Mechanical Engineering

The Department of Mechanical Engineering offers three graduate degree programs: the Master of Engineering (MEng), the Master of Science (MS), and the Doctor of Philosophy (PhD).

Master of Engineering (MEng)

This accelerated Masters of Engineering Program has been designed in collaboration with several other departments in the College of Engineering for the purpose of developing professional leaders who understand the technical, environmental, economic, and social issues involved in Mechanical Engineering. It is supported by the College of Engineering's Coleman Fung Institute for Engineering Leadership. For more information about this interdisciplinary program, please see the Fung Institute Website (http://funginstitute.berkeley.edu).

There are full-time and part-time options for pursuing this program.

Master of Science (MS)

The MS degree can be earned in conjunction with a PhD (for the MS/PhD option) or alone, though the majority of our MS students are on the doctoral track. Degrees are granted after completion of a program of study that emphasizes the application of the natural sciences to the analysis and solution of engineering problems. Advanced courses in engineering, math, and the sciences are normally included in a program that incorporates the engineering systems approach for the analysis of problems.

Doctor of Philosophy (PhD)

This degree can be completed in conjunction with a master of science degree or alone. Degrees are granted after completion of programs of study that emphasize the application of the natural sciences to the analysis and solution of engineering problems. Advanced courses in mathematics, chemistry, physics, and the life sciences are normally included in a program that incorporates the engineering systems approach for the analysis of problems.

Admission to the University

Minimum Requirements for Admission

The following minimum requirements apply to all graduate programs and will be verified by the Graduate Division:

1. A bachelor's degree or recognized equivalent from an accredited institution;
2. A grade point average of B or better (3.0);
3. If the applicant comes from a country or political entity (e.g., Quebec) where English is not the official language, adequate proficiency in English to do graduate work, as evidenced by a TOEFL score of at least 90 on the iBT test, 570 on the paper-and-pencil test, or an IELTS Band score of at least 7 (note that individual programs may set higher levels for any of these); and
4. Sufficient undergraduate training to do graduate work in the given field.

Applicants Who Already Hold a Graduate Degree

The Graduate Council views academic degrees not as vocational training certificates, but as evidence of broad training in research methods, independent study, and articulation of learning. Therefore, applicants who already have academic graduate degrees should be able to pursue new subject matter at an advanced level without need to enroll in a related or similar graduate program.

Programs may consider students for an additional academic master’s or professional master’s degree only if the additional degree is in a distinctly different field.

Applicants admitted to a doctoral program that requires a master’s degree to be earned at Berkeley as a prerequisite (even though the applicant already has a master’s degree from another institution in the same or a closely allied field of study) will be permitted to undertake the second master’s degree, despite the overlap in field.

The Graduate Division will admit students for a second doctoral degree only if they meet the following guidelines:

1. Applicants with doctoral degrees may be admitted for an additional doctoral degree only if that degree program is in a general area of knowledge distinctly different from the field in which they earned their original degree. For example, a physics PhD could be admitted to a doctoral degree program in music or history; however, a student with a doctoral degree in mathematics would not be permitted to add a PhD in statistics.
2. Applicants who hold the PhD degree may be admitted to a professional doctorate or professional master’s degree program if there is no duplication of training involved.

Applicants may apply only to one single degree program or one concurrent degree program per admission cycle.

Required Documents for Applications

1. Transcripts: Applicants may upload unofficial transcripts with your application for the departmental initial review. If the applicant is admitted, then official transcripts of all college-level work will be required. Official transcripts must be in sealed envelopes as issued by the school(s) attended. If you have attended Berkeley, upload your unofficial transcript with your application for the departmental initial review. If you are admitted, an official transcript with evidence of degree conferral will not be required.
2. Letters of recommendation: Applicants may request online letters of recommendation through the online application system. Hard copies of recommendation letters must be sent directly to the program, not the Graduate Division.
3. Evidence of English language proficiency: All applicants from countries or political entities in which the official language is not English are required to submit official evidence of English language proficiency. This applies to applicants from Bangladesh, Burma, Nepal, India, Pakistan, Latin America, the Middle East, the People’s Republic of China, Taiwan, Japan, Korea, Southeast Asia, most European countries, and Quebec (Canada). However, applicants who, at the time of application, have already completed at least one year of full-time academic course work with grades of B or better at a US university may submit an official transcript from the US university to fulfill this requirement. The following courses will not fulfill this requirement:
   • courses in English as a Second Language,
   • courses conducted in a language other than English,
   • courses that will be completed after the application is submitted, and
   • courses of a non-academic nature.
If applicants have previously been denied admission to Berkeley on the basis of their English language proficiency, they must submit new test scores that meet the current minimum from one of the standardized tests.

Where to Apply
Visit the Berkeley Graduate Division application page (http://grad.berkeley.edu/admissions/apply).

Normative Time
Five years or 10 semesters.

Minimum Number of Units to Complete Degree
Thirty-six semester units.

Minimum Units Required in Order to Be Registered Each Semester
As a graduate student in ME, each student must enroll in 15 units each semester.

Maximum Amount of Independent Study Units (298, 299, 300 and Above)
Independent course units are not counted towards the 36 semester units needed to graduate. The maximum of these units you can enroll per semester are listed below.

- 298s: 8 units
- 299s: 12 units
- 300s: 6 units
- 600s: 8 units

Maximum Number of Courses that Can Be Transferred Towards Degree
Students can transfer up to two courses from another school towards the PhD.

GSI/ME 300-Level Course Requirement
Each student must either serve as a graduate student instructor (GSI) for at least one semester or have taken a 300-level course on teaching.

Minimum Grade Point Averages (GPAs)
All students are required to have the following minimum grade point averages:

- 3.5 in Major
- 3.0 in Minors

Required Emphases
Each student must declare one major area as well as two minors. At least one minor is required to be outside of the department. The minor fields are required to broaden the base of the studies and lend support to the major field as well as the dissertation research.

Required Number of Courses
- Five courses in your major, all of which must be letter graded.
- Three courses in your First Outside ME Minor (only 1 of these courses can be taken with the Satisfactory/Unsatisfactory option rather than letter graded).
- Two courses in your Inside ME or 2nd Outside ME Minor, all of which must be letter graded.
- Two courses to support your major or one minor.

Please note that 2/3 of the courses counted towards your degree must be letter graded.

Preliminary Examination
This written exam covers undergraduate coursework in their major field. Those students who do not have an exam in their major field must select one of the other available exams.

Qualifying Examination
The intent of the qualifying examination is to ascertain the breadth of the student’s comprehension in at least three subject areas related to the major field of study, and to determine whether the student has the ability to think incisively and critically about the theoretical and the practical aspects of these areas. The examination may consider a number of academic points of view and the criteria by which they may be evaluated.

Advancement to Candidacy
All students must complete the advancement to candidacy application directly after passing their qualifying exam.

PhD Dissertation
Filing your doctoral dissertation at the Graduate Division is one of the final steps leading to the award of your graduate degree. Your manuscript is a scholarly presentation of the results of the research you conducted. Dissertations are required of all students.

PhD Candidate Seminar
Each student must present their dissertation findings with at least one member of their dissertation committee present. The seminar must take place prior to the end of the semester in which you receive your degree.

For more detailed information, please refer to the following pages:
http://me.berkeley.edu/graduate-student-handbook/chapter-7-phd-doctorate-degree
http://grad.berkeley.edu/policy/degrees-policy/

Plan II
Normative Time
One and a half years or three semesters.

Minimum Number of Units To Complete Degree
Twenty-four semester units.

Course Restriction: Must be either in 200 series or 100 elective upper division series

Minimum Number of Mechanical Engineering Units
12 Semester Units (must be in 200 series and letter-graded with the exception of the optional 4 units of ME 299 that can be included in the 12).

Minimum Units To Be Registered Each Semester
As a graduate student in ME, each student must enroll in 15 Semester units each semester.

**Maximum Amount of Independent Study Units (298, 299, 300 And Above)**

The semester enrollment restrictions for independent study courses are as follows:

- 298s: 8 units
- 299s: 12 units
- 300s: 6 units

Please note that only 4 semester units of 299 can be counted towards the 24 unit total requirement.

**Minimum Required Number of Units in Major Field Area (E.g. Bioeng, Controls, Etc.)**

Twelve semester units from 200 or 100 upper division series.

**Maximum Number of Units Transferable Towards the Master’s Degree**

A master’s student may transfer up to 4 semester units or 6 quarter units of course work completed as a graduate student at another institution.

**Advancement To Candidacy**

If the MS is the student’s terminal degree, students should apply for advancement to candidacy in their second semester.

**Oral Presentation and Final Report**

An oral presentation and a written report are required. All committee members are required to be members of the Berkeley Division of the Academic Senate.

For more detailed information, please see the following websites:

- http://me.berkeley.edu/graduate-student-handbook/chapter-5-ms-master-science-degree
- http://grad.berkeley.edu/policy/degrees-policy/

Please note that the requirements above are for the Plan II MS Degree (which the majority of our students choose). If you are interested in the Plan I requirements, please see http://me.berkeley.edu/graduate-student-handbook/52-master-science-degree-requirements-plan-i.

**Normative Time**

Nine months or two semesters.

**Minimum Number of Units to Complete Degree**

Twenty-five semester units.

Course restriction: must be in 200 series.

**Minimum Number of Mechanical Engineering Units in Area of Concentration**

Twelve semester units (must be in 200 series and letter-graded).

**Minimum Grade Point Averages (GPAs)**

All students are required to have a minimum overall grade point average of 3.0.

**Minimum Units You Are Required to Take in Order to Be Registered Each Semester**

Full time graduate students must enroll in 12 Semester units each semester.

**Maximum Number of Units Transferable Towards Master’s of Engineering Degree**

A master of engineering student may petition to transfer up to 4 semester units or 6 quarter units of 200-level courses completed as a graduate student at another UC campus.

**Advancement To Candidacy**

Students should apply for advancement to candidacy at the beginning of their second semester.

**Written exam and Report**

An written exam and a report of the capstone project are required by the end of the spring semester as part of the completion of the Engineering 296 series.

**Concentrations**

- Advanced Energy Technology
- Experiential Advanced Control Systems Design
- Modeling & Simulation of Physical Processes & Systems
- Product Design

**Courses Required**

Approved individualized study list per student’s interest in concentration area, including the courses below:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGIN 270A</td>
<td>Organizational Behavior for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>ENGIN 270B</td>
<td>R&amp;D Technology Management &amp; Ethics</td>
<td>1</td>
</tr>
<tr>
<td>ENGIN 270C</td>
<td>Teaming &amp; Project Management</td>
<td>1</td>
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<tr>
<td>Choose ENGIN 270D or ENGIN 270E</td>
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<tr>
<td>ENGIN 270D</td>
<td>Entrepreneurship for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>ENGIN 270E</td>
<td>Technology Strategy &amp; Industry Analysis</td>
<td>1</td>
</tr>
<tr>
<td>Choose ENGIN 270F or ENGIN 270G</td>
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<tr>
<td>ENGIN 270F</td>
<td>Data Analytics</td>
<td>1</td>
</tr>
<tr>
<td>ENGIN 270G</td>
<td>Marketing &amp; Product Management</td>
<td>1</td>
</tr>
<tr>
<td>ENGIN 270H</td>
<td>Accounting &amp; Finance for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>ENGIN 296MA</td>
<td>Master of Engineering Capstone Project</td>
<td>3</td>
</tr>
<tr>
<td>ENGIN 296MB</td>
<td>Master of Engineering Capstone Project</td>
<td>2</td>
</tr>
</tbody>
</table>
| ENGIN 295   | Communications for Engineering Leaders (1 unit in fall and 1 unit in spring) | 1

For more detailed information, please refer to the following page:
http://me.berkeley.edu/graduate-student-handbook/62-master-engineering-degree-requirements.
Mechanical Engineering

MEC ENG C200 Design, Evaluate, and Scale Development Technologies 3 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016, Fall 2015
This required course for the Designated Emphasis in Development Engineering will include projects and case studies, many related to projects at UC Berkeley, such as those associated with the Development Impact Labs (DIL). Student teams will work with preliminary data to define the problem. They will then collect and analyze interview and survey data from potential users and begin to design a solution. Students will explore how to use novel monitoring technologies and “big data” for product improvement and evaluation. The student teams will use the case studies (with improvements based on user feedback and data analysis) to develop a plan for scaling and evaluation with a rigorous controlled trial.

