capabilities for use in homework and projects

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Grigoropoulos

## MEC ENG 154 Thermophysics for Applications 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

Development of classical thermodynamics from statistical treatment of microscale molecular behavior; Boltzmann distribution; partition functions; statistical-mechanical evaluation of thermodynamic properties; equilibrium; chemical equilibrium; phase transitions; molecular collisions; Maxwell-Boltzmann distribution; collision theory; elementary kinetic theory; molecular dynamics simulation of molecular collisions; kinetic Monte Carlo simulations of gas-phase and gas-surface reactions. Implications are explored for a variety of applications, which may include advanced combustion systems, renewable power systems, microscale transport in high heat flux electronics cooling, aerospace thermal management, and advanced materials processing.

### Objectives & Outcomes

**Course Objectives:** To introduce students to the statistical foundation of thermodynamics and provide skills to perform advanced calculations for analysis of advanced energy conversion processes and devices.

**Student Learning Outcomes:** a knowledge of contemporary issues  
 an ability to apply knowledge of mathematics, science, and engineering  
 an ability to communicate effectively  
 an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability  
 an ability to function on multi-disciplinary teams  
 an ability to identify, formulate, and solve engineering problems  
 an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** MEC ENG 40

**Credit Restrictions:** Student will not receive credit for this course if they have taken ME 254.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Frenklach, Carey

## MEC ENG 160 Ocean Engineering Seminar 2 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

Lectures on new developments in ocean, offshore, and arctic engineering.

### Objectives & Outcomes

**Course Objectives:** To provide exposure of the field of ocean engineering, arctic engineering and related subject areas to students with the intention to show the broad and interdisciplinary nature of this field, particularly recent or new developments.

**Student Learning Outcomes:** (f) an understanding of professional and ethical responsibility

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

Students will learn of new developments in ocean, offshore, and arctic engineering, connecting much of what is learned in other courses to practical applications and active research topics.

### Rules & Requirements

**Repeat rules:** Course may be repeated for credit with instructor consent.

### Hours & Format

**Fall and/or spring:** 15 weeks - 2 hours of seminar per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

**Grading/Final exam status:** Offered for pass/not pass grade only. Alternative to final exam.

**Instructors:** Makiharju, Alam

## MEC ENG C162 Introduction to Flight Mechanics 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This course introduces flight mechanics and a wide range of analysis and design techniques of relevance to the flight and performance characteristics of aerospace vehicles. The course consists of 6 major modules with the following topics: introduction, flow types, lift and drag, aircraft performance, stability and control, and, prominently, space flight. The entire course is enriched with numerous practical examples from real life that help to understand the practical use of the subject matter.

### Objectives & Outcomes

**Course Objectives:** This course intends to introduce undergraduate engineering majors with an interest in aerospace engineering to analysis and design techniques of relevance to the flight and performance characteristics of aerospace vehicles in a self-contained manner and in anticipation of the engineering science coursework in the upper division. Simultaneously, the course intends to make tangible connections between the theory and relevant practical examples in aerospace engineering by means of the discussion of research facilities at NASA Ames (wind-tunnels and simulators), X-planes, relevant airliner accidents, launch and re-entry telemetry data, etc.

**Student Learning Outcomes:** Upon completion of this course, students should be able to:

- Calculate lift and drag of a 2D airfoil and a 3D wing in subsonic and supersonic speed regimes
- Calculate thrust and power required for level flight
- Compute the range and endurance of propeller-driven as well as jet-powered aircraft
- Compute the necessary runway length for takeoff and landing
- Analyze aircraft trim conditions
- Assess longitudinal balance and static stability of an aircraft
- Find orbit parameters from the orbital geometry
- Design a Hohmann orbit transfer and compute the total DV
- Calculate peak deceleration and speed at touchdown in a re-entry path for ballistic as well as gliding flight.
- Describe and discuss various design methodologies and their trade-offs.

### Rules & Requirements

**Prerequisites:** MATH 52; PHYSICS 7A; and MEC ENG 106 (may be taken concurrently)

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Lombaerts, Papadopoulos

**Also listed as:** AERO ENG C162



## MEC ENG 163 Engineering Aerodynamics 3 Units

Terms offered: Fall 2025, Spring 2025, Fall 2022

Introduction to the lift, drag, and moment of two-dimensional airfoils, three-dimensional wings, and the complete airplane. Calculations of the performance and stability of airplanes in subsonic flight. The course run on two loosely aligned parallel tracks: a traditional sequence of lectures covering the basic topics in aerodynamics and a set of projects on vortex dynamics and aerodynamics that are loosely aligned with lectures. The distinguishing factor will be the extend of the projects assigned to the graduate level participants, which will be substantially more involved than those expected from the senior level participants.

### Rules & Requirements

**Prerequisites:** MEC ENG 40, MEC ENG 106

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Savas

## MEC ENG 164 Marine Statics and Structures 3 Units

Terms offered: Fall 2012, Fall 2011, Fall 2009

Terminology and definition of hull forms, conditions of static equilibrium and stability of floating submerged bodies. Effects of damage on stability. Structural loads and response. Box girder theory. Isotropic and orthotropic plate bending and bucking.

### Rules & Requirements

**Prerequisites:** Civil and Environmental Engineering 130 or 130N or consent of instructor

**Credit Restrictions:** Students will receive no credit for 164 after taking C164/Ocean Engineering C164; 2 units after taking 151.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Mansour

**Formerly known as:** C164

## MEC ENG 165 Ocean-Environment Mechanics 3 Units

Terms offered: Fall 2024, Fall 2022, Spring 2020

Ocean environment. Physical properties and characteristics of the oceans. Global conservation laws. Surface-waves generation. Gravity-wave mechanics, kinematics, and dynamics. Design consideration of ocean vehicles and systems. Model-testing techniques. Prediction of resistance and response in waves--physical modeling and computer models.

### Rules & Requirements

**Prerequisites:** MEC ENG 106 or CIV ENG 100

**Credit Restrictions:** Students will receive no credit for 165 after taking C165/Ocean Engineering C165.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Yeung

**Formerly known as:** C165

## MEC ENG C166 Introduction to Compressible Flow 3 Units

Terms offered: Fall 2024

This course introduces the theory of compressible flows (gases) and the mathematics representation of different flow regimes. Students will learn about the governing equations of general compressible flows and special cases such as inviscid and irrotational flows. The course will cover the following topics: 1D-flow, converging-diverging nozzle, normal and oblique shock definitions and practical examples for aerospace applications, Mach waves, wave equation, shock tube, transonic flow, supersonic flow, method of characteristics, and an introduction to hypersonic flows. Practical examples of aerospace applications such as turbomachinery flows, flow past an airfoil and a 3D wing will be included.

### Objectives & Outcomes

**Course Objectives:** This course intends to introduce undergraduate engineering majors with an interest in aerospace engineering to the theory and concepts of compressible flow regimes, their definitions, governing equations, and techniques to evaluate flow characteristics using a variety of real-world aerospace use cases including both internal and external flows.

**Student Learning Outcomes:**

- Be able to explain various terms in the governing equations of compressible flows and describe assumptions and derive equations for special flow types such as inviscid flows, quasi 1D flows, and irrotational flows.

- Define compressible flow and be able to provide a quantitative estimation of a flow to be compressible.
- Explain the flow behavior and characteristics in subsonic, transonic, supersonic and hypersonic flow regimes.