Objectives Outcomes

Course Objectives: Students will use multiple qualitative and quantitative methods to learn about user needs, to come up with new concepts and solutions, and to understand how new products and services achieve or fail to achieve their goals in a development setting.

Student Learning Outcomes: Students will be able to apply the skills to current challenges in development engineering
Students will develop a set of skills that will allow them to flourish in a climate of complex problem solving and design challenges in development engineering
Students will learn how to learn from users using qualitative and quantitative tools including surveys, interviews, new monitoring technologies, statistical analyses and experimental designs
Students will learn to participate in and lead innovation and creativity in collaborative settings

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Agogino, Levine
Also listed as: DEV ENG C200

Design, Evaluate, and Scale Development Technologies: Read Less [-]

MEC ENG C201 Modeling and Simulation of Advanced Manufacturing Processes 3 Units
This course provides the student with a modern introduction to the basic industrial practices, modeling techniques, theoretical background, and computational methods to treat classical and cutting edge manufacturing processes in a coherent and self-consistent manner.

Objectives Outcomes

Course Objectives: An introduction to modeling and simulation of modern manufacturing processes.

Rules & Requirements

Prerequisites: An undergraduate course in strength of materials or 122

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/Graduate
Grading: Letter grade.
Instructor: Zohdi
Also listed as: MAT SCI C286

Modeling and Simulation of Advanced Manufacturing Processes: Read Less [-]
MEC ENG C202 Computational Design of Multifunctional/Multiphysical Composite Materials 3 Units
Terms offered: Spring 2012
The course is self-contained and is designed in an interdisciplinary manner for graduate students in engineering, materials science, physics, and applied mathematics who are interested in methods to accelerate the laboratory analysis and design of new materials. Examples draw primarily from various mechanical, thermal, diffusive, and electromagnetic applications.

Rules & Requirements

Prerequisites: An undergraduate degree in the applied sciences or engineering

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/Graduate

Grading: Letter grade.

Instructor: Zohdi

Also listed as: MAT SCI C287

Computational Design of Multifunctional/Multiphysical Composite Materials: Read Less [-]

MEC ENG 203 Nanoscale Processing of Materials 3 Units
Terms offered: Not yet offered
This course surveys sub-micrometer pattern-transfer techniques and methods for handling materials with one or more sub-micrometer dimensions. The optical and mechanical principles underlying a spectrum of candidate lithography techniques are introduced, and extensive examples of industrial applications are discussed. Class material also covers techniques for assembling structures from zero-, one- and two-dimensional materials including nanoparticles, nanotubes, nanowires, and single- and few-atomic-layer sheets of van der Waals solids such as graphene and molybdenite.

Objectives Outcomes

Course Objectives: The objectives of the course are to:
• Make students aware of current capabilities and innovations in sub-micrometer lithography and in the handling of nanoscale materials;
• Equip students to select an appropriate lithography or processing technique for a given application from among multiple alternatives;
• Provide students with an understanding of the transformations of material that occur in sub-micrometer lithography techniques, such that they can understand why certain processing routes might be preferable to others for particular applications.

Student Learning Outcomes:
• Articulate the key requirements (i.e. resolution, maximum defect density, and multi-layer alignment precision) of micro- and nano-patterning processes to be used in a range of applications, such as semiconductors, hard disk-drives, large-area photovoltaics, and biomedical microdevices.
• Identify which of a set of available micro-/nano-patterning processes (e.g. extreme-UV lithography, directed self-assembly, multiple e-beam lithography, and imprint lithography) are suitable for a given patterning application.
• Accurately explain and distinguish between the physical transformations of material that occur in a number of sub-micrometer patterning processes, including imprint lithography, micro-contact printing, micro-embossing, and micro-gravure.
• Identify a number of currently open research questions relating to nanoscale processing of materials and suggest possible creative solutions to them.
• Use numerical simulation techniques to model the behavior of one or more lithographic techniques, including nanoimprint, photolithography, or electron-beam lithography. Use insights from modeling to optimize key process parameters and to make trade-offs in the geometrical design of a pattern that is to be fabricated.

Rules & Requirements

Prerequisites: An understanding of solid mechanics and statics, or permission of instructor. Experience programming in Matlab is desirable for simulation assignments

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructor: Taylor

Nanoscale Processing of Materials: Read Less [-]
MEC ENG 204 Advanced Manufacturing Systems Analysis, AMS 3 Units
Terms offered: Spring 2017, Spring 2016, Spring 2015
This course is designed to prepare students for technical leadership in industry. The objective is to provide insight and understanding on the main concepts and practices involved in analyzing, managing systems to deliver high quality, cost effectiveness and sustainable advantages.

The impact of this class on the Mechanical Engineering program includes delivering core production concepts and advanced skills that blend vision and advanced manufacturing elements. This course is highly recommended for students on the Product Design track in Mechanical Engineering’s Master of Engineering program.

Advanced Manufacturing Systems Analysis, AMS: Read More [+]

Objectives Outcomes
Course Objectives: The objective of this course is to ensure that our students:

a. Gain solid foundations on the analysis of Advanced Manufacturing Systems Analysis (AMS), including flow analysis concepts, frameworks and methodologies.
b. Understand and apply sustainable engineering practices.
c. Put into practice decision-making activities based on solid academic rigor, quantitative tools and simulation models oriented for AMS
d. Align their AMS to a company’s strategy to deliver business advantage.

Rules & Requirements
Prerequisites: This course is open to graduate students, with priority given to students in Mechanical Engineering’s Master of Engineering program

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

MEC ENG C205 Critical Making 4 Units
Critical Making will operationalize and critique the practice of “making” through both foundational literature and hands on studio culture. As hybrid practitioners, students will develop fluency in readily collaging and incorporating a variety of physical materials and protocols into their practice. Students will envision and create future computational experiences that critically explore social and culturally relevant technological themes. No previous technical knowledge is required to take this course. Class projects involve basic programming, electronic circuitry, and digital fabrication design. Tutorials and instruction will be provided, but students will be expected to develop basic skills in these areas to complete course projects.

Critical Making: Read More [+]

Objectives Outcomes
Course Objectives: The objective of this course is to ensure that our students:

a. Gain solid foundations on the analysis of Advanced Manufacturing Systems Analysis (AMS), including flow analysis concepts, frameworks and methodologies.
b. Understand and apply sustainable engineering practices.
c. Put into practice decision-making activities based on solid academic rigor, quantitative tools and simulation models oriented for AMS
d. Align their AMS to a company’s strategy to deliver business advantage.

Rules & Requirements
Prerequisites: This course is open to graduate students, with priority given to students in Mechanical Engineering’s Master of Engineering program

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 2 hours of studio per week
Summer:
6 weeks - 4 hours of lecture and 8 hours of studio per week
8 weeks - 4 hours of lecture and 4 hours of studio per week
10 weeks - 3 hours of lecture and 3 hours of studio per week

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Formerly known as: New Media 203
Also listed as: NWMEDIA C203

Critical Making: Read Less [-]
### MEC ENG 206 Engineering Design and Prototyping: Pedagogy & Assessment 3 Units

**Terms offered:** Prior to 2007

This course explores contemporary research in engineering design and prototyping, as well as related cognitive issues in engineering curricular development, pedagogy, and assessment. One recurring theme throughout the course will be the duality between learning and design: design-based research, design as a pedagogy for integrative learning and the role of cognition and the learning sciences in the practice of engineering design. It has been motivated by several reforms: (1) National efforts to better train and educate engineers for the engineering workplace in the 21st Century: to better prepare engineers to face multidisciplinary problems and product design in competitive industries and improve their skills in teamwork and communication.

**Engineering Design and Prototyping: Pedagogy & Assessment: Read More [+]**

#### Objectives Outcomes

**Course Objectives:** This course has been developed to bridge student’s previous knowledge of disciplinary research in design and prototyping with engineering education research.

- Provide learners the opportunity to question (usually tacit) assumptions about what engineering is, what the purpose and process of engineering education is, and who gets to be an engineer.
- Understand design as a pedagogy for integrative learning and the role of cognition and the learning sciences in the practice of engineering design and prototyping.
- Provide the participants with an understanding of theories and practices in content, assessment, and pedagogy for teaching engineering design and prototyping.
- Familiarize learners with quantitative and qualitative methodologies for data analysis associated with the assessment of design and prototyping interventions.
- Promote critical thinking and a social construction of knowledge by having face-to-face and online discussions of readings from a variety of sources.

**Student Learning Outcomes:** Students will be able to:

- Identify their own role in shaping engineering and engineering education, and explore paths of connecting their research in Mechanical Engineering (or a related field) educational interests in design and prototyping;
- Think critically, reflectively and holistically about engineering and education;
- Become aware of the theoretical and practical issues of learning, instruction, and assessment as these concern the design of educational environments and technologies;
- Apply design research methods to inform and validate designs involving educational issues.
- Articulate their own view of the design of educational tools and become more confident about their ability to work as an engineer and educational designer.

**Hours & Format**

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

**Additional Details**

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

**Grading:** Letter grade.

**Instructor:** Agogino

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### MEC ENG C210 Advanced Orthopedic Biomechanics 4 Units

**Terms offered:** Fall 2017, Fall 2016, Fall 2015

Students will learn the application of engineering concepts including statics, dynamics, optimization theory, composite beam theory, beam-on-elastic foundation theory, Hertz contact theory, and materials behavior. Topics will include 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. Students will be challenged in a MATLAB-based project to integrate the course material in an attempt to gain insight into contemporary design/analysis/problems.

**Advanced Orthopedic Biomechanics: Read More [+]**

#### Objectives Outcomes

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

- to learn the fundamental concepts of orthopaedic biomechanics;
- to enhance skills in mechanical engineering and bioengineering by analyzing the mechanical behavior of various complex biomedical problems.

**Student Learning Outcomes:** Working knowledge of various engineering concepts such as composite beam theory, beam-on-elastic-founder theory, Hertz contact theory and MATLAB-based optimization design analysis. 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.

**Rules & Requirements**

**Prerequisites:** ME C85/CE C30 or Bio Eng 102; concurrent enrollment

**Credit Restrictions:** Students will not receive credit for this course if they have taken ME C176/Bio E C119.

**Hours & Format**

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

**Additional Details**

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

**Grading:** Letter grade.

**Instructors:** O'Connell, Keaveny

**Also listed as:** BIO ENG C209

**Advanced Orthopedic Biomechanics: Read Less [-]**
MEC ENG 211 The Cell as a Machine 3 Units
Terms offered: Fall 2015, Fall 2013
This course offers a modular and systems mechanobiology (or "machine") perspective of the cell. Two vitally important components of the cell machinery will be studied in depth: (1) the integrin-mediated focal adhesions system that enables the cell to adhere to, and communicate mechano-chemical signals with, the extracellular environment, and (2) the nuclear pore complex, a multi-protein gateway for traffic in and out of the nucleus that regulates gene expression and affects protein synthesis.