### Rules & Requirements

**Prerequisites:** MEC ENG 104, MEC ENG 163

**Credit Restrictions:** Students will receive no credit for AERO ENG C166 after completing MEC ENG 166. A deficient grade in AERO ENG C166 may be removed by taking MEC ENG 166, or MEC ENG 166.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Papadopoulos, Gollner, Marcus, Savas

**Also listed as:** AERO ENG C166

## MEC ENG 167 Microscale Fluid Mechanics 3 Units

Terms offered: Spring 2018, Spring 2016, Spring 2015

Phenomena of physical, technological, and biological significance in flows of gases and liquids at the microscale. The course begins with familiar equations of Newtonian fluid mechanics, then proceeds to the study of essentially 1-D flows in confined geometries with the lubrication equations. Next is a study of the flow of thin films spreading under gravity or surface tension gradients. Lubrication theory of compressible gases leads to consideration of air bearings. Two- and 3-D flows are treated with Stokes' equations. Less familiar physical phenomena of significance and utility at the microscale are then considered: intermolecular forces in liquids, slip, diffusion and bubbles as active agents. A review of relevant aspects of electricity and magnetism precedes a study of electrowetting and electrokinetically driven liquid flows.

### Rules & Requirements

**Prerequisites:** 40, 106, 109, (106 and 109 may be taken concurrently) Physics 7B or equivalent

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Morris, Szeri

## MEC ENG 168 Mechanics of Offshore Systems 3 Units

Terms offered: Spring 2025, Fall 2023, Fall 2022

This course covers major aspects of offshore engineering including ocean environment, loads on offshore structures, cables and mooring, underwater acoustics and arctic operations.

### Objectives & Outcomes

**Course Objectives:** To provide a basic to intermediate level of treatment of engineering systems that operate in coastal, offshore, and arctic environment. Students will acquire an understanding of the unique and essential character of the marine fields and the analysis tools to handle the engineering aspects of them.

**Student Learning Outcomes:** (a) an ability to apply knowledge of mathematics, science, and engineering  
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability  
(d) an ability to function on multi-disciplinary teams  
(e) an ability to identify, formulate, and solve engineering problems  
(j) a knowledge of contemporary issues  
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** MEC ENG C85 / CIV ENG C30 and MEC ENG 106; MEC ENG 165 is recommended

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Alam

## MEC ENG 170 Engineering Mechanics III 3 Units

Terms offered: Fall 2022, Spring 2020, Spring 2019

This course builds upon material learned in 104, examining the dynamics of particles and rigid bodies moving in three dimensions. Topics include non-fixed axis rotations of rigid bodies, Euler angles and parameters, kinematics of rigid bodies, and the Newton-Euler equations of motion for rigid bodies. The course material will be illustrated with real-world examples such as gyroscopes, spinning tops, vehicles, and satellites. Applications of the material range from vehicle navigation to celestial mechanics, numerical simulations, and animations.

### Rules & Requirements

**Prerequisites:** MEC ENG 104 or consent of instructor

### Hours & Format

**Fall and/or spring:** 15 weeks - 3-3 hours of lecture and 0-1 hours of discussion per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** O'Reilly, Casey

## MEC ENG 172 Wildland Fires: Science and Applications 3 Units

Terms offered: Fall 2024, Spring 2022

This course presents an introduction to the global problem of wildland fires with an overview of the social, political and environmental issues posed as well as detailed coverage of the science, technology and applications used to predict, prevent and suppress wildland fires. Some specific topics covered will include fire spread theory, risk mapping, research instrumentation, suppression, ignition sources, relevant codes and standards, remote sensing, smoke management, and extreme fire behavior. Engineering analyses in many of these areas, as well as specific coverage of fire protection design in the Wildland-Urban Interface (WUI) will also be covered.

### Objectives & Outcomes

**Course Objectives:** The course objectives are to provide students with the knowledge necessary to work within the highly interdisciplinary field of wildland fire, including a broad understanding of the social, ecological, and economic factors influencing wildland fire, a firm understanding of the underlying mechanisms affecting wildland fire processes, and an ability to apply the tools necessary to predict the spread rate and intensity of wildland fires and assess protection of WUI communities.

- Student Learning Outcomes:**
- (a) An ability to apply knowledge of mathematics, science, and engineering.
  - (b) An ability to design and conduct experiments, as well as to analyze and interpret data.
  - (c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
  - (d) An ability to function on multi-disciplinary teams.
  - (e) An ability to identify, formulate, and solve engineering problems.
  - (f) An understanding of professional and ethical responsibility.
  - (g) An ability to communicate effectively.
  - (h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
  - (i) A recognition of the need for, and an ability to engage in life-long learning.
  - (j) A knowledge of contemporary issues.
  - (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** MEC ENG 109 or equivalent course in heat transfer (may be taken concurrently)

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Michael Gollner

## MEC ENG 173 Fundamentals of Acoustics 3 Units

Terms offered: Spring 2017, Spring 2013, Spring 2011

Plane and spherical sound waves. Sound intensity. Propagation in tubes and horns. Resonators. Standing waves. Radiation from oscillating surface. Reciprocity. Reverberation and diffusion. Electro-acoustic loud speaker and microphone problems. Environmental and architectural acoustics. Noise measurement and control. Effects on man.

### Rules & Requirements

**Prerequisites:** MEC ENG 104

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Johnson

## MEC ENG 174 Nonlinear and Random Vibrations 3 Units

Terms offered: Spring 2021

Oscillations in nonlinear systems having one or two degrees of freedom. Graphical, iteration, perturbation, and asymptotic methods. Self-excited oscillations and limit cycles. Random variables and random processes. Analysis of linear and nonlinear, discrete and continuous, mechanical systems under stationary and non-stationary excitations.

### Objectives & Outcomes

**Course Objectives:** To give a compact, consistent, and reasonably connected account of the theory of nonlinear vibrations and uncertainty analysis. Applications will be mentioned whenever feasible. A secondary purpose is to survey some topics of contemporary research.

**Student Learning Outcomes:** Acquired necessary knowledge and scientific maturity to apply methods of nonlinear and uncertainty analysis in engineering design and optimization.

An ability to apply knowledge of mathematics, science, and engineering. An ability to identify, formulate, and solve engineering problems. The broad education necessary to understand the impact of engineering solutions in a global and societal context. A knowledge of contemporary issues. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

This course provides valuable training in the modeling and analysis of mechanical engineering systems using nonlinear and uncertainty analysis. It also serves to reinforce and emphasize the connection between fundamental engineering science and practical problem solving.

### Rules & Requirements

**Prerequisites:** MEC ENG 104

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Ma

## MEC ENG 175 Intermediate Dynamics 3 Units

Terms offered: Fall 2024, Spring 2023, Spring 2022

This course introduces and investigates Lagrange's equations of motion for particles and rigid bodies. The subject matter is particularly relevant to applications comprised of interconnected and constrained discrete mechanical components. The material is illustrated with numerous examples. These range from one-dimensional motion of a single particle to three-dimensional motions of rigid bodies and systems of rigid bodies.

### Objectives & Outcomes

**Course Objectives:** Introduce students to the notion of exploiting differential geometry to gain insight into the dynamics of a mechanical system. Familiarize the student with classifications and applications of generalized forces and kinematical constraints. Enable the student to establish Lagrange's equations of motion for a single particle, a system of particles and a single rigid body. Establish equivalence of equations of motion using the Lagrange and Newton-Euler approaches. Discuss the developments of analytical mechanics drawing from applications in navigation, vehicle dynamics, toys, gyroscopes, celestial mechanics, satellite dynamics and computer animation.

**Student Learning Outcomes:** This course provides valuable training in the modeling and analysis of mechanical engineering systems using systems of particles and/or rigid bodies. It also serves to reinforce and emphasize the connection between fundamental engineering science and practical problem-solving.