Rules & Requirements
Prerequisites: Mathematics 54; Physics 7A; graduate standing
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/Graduate
Grading: Letter grade.
Instructor: Mofrad

The Cell as a Machine: Read Less [-]

MEC ENG C212 Heat and Mass Transport in Biomedical Engineering 3 Units
Terms offered: Spring 2008, Fall 2007, Spring 2006, Spring 2005
Fundamental processes of heat and mass transport in biological systems; organic molecules, cells, biological organs, whole animals. Derivation of mathematical models and discussion of experimental procedures. Applications to biomedical engineering.

Rules & Requirements
Prerequisites: 106 and 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/Graduate
Grading: Letter grade.
Instructor: Berger, Liepmann

Also listed as: BIO ENG C212
Heat and Mass Transport in Biomedical Engineering: Read Less [-]

MEC ENG C213 Fluid Mechanics of Biological Systems 3 Units
Terms offered: Spring 2016, Spring 2014, Spring 2011
Fluid mechanical aspects of various physiological systems, the circulatory, respiratory, and renal systems. Motion in large and small blood vessels. Pulsatile and peristaltic flows. Other biofluidmechanical flows: the ear, eye, etc. Instrumentation for fluid measurements in biological systems and for medical diagnosis and applications. Artificial devices for replacement of organs and/or functions, e.g. blood oxygenators, kidney dialysis machines, artificial hearts/circulatory assist devices.

Rules & Requirements
Prerequisites: 106 or equivalent; 265A or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Berger, Liepmann

Also listed as: BIO ENG C213
Fluid Mechanics of Biological Systems: Read Less [-]

MEC ENG C214 Advanced Tissue Mechanics 3 Units
Terms offered: Spring 2018, Spring 2017, Spring 2015
The goal of this course is to provide a foundation for characterizing and understanding the mechanical behavior of load-bearing tissues. A variety of mechanics topics will be introduced, including anisotropic elasticity and failure, cellular solid theory, biphasic theory, and quasi-linear viscoelasticity (QLV) theory. Building from this theoretical basis, we will explore the constitutive behavior of a wide variety of biological tissues. After taking this course, students should have sufficient background to independently study the mechanical behavior of most biological tissues. Formal discussion section will include a seminar series with external speakers.

Rules & Requirements
Prerequisites: 102A, 176, 185; graduate standing 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/Graduate
Grading: Letter grade.

Also listed as: BIO ENG C214
Advanced Tissue Mechanics: Read Less [-]
MEC ENG C215 Advanced Structural Aspects of Biomaterials 4 Units
Terms offered: Spring 2018, Spring 2016, Fall 2013
This course covers the structure and mechanical functions of load bearing tissues and their replacements. Biocompatibility of biomaterials and host response to structural implants are examined. Quantitative treatment of biomechanical issues and constitutive relationships of materials are covered in order to design implants for structural function. Material selection for load bearing applications including reconstructive surgery, orthopedics, dentistry, and cardiology are addressed.

Advanced Structural Aspects of Biomaterials: Read More [+]

Rules & Requirements
Credit Restrictions: Students should not receive credit if they've taken ME ME C117 or Bio Eng C117.

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/Graduate
Grading: Letter grade.
Also listed as: BIO ENG C222
Advanced Structural Aspects of Biomaterials: Read Less [-]

MEC ENG C216 Molecular Biomechanics and Mechanobiology of the Cell 4 Units
Terms offered: Spring 2016, Spring 2015, Spring 2014
This course develops and applies scaling laws and the methods of continuum and statistical mechanics to understand micro- and nano-scale mechanobiological phenomena involved in the living cell with particular attention the nucleus and the cytoskeleton as well as the interactions of the cell with the extracellular matrix and how these interactions may cause changes in cell architecture and biology, consequently leading to functional adaptation or pathological conditions.

Molecular Biomechanics and Mechanobiology of the Cell: Read More [+]

Objectives Outcomes
Course Objectives: This course, which is open to 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: Math 54; Physics 7A; BioE 102 or ME C85 or instructor's consent

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/Graduate
Grading: Letter grade.
Instructor: Mofrad
Also listed as: BIO ENG C215
Molecular Biomechanics and Mechanobiology of the Cell: Read Less [-]
MEC ENG C217 Biomimetic Engineering -- Engineering from Biology 3 Units
Terms offered: Fall 2018, Fall 2017, Spring 2014, Fall 2010
Study of nature's solutions to specific problems with the aim of determining appropriate engineering analogs. Morphology, scaling, and design in organisms applied to engineering structures. Mechanical principles in nature and their application to engineering devices. Mechanical behavior of biological materials as governed by underlying microstructure, with the potential for synthesis into engineered materials. Trade-offs between redundancy and efficiency. Students will work in teams on projects where they will take examples of designs, concepts, and models from biology and determine their potential in specific engineering applications.

Rules & Requirements
Prerequisites: Graduate standing in engineering or consent of instructor

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Dharan

Also listed as: BIO ENG C217/INTEGBI C217

MEC ENG C218 Introduction to MEMS Design 4 Units
Physics, fabrication, and design of micro-electromechanical systems (MEMS). Micro and nanofabrication processes, including silicon surface and bulk micromachining and non-silicon micromachining. Integration strategies and assembly processes. Microsensor and microactuator devices: electrostatic, piezoresistive, piezoelectric, thermal, magnetic transduction. Electronic position-sensing circuits and electrical and mechanical noise. CAD for MEMS. Design project is required.

Rules & Requirements
Prerequisites: Graduate standing in engineering or science; undergraduates with 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/Graduate
Grading: Letter grade.
Instructors: Nguyen, Pister

Also listed as: EL ENG C247B

MEC ENG C219 Parametric and Optimal Design of MEMS 3 Units
Terms offered: Spring 2013, Spring 2012, Spring 2011
Parametric design and optimal design of MEMS. Emphasis on design, not fabrication. Analytic solution of MEMS design problems to determine the dimensions of MEMS structures for specified function. Trade-off of various performance requirements despite conflicting design requirements. Structures include flexure systems, accelerometers, and rate sensors.

Rules & Requirements
Prerequisites: Graduate standing or consent of instructor

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Lin, Pisano
Formerly known as: 219

Also listed as: EL ENG C246
MEC ENG 220 Precision Manufacturing 3 Units
Terms offered: Fall 2015, Fall 2013, Fall 2012
Introduction to precision engineering for manufacturing. Emphasis on
design and performance of precision machinery for manufacturing. Topics
include machine tool elements and structure, sources of error (thermal,
static, dynamic, process related), precision machining processes
and process models (diamond turning and abrasive (fixed and free)
processes), sensors for process monitoring and control, metrology,
actuators, machine design case studies and examples of precision
component manufacture.

Rules & Requirements
Prerequisites: 101, 102B, or consent of instructor

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Dornfeld

MEC ENG 221 Graduate Introduction to Lean Manufacturing Systems 3 Units
Terms offered: Spring 2018, Fall 2006, Fall 2004
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: Graduate standing in Engineering, or consent of instructor
Credit Restrictions: Students will not receive credit for this course after
taking ME 101.

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/Graduate
Grading: Letter grade.
Instructor: McMains
MEC ENG C223 Polymer Engineering 3 Units
Terms offered: Fall 2017, Fall 2015, Fall 2014
A survey of the structure and mechanical properties of advanced engineering polymers. Topics include rubber elasticity, viscoelasticity, mechanical properties, yielding, deformation, and fracture mechanisms of various classes of polymers. The course will discuss degradation schemes of polymers and long-term performance issues. The class will include polymer applications in bioengineering and medicine.

Rules & Requirements
Prerequisites: Civil Engineering 130, Engineering 45

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/Graduate
Grading: Letter grade.
Also listed as: BIO ENG C223

Polymer Engineering: Read More [+]
Polymer Engineering: Read Less [-]

MEC ENG 224 Mechanical Behavior of Engineering Materials 3 Units
Terms offered: Fall 2018, Fall 2016, Fall 2015
This course covers elastic and plastic deformation under static and dynamic loads. Prediction and prevention of failure by yielding, fracture, fatigue, creep, corrosion, and wear. Basic elasticity and plasticity theories are discussed.

Rules & Requirements
Prerequisites: Civil and Environmental Engineering 130 or 130N; Engineering 45

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.

Mechanical Behavior of Engineering Materials: Read Less [-]

MEC ENG C225 Deformation and Fracture of Engineering Materials 4 Units
Terms offered: Spring 2018, Spring 2016, Spring 2015
This course covers deformation and fracture behavior of engineering materials for both monotonic and cyclic loading conditions.

Rules & Requirements
Prerequisites: Civil Engineering 130, Engineering 45

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Ritchie, Pruitt, Komvopoulos
Also listed as: MAT SCI C212

Deformation and Fracture of Engineering Materials: Read Less [-]

MEC ENG 226 Tribology 3 Units
Terms offered: Fall 2016, Spring 2016, Spring 2013

Rules & Requirements
Prerequisites: 102B, 104, 108

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Komvopoulos

Tribology: Read Less [-]
MEC ENG 227 Mechanical Behavior of Composite Materials 3 Units
Terms offered: Spring 2013, Fall 2010, Fall 2008
Rules & Requirements
Prerequisites: Graduate standing or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Dharan
Mechanical Behavior of Composite Materials: Read Less [-]

MEC ENG 229 Design of Basic Electro-Mechanical Devices 3 Units
Terms offered: Spring 2018, Spring 2017, Spring 2015
Fundamental principles of magnetics, electro-magnetics, and magnetic materials as applied to design and operation of electro-mechanical devices. Type of device to be used in a particular application and dimensions of parts for the overall design will be discussed. Typical applications covered will be linear and rotary actuators, stepper motors, AC motors, and DC brush and brushless motors. A design project is required.
Design of Basic Electro-Mechanical Devices: Read More [+]
Rules & Requirements
Prerequisites: EECS 100, graduate standing or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Borrelli
Design of Basic Electro-Mechanical Devices: Read Less [-]

MEC ENG 230A Predictive Control 2 Units
Terms offered: Fall 2018
Advanced optimization, polyhedra manipulation, and multiparametric programming. Robust Invariant set theory. Analysis and design of model predictive controllers (MPC) for linear and nonlinear systems. Stochastic MPC. Learning MPC. Computational oriented models of hybrid systems. Analysis and design of constrained predictive controllers for hybrid systems.
Predictive Control: Read More [+]
Objectives Outcomes
Course Objectives: The course is designed for graduate students who want to expand their knowledge on model predictive control. 80% will be focusing on advanced theory. 20% on applications.
Student Learning Outcomes: At the end of the course, the students will write a theoretical paper on MPC and/or will design an application where the advanced theory is implemented.
Rules & Requirements
Prerequisites: ME C232 and ME C231A
Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Borrelli
Predictive Control: Read Less [-]
MEC ENG 230B Advanced System Theory: Control-Oriented Robustness Analysis 2
Units
Terms offered: Not yet offered
Theoretical development of the common methods in control system robustness analysis, including general dissipative systems and supply rates, structured singular value, and integral quadratic constraints. Transforming theory into pragmatic algorithms. Use cases in industrial examples.
Advanced System Theory: Control-Oriented Robustness Analysis: Read More [+]

Objectives Outcomes
Course Objectives: The course is designed for graduate students who want to quickly expand their knowledge on robustness analysis comprising one part of a complete validation process for complex feedback systems. Students will learn about theory, algorithms, applications and existing software.