- a) An ability to apply knowledge of mathematics, science, and engineering.
- e) An ability to identify, formulate, and solve engineering problems.
- h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
- j) A knowledge of contemporary issues.
- k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** MEC ENG 104

**Credit Restrictions:** Students will receive no credit for MEC ENG 175 after completing MEC ENG 271.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** O'Reilly, Casey

## MEC ENG C176 Orthopedic Biomechanics 4 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022

Statics, dynamics, optimization theory, composite beam theory, beam-on-elastic foundation theory, Hertz contact theory, and materials behavior. Forces and moments acting on human joints; composition and mechanical behavior of orthopedic biomaterials; design/analysis of artificial joint, spine, and fracture fixation prostheses; musculoskeletal tissues including bone, cartilage, tendon, ligament, and muscle; osteoporosis and fracture-risk predication of bones; and bone adaptation. MATLAB-based project to integrate the course material.

### Rules & Requirements

**Prerequisites:** MEC ENG C85 / CIV ENG C30 or BIO ENG 102 (concurrent enrollment OK). Proficiency in MatLab or equivalent. Prior knowledge of biology or anatomy is not assumed

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Keaveny

**Also listed as:** BIO ENG C119

## MEC ENG C178 Designing for the Human Body 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2019, Fall 2018, Fall 2017

The course provides project-based learning experience in understanding product design, with a focus on the human body as a mechanical machine. Students will learn the design of external devices used to aid or protect the body. Topics will include forces acting on internal materials (e.g., muscles and total replacement devices), forces acting on external materials (e.g., prosthetics and crash pads), design/analysis of devices aimed to improve or fix the human body, muscle adaptation, and soft tissue injury. Weekly laboratory projects will incorporate EMG sensing, force plate analysis, and interpretation of data collection (e.g., MATLAB analysis) to integrate course material to better understand contemporary design/analysis/problems.

### Objectives & Outcomes

**Course Objectives:** The purpose of this course is twofold:

- to learn the fundamental concepts of designing devices to interact with the human body;
- to enhance skills in mechanical engineering and bioengineering by analyzing the behavior of various complex biomedical problems;
- To explore the transition of a device or discovery as it goes from “benchtop to bedside”.

### Student Learning Outcomes: RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES

- (a) an ability to apply knowledge of mathematics, science, and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (d) an ability to function on multi-disciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Working knowledge of design considerations for creating a device to protect or aid the human body, force transfer and distribution, data analysis, and FDA approval process for new devices. Understanding of basic concepts in orthopaedic biomechanics and the ability to apply the appropriate engineering concepts to solve realistic biomechanical problems, knowing clearly the assumptions involved. Critical analysis of current literature and technology.

### Rules & Requirements

**Prerequisites:** PHYSICS 7A, MATH 51, and MATH 52; and proficiency in MatLab or equivalent. Prior knowledge of biology or anatomy is not assumed

**Credit Restrictions:** There will be no credit given for MEC ENG C178 / BIO ENG C137 after taking MEC ENG 178.

### Hours & Format

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



## MEC ENG 179 Augmenting Human Dexterity 4 Units

Terms offered: Spring 2023, Spring 2022, Spring 2021

This course provides hands-on experience in designing prostheses and assistive technologies using user-centered design. Students will develop a fundamental understanding of the state-of-the-art, design processes and product realization. Teams will prototype a novel solution to a disabilities-related challenge, focusing on upper-limb mobility or dexterity. Lessons will cover biomechanics of human manipulation, tactile sensing and haptics, actuation and mechanism robustness, and control interfaces. Readings will be selected from texts and academic journals available through the UCB online library system and course notes. Guest speakers will be invited to address cutting edge breakthroughs relevant to assistive technology and design.

### Objectives & Outcomes

**Course Objectives:** The course objectives are to:

- Learn the fundamental principles of biomechanics, dexterous manipulation, and electromechanical systems relevant for non-invasive, cutting-edge assistive device and prosthesis design.
- Enhance skill in the areas of human-centered design, teamwork and communication through the practice of conducting labs and a project throughout the semester.