Student Learning Outcomes: Students will gain a deep understanding of the modeling assumptions and precise results offered by current state-of-the-art robustness analysis techniques. The wide applicability as well as the limitations of the techniques will be emphasized. The course concludes with a self-directed project, covering a theoretical, algorithmic or applications-oriented issue of interest to each individual student.

Rules & Requirements
Prerequisites: Basic graduate background in linear algebra and linear differential equations (ME C232 or EECS 221A or equivalent)

Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.

Instructor: Packard

Advanced System Theory: Control-Oriented Robustness Analysis: Read Less [-]

MEC ENG C231A Experiential Advanced Control Design I 3 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
Experience-based learning in the design of SISO and MIMO feedback controllers for linear systems. The student will master skills needed to apply linear control design and analysis tools to classical and modern control problems. In particular, the participant will be exposed to and develop expertise in two key control design technologies: frequency-domain control synthesis and time-domain optimization-based approach.
Experiential Advanced Control Design I: Read More [+]

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/Graduate
Grading: Letter grade.

Also listed as: EL ENG C220B

Experiential Advanced Control Design I: Read Less [-]

MEC ENG C231B Experiential Advanced Control Design II 3 Units
Terms offered: Spring 2018, Spring 2017
Experience-based learning in the design, analysis, and verification of automatic control systems. The course emphasizes the use of computer-aided design techniques through case studies and design tasks. The student will master skills needed to apply advanced model-based control analysis, design, and estimation to a variety of industrial applications. The role of these specific design methodologies within the larger endeavor of control design is also addressed.
Experiential Advanced Control Design II: Read More [+]

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/Graduate
Grading: Letter grade.

Also listed as: EL ENG C220C

Experiential Advanced Control Design II: Read Less [-]
MEC ENG C232 Advanced Control Systems I
3 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
Input-output and state space representation of linear continuous and
discrete time dynamic systems. Controllability, observability, and stability.
Modeling and identification. Design and analysis of single and multi-
variable feedback control systems in transform and time domain. State
observer. Feedforward/preview control. Application to engineering
systems.
Advanced Control Systems I: Read More [+]
Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.

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/Graduate
Grading: Letter grade.
Instructors: Borrelli, Horowitz, Tomizuka, Tomlin

Also listed as: EL ENG C220A
Advanced Control Systems I: Read Less [-]

MEC ENG 233 Advanced Control Systems II
3 Units
Linear Quadratic Optimal Control, Stochastic State Estimation, Linear
Quadratic Gaussian Problem, Loop Transfer Recovery, Adaptive Control
and Model Reference Adaptive Systems, Self Tuning Regulators,
Repetitive Control, Application to engineering systems.
Advanced Control Systems II: Read More [+]
Rules & Requirements
Prerequisites: 232

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Packard, Poolla

Multivariable Control System Design: Read Less [-]

MEC ENG 234 Multivariable Control System
Design 3 Units
Terms offered: Fall 2016, Spring 2015, Spring 2011
Analysis and synthesis techniques for multi-input (MIMO) control
systems. Emphasis is on the effect that model uncertainty has on the
design process.
Multivariable Control System Design: Read More [+]
Rules & Requirements
Prerequisites: 232 or EECS 221A, as well as firm foundation in classical
control

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Tomizuka, Horowitz

Multivariable Control System Design: Read Less [-]

MEC ENG 235 Design of Microprocessor-
Based Mechanical Systems 4 Units
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.
Design of Microprocessor-Based Mechanical Systems: Read More [+]
Rules & Requirements
Prerequisites: 132, or C134/Electrical Engineering and Computer
Science C128, or any basic undergraduate course in controls
Repeat rules: Course may be repeated for credit without restriction.

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/Graduate
Grading: Letter grade.
Design of Microprocessor-Based Mechanical Systems: Read Less [-]
MEC ENG C236 Control and Optimization of Distributed Parameters Systems 3 Units
Terms offered: Fall 2018, Fall 2017, Spring 2016, Spring 2015
Control and Optimization of Distributed Parameters Systems: Read More [+]
Rules & Requirements
Prerequisites: Engineering 77, Mathematics 54 (or equivalent), or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Also listed as: CIV ENG C291F/EL ENG C291
Control and Optimization of Distributed Parameters Systems: Read Less [-]

MEC ENG 237 Control of Nonlinear Dynamic Systems 3 Units
Terms offered: Spring 2016, Spring 2015, Fall 2013
Control of Nonlinear Dynamic Systems: Read More [+]
Objectives Outcomes
Course Objectives: To develop non-simulative/analytical tools to predict the stability and performance of nonlinear systems and to develop an appreciation for the differences between linear and nonlinear systems such as multiple equilibrium points, initial condition dependent stability. To develop controller synthesis methods for nonlinear and uncertain dynamic systems.
Student Learning Outcomes: The ability to design, evaluate and implement closed loop controllers for highly nonlinear and uncertain systems.
Rules & Requirements
Prerequisites: ME C232
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/Graduate
Grading: Letter grade.
Control of Nonlinear Dynamic Systems: Read Less [-]
**MEC ENG C237 Nonlinear Systems 3 Units**
Terms offered: Spring 2018

**Rules & Requirements**
Prerequisites: Math 54, or equivalent (undergraduate level Ordinary Differential Equations and Linear Algebra)

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

**Additional Details**
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Arcak, Tomlin, Kameshwar
Also listed as: EL ENG C222

**MEC ENG 238 Advanced Micro/Nano Mechanical Systems Laboratory 3 Units**
Terms offered: Spring 2018, 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: EE 16A or 40, Physics 7B, ME 106, (ME119 or ME118 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/Graduate
Grading: Letter grade.
Instructor: Kazerooni

**MEC ENG 239 Advanced Design and Automation 4 Units**
Terms offered: Fall 2018, Fall 2014, Spring 2013
This course will provide students with a solid understanding of smart products and the use of embedded microcomputers in products and machines. The course has two components: 1.) Formal lectures. Students receive a set of formal lectures on the design of smart machines and products that use embedded microcomputers. The materials cover machine components, actuators, sensors, basic electronic devices, embedded microprocessor systems and control, power transfer components, and mechanism design. 2.) Projects. Students will design and construct prototype products that use embedded microcomputers.

**Rules & Requirements**
Prerequisites: Graduate standing in engineering or science and one course in Control

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

**Additional Details**
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Kazerooni

**MEC ENG 240A Advanced Marine Structures I 3 Units**
Terms offered: Fall 2013, Spring 2013, Spring 2012
This course introduces a probabilistic description of ocean waves and wave loads acting on marine structures. These topics are followed with discussion of structural strength and reliability analysis.

**Rules & Requirements**
Prerequisites: Graduate standing; Statistics 25 or equivalent

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

**Additional Details**
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Mansour

Advanced Micro/Nano Mechanical Systems Laboratory: Read Less [-]
MEC ENG 240B Advanced Marine Structures II 3 Units
Terms offered: Spring 2015, Fall 2014, Spring 2014
This course is concerned with the structural response of marine structures to environmental loads. Overall response of the structure as well as the behavior of its members under lateral and compressive loads are discussed.
Advanced Marine Structures II: Read More [+]
Rules & Requirements
Prerequisites: Consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Mansour
Advanced Marine Structures II: Read Less [-]

MEC ENG 241A Marine Hydrodynamics I 3 Units
Terms offered: Fall 2016, Fall 2015, Spring 2014
Marine Hydrodynamics I: Read More [+]
Objectives Outcomes
Course Objectives: To provide students with a sufficient introduction to each of the topics of the course so that he/she will be able to understand the background of current literature in the hydrodynamics of marine vehicles, offshore engineering, and other ocean-related activities.
Student Learning Outcomes: Students with ocean- and marine-related interest will develop the necessary theoretical and experimental background to keep up with existing literature and begin research on contemporary topics.
Rules & Requirements
Prerequisites: Mechanical Engineering 165 recommended or graduate standing
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/Graduate
Grading: Letter grade.
Instructor: Yeung
Marine Hydrodynamics I: Read Less [-]
MEC ENG 241B Marine Hydrodynamics II 3 Units
Terms offered: Spring 2017, Spring 2016, Fall 2014
Momentum analysis for bodies moving in a fluid. Added-mass theory.
Matched asymptotic slender-body theory. Small bodies in a current.
Theory of motion of floating bodies with and without forward speed.
Radiation and diffraction potentials. Wave forces. Hydro-elasticity
formulation. Ocean-wave energy. Memory effects in time domain.
Second-order formulation. Impact hydrodynamics, Hydrofoil theory and
lifting surface.
Marine Hydrodynamics II: Read More [+]

Objectives Outcomes
Course Objectives: To provide students with a sufficient introduction to
each of the topics of the course so that he/she will be able to understand
the background of current literature in the hydrodynamics of marine
vehicles, offshore engineering, and renewable ocean energy
Student Learning Outcomes: Students with ocean- and marine-
related interest will develop the necessary theoretical and experimental
background to keep up with existing literature and begin research on
contemporary topics.

Rules & Requirements
Prerequisites: 260A or 241A, or CEE 200A recommended

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/Graduate
Grading: Letter grade.
Instructor: Yeung

Marine Hydrodynamics II: Read Less [-]

MEC ENG 243 Advanced Methods in Free-Surface Flows 3 Units
Terms offered: Spring 2016, Fall 2012, Spring 2009
Analytical and numerical methods in free-surface problems. Elements
of inviscid external lifting and nonlifting flows. Analytical solutions in
special coordinate systems. Integral-equation methods: formulations
and implementations. Multiple-bodies interaction problems. Free-surface
Green functions in two and three dimensions. Hybrid integral-equation
methods. Finite-element formulations. Variational forms in time-harmonic
flows. Finite-difference forms, stability, and accuracy. Boundary-fitted
coordinates methods. Unsteady linearized wave-body interaction in
time domain. Nonlinear breaking waves calculations. Particle dynamics.
Extensive hands-on experience of microcomputers and/or workstations in
developing solution.
Advanced Methods in Free-Surface Flows: Read More [+]

Objectives Outcomes
Course Objectives: To present a relatively broad spectrum of analytical
and numerical methods commonly used in tackling wave-body interaction
problems. Topics covered include classical techniques in special
coordinate systems, modern computational techniques based on
boundary-integral, finite-element, and boundary-fitted coordinates
methods. Lectures focus on formulations and implementation techniques.
Students are given opportunities to implement methods discussed in
class on workstations or mainframe.
Student Learning Outcomes: Students will be conversant and have
abilities to handle fluid-structure interactions problems with free-surface
present.

Rules & Requirements
Prerequisites: ME 260A or CEE 200A; ME 241B recommended or with
Instructor’s permission

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/Graduate
Grading: Letter grade.
Instructor: Yeung

Advanced Methods in Free-Surface Flows: Read Less [-]
MEC ENG 245 Oceanic and Atmospheric Waves 3 Units
Terms offered: Spring 2018, Spring 2016, Spring 2015
Covers dynamics of wave propagation in the ocean and the atmosphere. Specifically, formulation and properties of waves over the surface of a homogenous fluid, interfacial waves in a two-/multi-layer density stratified fluid, and internal waves in a continuous stratification will be discussed.