**Student Learning Outcomes:** (a) an ability to apply knowledge of mathematics, science, and engineering  
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability  
(e) an ability to identify, formulate, and solve engineering problems  
(f) an understanding of professional and ethical responsibility  
(g) an ability to communicate effectively  
(j) a knowledge of contemporary issues

### Rules & Requirements

**Prerequisites:** MEC ENG 132 or equivalent. Proficiency with Matlab or equivalent programming language

**Credit Restrictions:** Students will receive no credit for MEC ENG 179 after completing MEC ENG 270.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Stuart

## MEC ENG C180 Engineering Analysis Using the Finite Element Method 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023

This is an introductory course on the finite element method and is intended for seniors in engineering and applied science disciplines. The course covers the basic topics of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems. Finite element formulations for several important field equations are introduced using both direct and integral approaches. Particular emphasis is placed on computer simulation and analysis of realistic engineering problems from solid and fluid mechanics, heat transfer, and electromagnetism. The course uses FEMLAB, a multiphysics MATLAB-based finite element program that possesses a wide array of modeling capabilities and is ideally suited for instruction. Assignments will involve both paper- and computer-based exercises. Computer-based assignments will emphasize the practical aspects of finite element model construction and analysis.

### Rules & Requirements

**Prerequisites:** Engineering 7 or 77 or Computer Science 61A; Mathematics 53 and 54; senior status in engineering or applied science

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Also listed as:** CIV ENG C133

## MEC ENG C184 Flight Vehicle Structures and Aeroelasticity 3 Units

Terms offered: Spring 2025

This course introduces engineering students to the analysis and design of load-bearing components of flight structures, ranging from subsonic aircraft to rockets. Emphasis is placed on the quasi-static and dynamic analysis of structural components which are prevalent in aerospace engineering. Attention is also devoted to a comprehensive design roadmap of flight vehicle structures from the full system- to the individual component-level

### Objectives & Outcomes

**Course Objectives:** 1. Familiarize students with the different load-bearing components and loads encountered in flight vehicles.

2. Sharpen the students' skills in the statics and dynamics of thin-walled structures.

3. Enhance the students' aerospace engineering design skills by leveraging the use of the finite element method as a tool for both global and local analysis.

**Student Learning Outcomes:** Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

(g) A knowledge of contemporary issues.

Ability to apply knowledge of mathematics, science, and engineering.

Ability to design and conduct experiments, as well as to analyze and interpret data

Ability to identify, formulate, and solve engineering problems.

Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Understanding of professional and ethical responsibility.

### Rules & Requirements

**Prerequisites:** CIV ENG C30 / MEC ENG C85, and MEC ENG 104 or CIV ENG 126

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Papadopoulos

**Formerly known as:** Mechanical Engineering 184

## MEC ENG 185 Introduction to Continuum Mechanics 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This course is a general introduction to the fundamental concepts of the mechanics of continuous media. Topics covered include the kinematics of deformation, the concept of stress, and the conservation laws for mass, momentum and energy. This is followed by an introduction to constitutive theory with applications to well-established models for viscous fluids and elastic solids. The concepts are illustrated through the solution of tractable initial-boundary-value problems. This course presents foundation-level coverage of theory underlying a number of sub-fields, including Fluid Mechanics, Solid Mechanics and Heat Transfer.

### Objectives & Outcomes

**Course Objectives:** Students will gain a deep understanding of the concepts and methods underlying modern continuum mechanics. The course is designed to equip students with the background needed to pursue advanced work in allied fields.

**Student Learning Outcomes:** ABET Outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering,

(e) an ability to identify, formulate, and solve engineering problems,

(g) an ability to communicate effectively,

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context,

(i) a recognition of the need for, and an ability to engage in life-long learning,

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

**Prerequisites:** PHYSICS 7A, MATH 53, and MATH 54; some prior exposure to the elementary mechanics of solids and fluids

**Credit Restrictions:** Students will not receive credit if they have taken ME 287.

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructors:** Casey, Johnson, Papadopoulos, Steigmann

## MEC ENG 190L Practical Control System Design: A Systematic Loopshaping Approach 1 Unit

Terms offered: Spring 2018, Fall 2015, Spring 2014

After a review of basic loopshaping, we introduce the loopshaping design methodology of McFarlane and Glover, and learn how to use it effectively. The remainder of the course studies the mathematics underlying the new method (one of the most prevalent advanced techniques used in industry) justifying its validity.

### Rules & Requirements

**Prerequisites:** MEC ENG 132, MEC ENG C134/EL ENG C128, or similar introductory experience regarding feedback control systems

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Packard

## MEC ENG 190M Model Predictive Control 1 Unit

Terms offered: Spring 2015, Fall 2009

Basics on optimization and polyhedra manipulation. Analysis and design of constrained predictive controllers for linear and nonlinear systems.

### Rules & Requirements

**Prerequisites:** MEC ENG 132

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Borrelli

## MEC ENG 190Y Practical Control System Design: A Systematic Optimization Approach 1 Unit

Terms offered: Spring 2013, Spring 2010, Spring 2009

The Youla-parametrization of all stabilizing controllers allows certain time-domain and frequency-domain closed-loop design objectives to be cast as convex optimizations, and solved reliably using off-the-shelf numerical optimization codes. This course covers the Youla parametrization, basic elements of convex optimization, and finally control design using these techniques.

### Rules & Requirements

**Prerequisites:** MEC ENG 132, MEC ENG C134/EL ENG C128, or similar introductory experience regarding feedback control systems

### Hours & Format

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Packard

## MEC ENG 191K Professional Communication 3 Units

Terms offered: Summer 2023 First 6 Week Session, Summer 2023 Second 6 Week Session, Spring 2022

This course is designed to enhance students' written and oral communication skills. Written work consists of informal documents--correspondence, internal reports, and reviews--and formal work--proposals, conference papers, journal articles, and websites. Presentations consist of informal and formal reports, including job and media interviews, phone interviews, conference calls, video conferences, progress reports, sales pitches, and feasibility studies.

### Rules & Requirements

**Prerequisites:** Reading and Composition parts A and B

### Hours & Format

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

### Summer:

6 weeks - 8 hours of lecture per week

8 weeks - 5.5 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 193A Special Topics in Biomechanical Engineering 1 - 4 Units

Terms offered: Spring 2022, Spring 2017

This 193 series covers current topics of research interest in biomechanical engineering. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Course objectives will vary.

**Student Learning Outcomes:** Student outcomes will vary.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG 193B Special Topics in Controls 1 - 4 Units

Terms offered: Fall 2025, Spring 2023, Fall 2020

This 193 series covers current topics of research interest in controls. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary with course.

**Student Learning Outcomes:** Will vary with course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 193C Special Topics in Design 1 - 4 Units

Terms offered: Spring 2023, Fall 2018, Fall 2016

This 193 series covers current topics of research interest in design. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary with course.

**Student Learning Outcomes:** Will vary with course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG 193D Special Topics in Dynamics 1 - 4 Units

Terms offered: Prior to 2007

This 193 series covers current topics of research interest in dynamics. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary with course.

**Student Learning Outcomes:** Will vary with course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG 193E Special Topics in Energy Science and Technology 1 - 4 Units

Terms offered: Spring 2024, Spring 2023, Spring 2022

This 193 series covers current topics of research interest in energy science and technology. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary with course.

**Student Learning Outcomes:** Will vary with course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG 193F Special Topics in Fluids 1 - 4 Units

Terms offered: Prior to 2007

This 193 series covers current topics of research interest in fluids. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary with course.

**Student Learning Outcomes:** Will vary with course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG 193G Special Topics in Manufacturing 1 - 4 Units

Terms offered: Spring 2025

This 193 series covers current topics of research interest in manufacturing. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary by course.

**Student Learning Outcomes:** Will vary by course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG 193H Special Topics in Materials 1 - 4 Units

Terms offered: Spring 2020

This 193 series covers current topics of research interest in materials. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary with course.

**Student Learning Outcomes:** Will vary with course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG 193I Special Topics in Mechanics 1 - 4 Units

Terms offered: Prior to 2007

This 193 series covers current topics of research interest in mechanics. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary with course.