Prerequisites: Mechanical Engineering 241A or 241B or 260A or Civil and Environmental Engineering 200A or equivalent courses

Rules & Requirements

Prerequisites: Mechanical Engineering 241A or 241B or 260A or Civil and Environmental Engineering 200A or equivalent courses

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/Graduate

Grading: Letter grade.

MEC ENG 246 Advanced Energy Conversion Principles 3 Units
Terms offered: Fall 2018, Spring 2018, Fall 2016
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. 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.

Objectives Outcomes

Course Objectives: This class provides students with an understanding of the thermophysical principles that govern energy conversion processes of different types, and will introduce them to modern computational methods for modeling the performance of energy conversion processes, devices and systems. This course is a capstone experience for ME students, synthesizing thermodynamics, fluid dynamics, heat transfer and computational analysis tools to facilitate engineering design analysis.

Student Learning Outcomes: This course will provide a foundation for design analysis of energy conversion systems encountered in a variety of applications.

Rules & Requirements

Prerequisites: Engineering 7, Mechanical Engineering 40, Mechanical Engineering 106, and Mechanical Engineering 109 or their equivalents

Credit Restrictions: Students will receive no credit for Mechanical Engineering 246 after taking Mechanical Engineering 146.

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/Graduate

Grading: Letter grade.

Instructor: Carey

Advanced Energy Conversion Principles: Read Less [-]
MEC ENG 250A Advanced Conductive and Radiative Transport 3 Units
Terms offered: Not yet offered
Advanced Conductive and Radiative Transport: Read More [+]

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 (Mechanical Engineering 40, Mechanical Engineering 106 and Mechanical Engineering 109 or equivalent). 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 will not be able to receive credit for this course if they have taken Mechanical Engineering 151, 151A or 251.

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructor: Grigoropoulos

Advanced Conductive and Radiative Transport: Read Less [-]

MEC ENG 250B Advanced Convective Transport and Computational Methods 3 Units
Terms offered: Not yet offered
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.
Advanced Convective Transport and Computational Methods: Read More [+]

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 near 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: 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 (Mechanical Engineering 40, Mechanical Engineering 106 and Mechanical Engineering 109 or equivalent). 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 will not be able to receive credit for this course if they have taken Mechanical Engineering 252.

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructor: Carey

Advanced Convective Transport and Computational Methods: Read Less [-]
MEC ENG 251 Heat Conduction 3 Units
Terms offered: Spring 2018, Fall 2016, Fall 2015
Analytical and numerical methods for the determination of the conduction of heat in solids.
Heat Conduction: Read More [+]
Rules & Requirements
Prerequisites: 151; Engineering 230A
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Heat Conduction: Read Less [-]

MEC ENG 252 Heat Convection 3 Units
Terms offered: Spring 2017, Spring 2015, Spring 2014
The transport of heat in fluids in motion; free and forced convection in laminar and turbulent flow over surfaces and within ducts.
Heat Convection: Read More [+]
Rules & Requirements
Prerequisites: 151, 265A; Engineering 230A
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Greif
Heat Convection: Read Less [-]

MEC ENG 253 Thermal Radiation 3 Units
Terms offered: Spring 2018, Fall 2015, Fall 2013
Thermal radiation properties of gases, liquids, and solids; the calculation of radiant energy transfer.
Thermal Radiation: Read More [+]
Rules & Requirements
Prerequisites: 151
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Grigoropoulos, Majumdar
Thermal Radiation: Read Less [-]

MEC ENG 254 Thermodynamics I 3 Units
Terms offered: Fall 2018, Spring 2018, Fall 2016
Thermodynamics I: Read More [+]
Rules & Requirements
Prerequisites: 40
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Carey
Thermodynamics I: Read Less [-]
MEC ENG 255 Advanced Combustion Processes 3 Units
Terms offered: Fall 2018, Fall 2016, Fall 2015
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.
Advanced Combustion Processes: Read More [+]

Objectives Outcomes
Course Objectives: The course provides an introduction to the subject of combustion, covering a broad range of topics important to the fields of energy conversion, engines, pollution and fires. It consists of classroom lectures and laboratory demonstration. It treats the fundamental processes occurring in combustion systems and emphasizes on technological-problem solving skills. The laboratory demonstrations provide practical experience with real combustion systems. The course also uses computer programs to aid the students in the calculations and analysis, especially in thermodynamics and chemical kinetics.

Student Learning Outcomes: Upon completion of the course, students shall be able to:
Understand and calculate the stoichiometry, adiabatic flame temperature and heat of combustion of a fuel and oxidizer mixture. Understand the role of elementary and global reactions. Calculate reaction rates. Know how to use computer codes (e.g. Cantera) to solve combustion problems. Understand and calculate the ignition characteristics of a fuel and oxidizer mixture: flammability limits, self-ignition. Understand and calculate the structure and properties of a premixed flame: propagation speed, thickness, quenching distance, and minimum ignition energy. Understand and calculate the structure and properties of a diffusion flame: height, lift-off distance and blow-off limit. Understand the formation of pollutants from hydrocarbon combustion. Understand the operation of practical systems, specifically, furnaces and boilers, spark ignition and diesel internal combustion engines, and gas turbines.

Rules & Requirements
Prerequisites: ME 40, ME 106, and ME 109 (or their equivalents)
Credit Restrictions: Students will receive no credit for this course if they have taken ME 140.

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/Graduate
Grading: Letter grade.
Instructor: Chen

MEC ENG 256 Combustion 3 Units
Terms offered: Fall 2017, Spring 2015, Spring 2014
Combustion: Read More [+]

Objectives Outcomes
Course Objectives: This course provides students a solid foundation in combustion sciences and technologies relevant to current and future energy conversion devices using combustion.

Student Learning Outcomes: Students will have the ability to perform critical analyses of current and future reacting systems using analytical and numerical methods. For practical combustion systems with complex geometries, students will have gained sufficient background to further their capabilities of using advanced numerical models.

Rules & Requirements
Prerequisites: ME 40, ME 106, and ME 109 (106 and 109 may be taken concurrently) or their equivalents. ME 140/ME255 is recommended

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/Graduate
Grading: Letter grade.
Instructor: Chen

Advanced Combustion: Read Less [-]

MEC ENG 257 Advanced Combustion 3 Units
Terms offered: Fall 2016, Fall 2014, Fall 2012
Critical analyses of combustion phenomenon. Conservation relations applied to reacting systems. Reactions are treated by both asymptotic and numerical methods. Real hydrocarbon kinetics are used; where available reduced kinetic mechanics are introduced. Flame propagation theory and experiments are discussed in detail for both laminar and turbulent flows.
Advanced Combustion: Read More [+]

Rules & Requirements
Prerequisites: 256

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.

Advanced Combustion: Read Less [-]
MEC ENG 258 Heat Transfer with Phase Change 3 Units
Terms offered: Fall 2018, Spring 2016, Spring 2015
Heat transfer associated with phase change processes. Topics include thermodynamics of phase change, evaporation, condensation, nucleation and bubble growth, two phase flow, convective boiling and condensation, melting and solidification.
Heat Transfer with Phase Change: Read More [+]
Rules & Requirements

Prerequisites: 151

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Carey

Heat Transfer with Phase Change: Read Less [-]

MEC ENG 259 Microscale Thermophysics and Heat Transfer 3 Units
Terms offered: Fall 2017, Spring 2016, Spring 2014
This course introduces advanced statistical thermodynamics, nonequilibrium thermodynamics, and kinetic theory concepts used to analyze thermophysics of microscale systems and explores applications in which microscale transport plays an important role.
Microscale Thermophysics and Heat Transfer: Read More [+]
Rules & Requirements

Prerequisites: 151, 254, or consent of instructor

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Carey, Majumdar

Microscale Thermophysics and Heat Transfer: Read Less [-]

MEC ENG 260A Advanced Fluid Mechanics I 3 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
Introduces the foundations of fluid mechanics. Exact flow solutions are used to develop a physical insight of the fluid flow phenomena. Rigorous derivation of the equations of motion. Incompressible and compressible potential flows. Canonical viscous flows.
Advanced Fluid Mechanics I: Read More [+]
Rules & Requirements

Prerequisites: 106; 185 (strongly recommended) or consent of instructor

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Carey, Majumdar

Advanced Fluid Mechanics I: Read Less [-]

MEC ENG 260B Advanced Fluid Mechanics II 3 Units
Develops a working knowledge of fluid mechanics by identifying the essential physical mechanism in complex canonical flow problems which leads to simplified yet accurate formulation. Boundary layers, creeping flows, rotational flows, rotating flows. Stability and transition, introduction to turbulence.
Advanced Fluid Mechanics II: Read More [+]
Rules & Requirements

Prerequisites: 260A 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/Graduate
Grading: Letter grade.

Advanced Fluid Mechanics II: Read Less [-]
MEC ENG 262 Hydrodynamic Stability and Instability 3 Units
Terms offered: Fall 2018, Fall 2014, Fall 2012
Discussions of linear and nonlinear instabilities in a variety of fluid flows: thermal convection, Rayleigh-Taylor flows, shearing flows, circular and cylindrical Couette flows (i.e., centrifugal instability). Use of the Landau equation, bifurcation diagrams, and energy methods for nonlinear flows. Hydrodynamic Stability and Instability: Read More [+]
Rules & Requirements
Prerequisites: 185 and 106, or equivalents
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Marcus
Hydrodynamic Stability and Instability: Read Less [-]

MEC ENG 263 Turbulence 3 Units
Terms offered: Spring 2017, Fall 2012, Spring 2010
Turbulence: Read More [+]
Rules & Requirements
Prerequisites: 260A-260B or equivalent
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Savas
Turbulence: Read Less [-]

MEC ENG 266 Geophysical and Astrophysical Fluid Dynamics 3 Units
Terms offered: Spring 2015, Spring 2013, Spring 2008
This course examines high-Reynolds number flows, including their stability, their waves, and the influence of rotating and stratification as applied to geophysical and astrophysical fluid dynamics as well as to engineering flows. Examples of problems studies include vortex dynamics in planetary atmospheres and protoplanetary disks, jet streams, and waves (Rossby, Poincare, inertial, internal gravity, and Kelvin) in the ocean and atmosphere.
Geophysical and Astrophysical Fluid Dynamics: Read More [+]
Rules & Requirements
Prerequisites: Graduate-level standing or consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Marcus
Formerly known as: 260C
Geophysical and Astrophysical Fluid Dynamics: Read Less [-]

MEC ENG C268 Physicochemical Hydrodynamics 3 Units
Terms offered: Spring 2017, Fall 2013, Fall 2011, Spring 2011
Physicochemical Hydrodynamics: Read More [+]
Rules & Requirements
Prerequisites: A first graduate course in fluid mechanics sucs as 260A-260B
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Morris
Also listed as: CHM ENG C268
Physicochemical Hydrodynamics: Read Less [-]
MEC ENG 273 Oscillations in Linear Systems 3 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
Response of discrete and continuous dynamical systems, damped and undamped, to harmonic and general time-dependent loading. Convolution integrals and Fourier and Laplace transform methods. Lagrange's equations; eigensolutions; orthogonality; generalized coordinates; nonreciprocal and degenerate systems; Rayleigh's quotient. Oscillations in Linear Systems: Read More [+]

Objectives Outcomes

Course Objectives: To give a compact, consistent, and reasonably connected account of the theory of linear vibration at the advanced level. A secondary purpose is to survey some topics of contemporary research. Applications will be mentioned whenever feasible.

Student Learning Outcomes: Acquired necessary knowledge and scientific maturity to begin research in dynamics and vibration.

Rules & Requirements

Prerequisites: ME 104 and ME 133 or their equivalents

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/Graduate

Grading: Letter grade.