**Student Learning Outcomes:** Will vary with course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG 193J Special Topics in MEMS/Nano 1 - 4 Units

Terms offered: Prior to 2007

This 193 series covers current topics of research interest in MEMS/nano. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary with course.

**Student Learning Outcomes:** Will vary with course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG 193K Special Topics in Ocean Engineering 1 - 4 Units

Terms offered: Prior to 2007

This 193 series covers current topics of research interest in ocean engineering. The course content may vary semester to semester. Check with the department for current term topics.

### Objectives & Outcomes

**Course Objectives:** Will vary by course.

**Student Learning Outcomes:** Will vary by course.

### Rules & Requirements

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

### Hours & Format

#### Fall and/or spring:

6 weeks - 2.5-10 hours of lecture per week

8 weeks - 2-7.5 hours of lecture per week

10 weeks - 1.5-6 hours of lecture per week

15 weeks - 1-4 hours of lecture per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

**Instructor:** Faculty

## MEC ENG H194 Honors Undergraduate Research 2 - 4 Units

Terms offered: Summer 2025 8 Week Session, Summer 2025 First 6 Week Session, Summer 2025 Second 6 Week Session

Final report required. Students who have completed a satisfactory number of advanced courses may pursue original research under the direction of one of the members of the faculty. A maximum of three units of H194 may be used to fulfill technical elective requirements in the Mechanical Engineering program (unlike 198 or 199, which do not satisfy technical elective requirements). Students can use a maximum of three units of graded research units (H194 or 196) towards their technical elective requirement.

### Rules & Requirements

**Prerequisites:** 3.3 cumulative GPA or higher, consent of instructor and adviser, and senior standing

**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

#### Summer:

6 weeks - 1-5 hours of independent study per week

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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



## MEC ENG 196 Undergraduate Research 2 - 4 Units

Terms offered: Summer 2025 Second 6 Week Session, Summer 2024 Second 6 Week Session, Spring 2024

Students who have completed a satisfactory number of advanced courses may pursue original research under the direction of one of the members of the staff. A maximum of three units of 196 may be used to fulfill technical elective requirements in the Mechanical Engineering program (unlike 198 or 199, which do not satisfy technical elective requirements). Students can use a maximum of three units of graded research units (H194 or 196) towards their technical elective requirement. Final report required.

### Rules & Requirements

**Prerequisites:** Consent of instructor and adviser; junior or senior standing

**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

#### Summer:

6 weeks - 5-10 hours of independent study per week

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

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 197 Undergraduate Engineering Field Studies 1 - 4 Units

Terms offered: Spring 2024, Fall 2015, Summer 2015 10 Week Session  
Supervised experience relative to specific aspects of practice in engineering. Under guidance of a faculty member, the student will work in industry, primarily in an internship setting or another type of short-time status. Emphasis is to attain practical experience in the field.

### Objectives & Outcomes

**Student Learning Outcomes:** (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context  
(j) a knowledge of contemporary issues  
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### Rules & Requirements

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

### Hours & Format

**Fall and/or spring:** 15 weeks - 3-12 hours of internship per week

#### Summer:

6 weeks - 8-30 hours of internship per week

10 weeks - 5-18 hours of internship per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## MEC ENG 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units

Terms offered: Spring 2025, Fall 2024, Fall 2023

Group study of a selected topic or topics in Mechanical Engineering. Credit for 198 or 199 courses combined may not exceed 4 units in any single term. See College for other restrictions.

### Rules & Requirements

**Prerequisites:** Upper division standing and good academic standing

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

### Hours & Format

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

**Summer:** 10 weeks - 1.5-6 hours of directed group study per week

### Additional Details

**Subject/Course Level:** Mechanical Engineering/Undergraduate

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

## **MEC ENG 199 Supervised Independent Study 1 - 4 Units**

Terms offered: Fall 2025, Summer 2025 8 Week Session, Spring 2025  
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

**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:** Mechanical Engineering/Undergraduate

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