Instructor: Ma

Random Oscillations in Linear Systems: Read Less [-]

MEC ENG 274 Random Oscillations of Mechanical Systems 3 Units
Terms offered: Spring 2018, Spring 2015, Spring 2011

Random Oscillations of Mechanical Systems: Read More [+]

Objectives Outcomes

Course Objectives: To give a compact, consistent, and reasonably connected account of the theory of linear vibration at the advanced level. A secondary purpose is to survey some topics of contemporary research.

Student Learning Outcomes: Acquired necessary knowledge and scientific maturity to begin research in dynamics and vibration.

Rules & Requirements

Prerequisites: ME 104 and ME 133 or their equivalents

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructor: Ma

Oscillations in Linear Systems: Read Less [-]

MEC ENG 275 Advanced Dynamics 3 Units
Terms offered: Spring 2017, Spring 2015, Spring 2012


Advanced Dynamics: Read More [+]

Rules & Requirements

Prerequisites: 175

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Advanced Dynamics: Read Less [-]

MEC ENG 277 Nonlinear and Random Vibrations 3 Units
Terms offered: Spring 2016, Spring 2014, Spring 2012


Nonlinear and Random Vibrations: Read More [+]

Objectives Outcomes

Course Objectives: To give a compact, consistent, and reasonably connected account of the theory of nonlinear vibrations and uncertainty analysis at the advanced level. A secondary purpose is to survey some topics of contemporary research.

Student Learning Outcomes: Acquired necessary knowledge and scientific maturity to begin research in nonlinear vibrations and uncertainty analysis.

Rules & Requirements

Prerequisites: Mechanical Engineering 104 and Mechanical Engineering 133 or their equivalent

Credit Restrictions: Students will not receive credit if they have taken Mechanical Engineering 274.

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/Graduate

Grading: Letter grade.

Instructor: Ma

Nonlinear and Random Vibrations: Read Less [-]
MEC ENG C278 Adv Designing for the Human Body 3 Units
Terms offered: 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., prothetics 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.
Adv Designing for the Human Body: Read More [+]Objectives Outcomes

Course Objectives: The purpose of this course is twofold:
• to learn the fundamental concepts of designing devices that 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”.
• Three separate written projects evaluating devices that interact with the body. Projects will focus on 1) biomechanical analysis, 2) FDA regulations and procedures, and 3) design lifecycle.

Student Learning Outcomes: 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: 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.<BR/>

Hours & Format
Fall and/or spring: 15 weeks - 1-3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: O'Connell
Also listed as: BIO ENG C237
Adv Designing for the Human Body: Read Less [-]

MEC ENG C279 Introduction to Statistical Mechanics for Engineers 3 Units
Terms offered: Spring 2017, Fall 2013, Fall 2012
Introduction to Statistical Mechanics for Engineers: Read More [+]Objectives Outcomes

Course Objectives: To provide a modern introduction to the application of statistical mechanics for engineering with a particular emphasis on mechanical response.

Rules & Requirements
Prerequisites: CE C231 or MSE C211 or ME 185 or consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Govindjee, Papadopoulos
Also listed as: CIV ENG C235
Introduction to Statistical Mechanics for Engineers: Read Less [-]

MEC ENG 280A Introduction to the Finite Element Method 3 Units
Terms offered: Fall 2018, Fall 2017, Fall 2016
Introduction to the Finite Element Method: Read More [+]Objectives Outcomes

Rules & Requirements
Prerequisites: Mathematics 50A-50B; some familiarity with elementary field theories of solid/fluid mechanics and/or thermal science

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/Graduate
Grading: Letter grade.
Instructors: Papadopoulos, Zohdi
Formerly known as: 280
Introduction to the Finite Element Method: Read Less [-]
MEC ENG 280B Finite Element Methods in Nonlinear Continua 3 Units
Terms offered: Spring 2016, Spring 2013, Spring 2009

Rules & Requirements
Prerequisites: 280A or equivalent; background in continuum mechanics at the level of 185

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Papadopoulos

Finite Element Methods in Nonlinear Continua: Read Less [-]

MEC ENG 281 Methods of Tensor Calculus and Differential Geometry 3 Units
Terms offered: Fall 2017, Fall 2015, Spring 2012
Methods of tensor calculus and classical differential geometry. The tensor concept and the calculus of tensors, the Riemann-Christoffel tensor and its properties, Riemannian and Euclidean spaces. Geometry of a surface, formulas of Weingarten, and equations of Gauss and Codazzi.

Rules & Requirements
Prerequisites: Mathematics 53 and 54

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Papadopoulos

Methods of Tensor Calculus and Differential Geometry: Read Less [-]

MEC ENG 282 Theory of Elasticity 3 Units
Terms offered: Spring 2018, Spring 2016, Fall 2014
Fundamentals and general theorems of the linear theory of elasticity (in three dimensions) and the formulation of static and dynamic boundary value problems. Application to torsion, flexure, and two-dimensional problems of plane strain, generalized plane stress, and bending of plates. Representation of basic field equations in terms of displacement potentials and stress functions. Some basic three-dimensional solutions.

Rules & Requirements
Prerequisites: 185

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Bogy, Steigmann

Theory of Elasticity: Read Less [-]

MEC ENG 283 Wave Propagation in Elastic Media 3 Units
Terms offered: Fall 2013, Fall 2012, Fall 2009
Propagation of mechanical disturbances in unbounded and bounded media. Surface waves, wave reflection and transmission at interfaces and boundaries. Stress waves due to periodic and transient sources. Some additional topics may vary with instructor.

Rules & Requirements
Prerequisites: 185

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Bogy

Wave Propagation in Elastic Media: Read Less [-]
MEC ENG 284 Nonlinear Theory of Elasticity 3 Units
Terms offered: Spring 2017, Spring 2014, Spring 2013

Objectives Outcomes

Course Objectives: To provide students with a working knowledge of elasticity.

Student Learning Outcomes: Ability to embark on modern research in the field.

Rules & Requirements

Prerequisites: ME 185 or equivalent

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/Graduate

Grading: Letter grade.

Instructor: Casey

Nonlinear Theory of Elasticity: Read Less [-]

MEC ENG 285B Surfaces of Discontinuity and Inhomogeneities in Deformable Continua 3 Units
Terms offered: Fall 2011, Spring 2010, Fall 2008

Rules & Requirements

Prerequisites: 185

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructor: Casey

Surfaces of Discontinuity and Inhomogeneities in Deformable Continua: Read Less [-]

MEC ENG 285A Foundations of the Theory of Continuous Media 3 Units
Terms offered: Spring 2018, Spring 2016, Spring 2015
A general development of thermodynamics of deformable media, entropy production, and related entropy inequalities. Thermomechanical response of dissipative media, including those for viscous fluids and nonlinear elastic solids. A discussion of invariance, internal constraints, material symmetry, and other special topics. Foundations of the Theory of Continuous Media: Read More [+]

Rules & Requirements

Prerequisites: 185

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructor: Casey

Formerly known as: 285

Foundations of the Theory of Continuous Media: Read Less [-]
MEC ENG 285C Electrodynamics of Continuous Media 3 Units
Terms offered: Spring 2015, Spring 2013, Spring 2010
This course presents the fundamentals of electromagnetic interactions in deformable continuous media. It develops the background necessary to understand various modern technologies involving MEMS devices, sensors and actuators, plasmas, and a wide range of additional phenomena. The emphasis of this course is on fundamentals, beginning with Maxwell's equations in vacuum, the ether relations and their extension to electromagnetic interactions in materials. The treatment is general within the limits of nonrelativistic physics and accommodates coupling with mechanical and thermal effects. The topics discussed are all developed at a general level including the effects of finite deformations. Various linear models, which are especially useful in applications, are developed through specialization of general theory. This course will be of interest to students in engineering, physics, and applied mathematics.
Electrodynamics of Continuous Media: Read More [+]

Rules & Requirements
Prerequisites: A first course in continuum mechanics (such as 185 or Civil Engineering 231.)

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Steigmann
Formerly known as: 284B

MEC ENG 285D Engineering Rheology 3 Units
Terms offered: Spring 2016, Spring 2014
Rheology is the study of the interaction between forces and the flow/ deformation of materials. It deals with aspects of the mechanics of materials that are not covered in the standard curriculum, such as the response of viscoelastic fluids and solids, together with methods for modeling and simulating their response. Such materials exhibit a host of counterintuitive phenomena that call for nonlinear modeling and a close interaction between theory and experiment. This is a special-topics course for graduate students seeking advanced knowledge of these phenomena and associated modeling.
Engineering Rheology: Read More [+]

Objectives Outcomes
Course Objectives: To expose students to the theory and methods of modern rheology, including: the mechanics of flow in complex non-Newtonian fluids and the mechanics of viscoelastic solids.

Student Learning Outcomes: Skill in modeling and simulating rheological problems.

Rules & Requirements
Prerequisites: A basic background in continuum mechanics (as covered in ME 185)
Repeat rules: Course may be repeated for credit when topic changes. Course may be repeated for credit when topic changes.

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Steigmann

Engineering Rheology: Read Less [-]
MEC ENG C285E Mechanics and Physics of Lipid Bilayers 3 Units
Terms offered: Fall 2017
Lipid bilayers constitute the membrane that encloses every animal cell and many of its interior structures, including the nuclear envelope, the organelles and the endoplasmic reticulum. This is a unique course devoted to modern developments in this exceptionally active field of research, ranging from models based on continuum theory to recent developments based on statistical mechanics.

Objectives Outcomes

Student Learning Outcomes: To expose students to advanced current work on the mechanics and physics of lipid bilayers (a very active field of current research relevant to biomechanics and biophysics)

Rules & Requirements

Prerequisites: Mechanical Engineering 185 or equivalent

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructor: Steigmann

Also listed as: CHM ENG C294A

Mechanics and Physics of Lipid Bilayers: Read Less [-]

MEC ENG 286 Theory of Plasticity 3 Units
Terms offered: Fall 2018, Spring 2015, Spring 2013
Formulation of the theory of plasticity relative to loading surfaces in both strain space and stress space and associated loading criteria. Nonlinear constitutive equations for finitely deformed elastic-plastic materials. Discussion of strain-hardening and special cases. Applications.

Theory of Plasticity: Read More [+]

Rules & Requirements

Prerequisites: 185

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructors: Casey, Papadopoulos

Theory of Plasticity: Read Less [-]

MEC ENG 287 Graduate Introduction to Continuum Mechanics 3 Units
Terms offered: Spring 2008, Spring 2004
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 subfields, including Fluid Mechanics, Solid Mechanics and Heat Transfer.

Objectives Outcomes

Course Objectives: This is a gateway course for graduate students entering the fields of Solid Mechanics and Fluid Mechanics. It is designed for students who require a rigorous foundation-level understanding in support of their future work in the theory, modeling and analysis of problems arising in the Engineering Sciences.

Student Learning Outcomes: 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 graduate work in allied fields.

Rules & Requirements

Prerequisites: Physics 7A, Math 53 and Math 54, as well as some prior exposure to the elementary mechanics of solids and fluids

Credit Restrictions: Students will receive no credit after taking ME 185.

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/Graduate

Grading: Letter grade.

Instructors: Casey, Johnson, Papadopoulos, Steigmann

Graduate Introduction to Continuum Mechanics: Read Less [-]
MEC ENG 288 Theory of Elastic Stability 3 Units
Terms offered: Spring 2009, Fall 2007, Fall 1999
Theory of Elastic Stability: Read More [+]
Rules & Requirements
Prerequisites: 185 and 273
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Steigmann
Theory of Elastic Stability: Read Less [-]

MEC ENG 289 Theory of Shells 3 Units
Terms offered: Spring 2017, Spring 2012, Fall 2007
A direct formulation of a general theory of shells and plates based on the concept of Cosserat (or Directed) surfaces. Nonlinear constitutive equations for finitely deformed elastic shells. Linear theory and a special nonlinear theory with small strain accompanied by large or moderately large rotation. Applications.
Theory of Shells: Read More [+]
Rules & Requirements
Prerequisites: 185 and 281
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Johnson, Steigmann
Theory of Shells: Read Less [-]

MEC ENG 290C Topics in Fluid Mechanics 3 Units
Terms offered: Spring 2015, Fall 2010, Fall 2003
Lectures on special topics which will be announced at the beginning of each semester that the course is offered. Topics may include transport and mixing, geophysical fluid dynamics, biofluid dynamics, oceanography, free surface flows, non-Newtonian fluid mechanics, among other possibilities.
Topics in Fluid Mechanics: Read More [+]
Rules & Requirements
Prerequisites: Consent of instructor
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Savas, Yeung
Topics in Fluid Mechanics: Read Less [-]
MEC ENG 290D Solid Modeling and CAD/CAM Fundamentals 3 Units
Terms offered: Fall 2018, Fall 2016, Fall 2014
Graduate survey of solid modeling research. Representations and algorithms for 3D solid geometry. Applications in design, analysis, planning, and manufacturing of mechanical parts, including CAD/CAM, reverse engineering, robotics, mold-making, and rapid prototyping.

Objectives
Course Objectives: Students will gain experience with critical close reading of primary sources, evaluating and synthesizing the content of research papers. They will design, implement, and analyze a sample of geometric algorithms for applications in Solid Modeling and CAD/CAM.

Student Learning Outcomes: Students will be familiar with seminal research and important solid modeling representations and fundamental geometric algorithms, giving them insight into the capabilities and limitations of commercial solid modeling systems. They will have gained programming experience and skills and an understanding of theoretical and practical concerns as they design, implement, and analyze a sample of geometric algorithms for applications in Solid Modeling and CAD/CAM.

Rules & Requirements
Prerequisites: An introductory programming course; graduate standing or consent of instructor

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: McMains

MEC ENG 290G Laser Processing and Diagnostics 3 Units
Terms offered: Spring 2018, Fall 2015, Spring 2013
The course provides a detailed account of laser interactions with materials in the context of advanced materials processing and diagnostics.

Rules & Requirements
Prerequisites: Graduate standing or undergraduate elective upon completion of ME109
Repeat rules: Course may be repeated for credit when topic changes. Course may be repeated for credit when topic changes.

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Grigoropoulos

Solid Modeling and CAD/CAM Fundamentals: Read Less [-]
MEC ENG 290H Green Product Development: Design for Sustainability 3 Units
Terms offered: Spring 2017, Spring 2013, Spring 2011
The focus of the course is management of innovation processes for sustainable products, from product definition to sustainable manufacturing and financial models. Using a project in which students will be asked to design and develop a product or service focused on sustainability, we will teach processes for collecting customer and user needs data, prioritizing that data, developing a product specification, sketching and building product prototypes, and interacting with the customer/community during product development. The course is intended as a very hands-on experience in the "green" product development process. The course will be a Management of Technology course offered jointly with the College of Engineering and the Haas School of Business. In addition, it will also receive credit towards the new Certificate on Engineering Sustainability and Environmental Management program. We aim to have half MBA students and half Engineering students (with a few other students, such as from the School of Information) in the class. The instructors will facilitate students to form mixed disciplinary reams for the development of their "green" products.

Green Product Development: Design for Sustainability: Read More [+]

Rules & Requirements

Prerequisites: Graduate standing in Engineering or Information, or consent of instructor

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructors: Agogino, Beckmann

Sustainable Manufacturing: Read Less [-]

MEC ENG 290I Sustainable Manufacturing 3 Units
Terms offered: Spring 2016, Spring 2015, Spring 2014
Sustainable design, manufacturing, and management as exercised by the enterprise is a poorly understood idea and one that is not intuitively connected to business value or engineering practice. This is especially true for the manufacturing aspects of most enterprises (tools, processes, and systems). This course will provide the basis for understanding (1) what comprises sustainable practices in for-profit enterprises, (2) how to practice and measure continuous improvement using sustainability thinking, techniques, and tools for product and manufacturing process design, and (3) the techniques for and value of effective communication of sustainability performance to internal and external audiences. Material in the course will be supplemented by speakers with diverse backgrounds in corporate sustainability, environmental consulting, non-governmental organizations, and academia.

Sustainable Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: Graduate standing, or consent of instructor, especially for students not in engineering, business, or other management of technology programs

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

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/Graduate

Grading: Letter grade.

Instructor: Dornfeld

Sustainable Manufacturing: Read Less [-]
MEC ENG 290J Predictive Control for Linear and Hybrid Systems 3 Units
Terms offered: Spring 2016, Fall 2014, Spring 2013
Advanced optimization, polyhedra manipulation, and multiparametric programming. Invariant set theory. Analysis and design of constrained predictive controllers for linear and nonlinear systems. Computational oriented models of hybrid systems. Analysis and design of constrained predictive controllers for hybrid systems.
Objectives Outcomes
Course Objectives: The course is designed for graduate students who want to expand their knowledge on optimization-based control design. 50% will be focusing on advanced theory. 50% on applications.
Student Learning Outcomes: At the end of the course, the students will write a theoretical paper on MPC and will design an experiment where the theory is implemented.
Rules & Requirements
Prerequisites: ME C232 and ME C231A
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Borrelli

MEC ENG 290KA Innovation through Design Thinking 2 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Designed for professionally-oriented graduate students, this course explores key concepts in design innovation based on the human-centered design approach called “design thinking.” Topics covered include human-centered design research, analysis of research to develop design principles, creativity techniques, user needs framing and strategic business modeling.
Objectives Outcomes
Student Learning Outcomes: The primary goal is to provide students with a set of innovation skills that will allow them to flourish in a climate of complex problem solving and design challenges. Students will develop expertise in innovation skills drawn from the fields of critical thinking, design thinking and systems thinking. Students should be able to apply the skills mastered to real world design problems.
Rules & Requirements
Prerequisites: Graduate level standing; Prior design course
Hours & Format
Fall and/or spring: 8 weeks - 4 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Agogino

Predictive Control for Linear and Hybrid Systems: Read More [+]
Innovation through Design Thinking: Read More [+]
Predictive Control for Linear and Hybrid Systems: Read Less [-]
Innovation through Design Thinking: Read Less [-]
MEC ENG 290KB Life Cycle Thinking in Engineering Design 1 Unit
Terms offered: Fall 2017, Fall 2016, Fall 2015
How do we design and manufacture greener products, and how do we know if they really are? This class both provides tools for sustainable design innovation and metrics to measure success. Students will use both creative and analytical skills, generating new ideas as well as evaluating designs with screening-level life cycle assessment.

Life Cycle Thinking in Engineering Design: Read More [+]

Objectives Outcomes

Course Objectives: The objective of this course is to provide students with the tools to frame, analyze, and redesign their projects in terms of life cycle environmental impacts, to improve the sustainability of their projects.

Student Learning Outcomes: Students can expect to depart the course understanding the practice of basic life cycle assessment, including how to set boundaries, choose functional units, and use LCA software. Students will also learn how to integrate this practice into new product development in the context of the “triple bottom line” – economy, environment and society. Students should be able to apply the skills mastered to real world design and engineering problems.

Rules & Requirements

Prerequisites: Graduate level standing; Prior design course

Hours & Format
Fall and/or spring: 8 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructor: Agogino

Life Cycle Thinking in Engineering Design: Read Less [-]

MEC ENG 290L Introduction to Nano-Biology 3 Units
Terms offered: Fall 2018, Spring 2017, Spring 2016
This course introduces graduate students in Mechanical Engineering to the nascent field of Nano-Biology. The course is comprised of both formal lectures and projects. Lectures will include an introduction to both molecular biology (components of cells, protein structure and function, DNA, gene regulation, etc.) and nanotechnology (“bottom up” and “top down” nanotechnologies), an overview of current instrumentation in biology, an in-depth description of the recent integration of molecular biology with nanotechnology (for sensing or labeling purposes, elucidating information on cells, etc.), and an introduction to Systems Biology (design principles of biological circuits).

Introduction to Nano-Biology: Read More [+]

Objectives Outcomes

Course Objectives: The course introduces engineering students to the interplay between Nanotechnology and Biology and serves to 1) broaden the areas of research that students might not have necessarily considered, 2) expose students to cutting-edge research, and 3) develop analytical skills.

Student Learning Outcomes: Students should be able to critique methods and techniques that researchers have used to study and probe biological systems at the nano-scale. They will learn how to write research proposals and how to give an effective presentation. Through the research proposals, students will learn about the scientific-research process: formulating the problem, determining the appropriate experimental methods, interpreting the results, and arriving at a conclusion. Through presentations, students will gain valuable experience in public speaking and learn the process by which they would have to propose a research problem, be it in academia or industry.

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/Graduate

Grading: Letter grade.

Instructor: Sohn

Introduction to Nano-Biology: Read Less [-]
MEC ENG 290M Expert Systems in Mechanical Engineering 3 Units
Terms offered: Fall 2005, Fall 2003, Spring 1999
Introduction to artificial intelligence and decision analysis in mechanical engineering. Fundamentals of analytic design, probability theory, failure analysis, risk assessment, and Bayesian and logical inference. Applications to expert systems in probabilistic mechanical engineering design and failure diagnostics. Use of automated influence diagrams to codify expert knowledge and to evaluate optimal design decisions.

Prerequisites: 102A and 102B or equivalent

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Agogino

MEC ENG 290N System Identification 3 Units
Terms offered: Fall 2010, Fall 2008, Spring 2007
This course is intended to provide a comprehensive treatment of both classical system identification and recent work in control-oriented system identification. Numerical, practical, and theoretical aspects will be covered. Topics treated include time and frequency domain methods, generalized parameter estimation, identification of structured non-linear systems, modeling uncertainty bounding, and state-space methods.

Prerequisites: 232, Electrical Engineering and Computer Sciences 221A or consent of instructor

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Poolla

MEC ENG 290P New Product Development: Design Theory and Methods 3 Units
Terms offered: Fall 2015, Fall 2013, Fall 2012
This course is aimed at developing the interdisciplinary skills required for successful product development in today's competitive marketplace. We expect students to be disciplinary experts in their own field (e.g., engineering, business). By bringing together multiple perspectives, we will learn how product development teams can focus their efforts to quickly create cost-effective products that exceed customers' expectations.

Prerequisites: Graduate standing, consent of instructor

Hours & Format
Fall and/or spring: 15 weeks - 3-3 hours of lecture and 0-1 hours of voluntary per week

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Agogino

Objectives Outcomes
Course Objectives: Students can expect to depart the semester understanding new product development processes as well as useful tools, techniques and organizational structures that support new product development practice.

Student Learning Outcomes: Students can expect to depart the semester understanding new product development processes as well as useful tools, techniques and organizational structures that support new product development practice in the context of the “triple bottom line” - economy, environment and society.
MEC ENG 290Q Dynamic Control of Robotic Manipulators 3 Units
Terms offered: Fall 2008, Spring 2007, Fall 2001

Prerequisites: 230, 232, or consent of instructor

MEC ENG 290R Topics in Manufacturing 3 Units
Terms offered: Fall 2017, Spring 2016, Fall 2014
Advanced topics in manufacturing research. Topics vary from year to year.

Prerequisites: Consent of instructor

MEC ENG 290U Interactive Device Design 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
This course teaches concepts and skills required to design, prototype, and fabricate interactive devices -- that is, physical objects that intelligently respond to user input and enable new types of interactions.

Prerequisites: Instructor consent

MEC ENG 290T Plasmonic Materials 3 Units
Terms offered: Fall 2017, Fall 2014, Spring 2013
This course deals with fundamental aspects of plasmonic materials. The electromagnetic responses of those artificially constructed materials will be discussed. Physics of surface plasmons and dispersion engineering will be introduced. Resonant phenomena associated with the negative permittivity and permeability and the left-handed propagation will be presented. Methods of design, fabrication, and characterization of plasmonic materials will be discussed.

Prerequisites: Physics 110A or consent of instructor

Course Objectives: To educate students in the hybrid design skills needed for today's electronic products. These combine mechanical devices, electronics, software, sensors, wireless communication and connections to the cloud. Students also learn scale up procedures for volume manufacturing.

Objectives Outcomes

Course Objectives: To educate students in the hybrid design skills needed for today's electronic products. These combine mechanical devices, electronics, software, sensors, wireless communication and connections to the cloud. Students also learn scale up procedures for volume manufacturing.

Student Learning Outcomes: 3D printed prototypes, learned software, programming and design skills

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Dornfeld, McMains, Wright
Topics in Manufacturing: Read Less [-]

Rules & Requirements

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

MEC ENG 290T Plasmonic Materials: Read More [+]
Rules & Requirements

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

MEC ENG 290U Interactive Device Design: Read More [+]
Objectives Outcomes

Course Objectives: To educate students in the hybrid design skills needed for today's electronic products. These combine mechanical devices, electronics, software, sensors, wireless communication and connections to the cloud. Students also learn scale up procedures for volume manufacturing.

Student Learning Outcomes: 3D printed prototypes, learned software, programming and design skills

Rules & Requirements

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

Interactive Device Design: Read Less [-]

Instructors: Hartmann, Wright

Plasmonic Materials: Read Less [-]

Instructors: Horowitz, Kazerooni

Dynamic Control of Robotic Manipulators: Read Less [-]
MEC ENG 290V Topics in Energy, Climate, and Sustainability 1 Unit

Terms offered: Prior to 2007
Weekly lecture series featuring guest speakers from academia, industry, government, and civil society. Speakers will address cutting-edge topics involving novel technologies in energy and climate; the production, consumption, and economic exchange of energy resources and commodities; and energy and climate policy. Undergraduate and graduate students welcome.

Topics in Energy, Climate, and Sustainability: Read More [+]

Objectives Outcomes

Course Objectives: Introduce UC Berkeley students to a variety of perspectives from stakeholders working on the science, technology, economics, and policy of energy and climate issues.

Student Learning Outcomes: Introduce students to interdisciplinary perspectives on energy and climate issues; attract top speakers to campus from academia, industry, government, and civil society; and build community at UC Berkeley around interdisciplinary energy and climate issues.

Rules & Requirements

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

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructors: Wright, Burns, Cullenward

Topics in Energy, Climate, and Sustainability: Read Less [-]

MEC ENG C290S Hybrid Systems and Intelligent Control 3 Units

Terms offered: Spring 2018, Spring 2016, Spring 2014

Hybrid Systems and Intelligent Control: Read More [+]

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Formerly known as: 291E

Also listed as: EL ENG C291E

Hybrid Systems and Intelligent Control: Read Less [-]

MEC ENG C290X Advanced Technical Communication: Proposals, Patents, and Presentations 3 Units

This course will help the advanced Ph.D. student further develop critically important technical communication traits via a series of lectures, interactive workshops, and student projects that will address the structure and creation of effective research papers, technical reports, patents, proposals, business plans, and oral presentations. One key concept will be the emphasis on focus and clarity—achieved through critical thinking regarding objectives and context. Examples will be drawn primarily from health care and bioengineering multidisciplinary applications.

Advanced Technical Communication: Proposals, Patents, and Presentations: Read More [+]

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructors: Keaveny, Pruitt

Also listed as: BIO ENG C290D

Advanced Technical Communication: Proposals, Patents, and Presentations: Read Less [-]
MEC ENG 292A Advanced Special Topics in Bioengineering 1 - 4 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
This 292 series covers current topics of research interest in bioengineering and biomechanics. The course content may vary semester to semester. Check with the department for current term topics.
Advanced Special Topics in Bioengineering: Read More [+]

Rules & Requirements

Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. 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/Graduate
Grading: Letter grade.
Instructor: Faculty

Advanced Special Topics in Bioengineering: Read Less [-]

MEC ENG 292B Advanced Special Topics in Controls 1 - 4 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
This 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.
Advanced Special Topics in Controls: Read More [+]

Objectives Outcomes

Course Objectives: Varies with course.
Student Learning Outcomes: Varies with course.

Rules & Requirements

Prerequisites: Graduate standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. 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/Graduate
Grading: Letter grade.

Advanced Special Topics in Controls: Read Less [-]
MEC ENG 292C Advanced Special Topics in Design 1 - 4 Units
Terms offered: Fall 2018, Spring 2018, Fall 2017
This 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.
Advanced Special Topics in Design: Read More [+]

Objectives Outcomes

Course Objectives: Varies with course.
Student Learning Outcomes: Varies with course.

Rules & Requirements
Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. 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/Graduate
Grading: Letter grade.

Advanced Special Topics in Design: Read Less [-]

MEC ENG 292D Advanced Special Topics in Dynamics 1 - 4 Units
Terms offered: Prior to 2007
This 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.
Advanced Special Topics in Dynamics: Read More [+]

Objectives Outcomes

Course Objectives: Varies with course.
Student Learning Outcomes: Varies with course.

Rules & Requirements
Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. 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/Graduate
Grading: Letter grade.

Advanced Special Topics in Dynamics: Read Less [-]
MEC ENG 292E Advanced Special Topics in Energy Science and Technology 1 - 4 Units

Terms offered: Fall 2018, Spring 2018, Fall 2017
This 292 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: Varies with course.
Student Learning Outcomes: Varies with course.

Rules & Requirements

Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. 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/Graduate
Grading: Letter grade.

Advanced Special Topics in Energy Science and Technology: Read Less [-]

MEC ENG 292F Advanced Special Topics in Fluids 1 - 4 Units

Terms offered: Prior to 2007
This 292 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: Varies with course.
Student Learning Outcomes: Varies with course.

Rules & Requirements

Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. 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/Graduate
Grading: Letter grade.

Advanced Special Topics in Fluids: Read Less [-]
MEC ENG 292G Advanced Special Topics in Manufacturing 1 - 4 Units
Terms offered: Prior to 2007
This 292 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.
Advanced Special Topics in Manufacturing: Read More [+]
Objectives Outcomes
Course Objectives: Varies with course.
Student Learning Outcomes: Varies with course.
Rules & Requirements
Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes.
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/Graduate
Grading: Letter grade.
Advanced Special Topics in Manufacturing: Read Less [-]

MEC ENG 292H Advanced Special Topics in Materials 1 - 4 Units
Terms offered: Prior to 2007
This 292 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.
Advanced Special Topics in Materials: Read More [+]
Objectives Outcomes
Course Objectives: Varies with course.
Student Learning Outcomes: Varies with course.
Rules & Requirements
Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes.
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/Graduate
Grading: Letter grade.
Advanced Special Topics in Materials: Read Less [-]
MEC ENG 292I Advanced Special Topics in Mechanics 1 - 4 Units
Terms offered: Prior to 2007
This 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.
Advanced Special Topics in Mechanics: Read More [+]
Objectives Outcomes
Course Objectives: Varies with course.
Student Learning Outcomes: Varies with course.
Rules & Requirements
Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. 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/Graduate
Grading: Letter grade.
Advanced Special Topics in Mechanics: Read Less [-]

MEC ENG 292J Advanced Special Topics in MEMS/Nano 1 - 4 Units
Terms offered: Spring 2018
This 292 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.
Advanced Special Topics in MEMS/Nano: Read More [+]
Objectives Outcomes
Course Objectives: Varies with course.
Student Learning Outcomes: Varies with course.
Rules & Requirements
Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. 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/Graduate
Grading: Letter grade.
Advanced Special Topics in MEMS/Nano: Read Less [-]
MEC ENG 292K Advanced Special Topics in Ocean Engineering 1 - 4 Units
Terms offered: Prior to 2007
This 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.
Advanced Special Topics in Ocean Engineering: Read More [+]
Objectives Outcomes
Course Objectives: Varies with course.
Student Learning Outcomes: Varies with course.
Rules & Requirements
Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. 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/Graduate
Grading: Letter grade.
Advanced Special Topics in Ocean Engineering: Read Less [-]

MEC ENG 297 Engineering Field Studies 1 - 12 Units
Terms offered: Spring 2018, Spring 2017, Fall 2016
Supervised experience relative to specific aspects of practice in engineering. Under guidance of a faculty member, the student will work in an internship in industry. Emphasis is to attain practical experience in the field.
Engineering Field Studies: Read More [+]
Rules & Requirements
Prerequisites: Graduate student standing or consent of instructor
Repeat rules: Course may be repeated for credit when topic changes. Course may be repeated for credit when topic changes.
Hours & Format
Fall and/or spring: 15 weeks - 1-12 hours of independent study per week
Summer:
6 weeks - 2.5-20 hours of independent study per week
10 weeks - 1.5-18 hours of independent study per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Offered for satisfactory/unsatisfactory grade only.
Engineering Field Studies: Read Less [-]

MEC ENG 298 Group Studies, Seminars, or Group Research 1 - 8 Units
Terms offered: Fall 2018, Spring 2018, Fall 2017
Advanced studies in various subjects through special seminars on topics to be selected each year. Informal group studies of special problems, group participation in comprehensive design problems, or group research on complete problems for analysis and experimentation.
Group Studies, Seminars, or Group Research: Read More [+]
Rules & Requirements
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 1-8 hours of independent study per week
Summer: 10 weeks - 1.5-12 hours of independent study per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Offered for satisfactory/unsatisfactory grade only.
Group Studies, Seminars, or Group Research: Read Less [-]

MEC ENG 299 Individual Study or Research 1 - 12 Units
Terms offered: Fall 2018, Spring 2018, Fall 2017
Investigations of advanced problems in mechanical engineering.
Individual Study or Research: Read More [+]
Rules & Requirements
Prerequisites: Graduate standing in engineering, physics, or mathematics
Repeat rules: Course may be repeated for credit without restriction.
Hours & Format
Fall and/or spring: 15 weeks - 1-12 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/Graduate
Grading: Offered for satisfactory/unsatisfactory grade only.
Individual Study or Research: Read Less [-]
MEC ENG 375 Teaching of Mechanical Engineering at the University Level 1 - 6 Units

Terms offered: Fall 2018, Spring 2018, Fall 2017
Weekly seminars and discussions on effective teaching methods. Educational objectives. Theories of learning. The lecture and alternative approaches. Use of media resources. Student evaluation. Laboratory instruction. Curricula in mechanical engineering. Practice teaching. This course is open to Teaching Assistants of Mechanical Engineering.

Rules & Requirements

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

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Formerly known as: Mechanical Engineering 301

Teaching of Mechanical Engineering at the University Level: Read Less [-]