Mechanical Engineering

Overview

The Department of Mechanical Engineering's research projects are primarily funded by the National Science Foundation, governmental agencies, and the many industries located around Berkeley and in the Silicon Valley. In this dynamic environment, students find themselves well positioned with job offers and exciting career opportunities throughout the United States, as well as worldwide.

In the new millennium, the field of mechanical engineering has entered a particularly vital era. The "information age," born in the last century, has already affected every aspect of the discipline and, without a doubt, revolutionized the field of mechanical engineering.

At the beginning of the twentieth century, mechanical engineers designed and worked with large rotating machines. Today, work spans all areas of energy production and transfer, as well as the vast area of system design and control. A survey of the faculty's current research projects is a voyage through a world complex enough to include robotics, miniaturization, automated manufacturing, automated highway systems, biomaterials, computer mechanics, improved efficiency internal combustion engines and energy systems, and the dynamics and control of both ground vehicles and aircraft.

Undergraduate Programs

Mechanical Engineering (http://guide.berkeley.edu/undergraduate/degree-programs/mechanical-engineering): BS, Minor
Materials Science and Engineering/Mechanical Engineering (http://guide.berkeley.edu/undergraduate/degree-programs/materials-science-engineering-mechanical-joint-major): BS (Joint Major)
Mechanical Engineering/Nuclear Engineering (http://guide.berkeley.edu/undergraduate/degree-programs/mechanical-engineering-nuclear): BS (Joint Major)
Mechanical Engineering and Business Administration (http://guide.berkeley.edu/undergraduate/degree-programs/mechanical-engineering-business-administration): BS (Joint Major)

Graduate Programs

Mechanical Engineering (http://guide.berkeley.edu/graduate/degree-programs/mechanical-engineering): MEng, MS, PhD

Mechanical Engineering

Expand all course descriptions [+]Collapse all course descriptions [-]
MEC ENG 40 Thermodynamics 3 Units
Terms offered: Summer 2020 10 Week Session, Spring 2020, Fall 2019
This course introduces the scientific principles that deal with energy conversion among different forms, such as heat, work, internal, electrical, and chemical energy. The physical science of heat and temperature, and their relations to energy and work, are analyzed on the basis of the four fundamental thermodynamic laws (zeroth, first, second, and third). These principles are applied to various practical systems, including heat engines, refrigeration cycles, air conditioning, and chemical reacting systems.
Thermodynamics: Read More [+]

Objectives & Outcomes

Course Objectives: 2) to develop analytic ability in real-world engineering applications using thermodynamics principles.
The objectives of this course are:
1) to provide the fundamental background of thermodynamics principles, and

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

Rules & Requirements

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

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Summer: 10 weeks - 4.5 hours of lecture and 1.5 hours of discussion per week

MEC ENG C85 Introduction to Solid Mechanics 3 Units
Terms offered: Spring 2020, Fall 2019, Spring 2019

Introduction to Solid Mechanics: Read More [+]

Rules & Requirements

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

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

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Summer:
6 weeks - 7.5 hours of lecture and 2.5 hours of discussion per week
10 weeks - 4.5 hours of lecture and 1.5 hours of discussion per week

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructors: Armero, Papadopoulos, Zohdi, Johnson

Also listed as: CIV ENG C30

Introduction to Solid Mechanics: Read Less [-]
MEC ENG W85 Introduction to Solid Mechanics 3 Units
Terms offered: Summer 2020 8 Week Session, Summer 2019 8 Week Session, Summer 2018 8 Week Session
Introduction to Solid Mechanics: Read More [+]

Objectives & Outcomes

Course Objectives: To learn statics and mechanics of materials

Student Learning Outcomes:
- Correctly draw free-body
- Apply the equations of equilibrium to two and three-dimensional solids
- Understand the concepts of stress and strain
- Ability to calculate deflections in engineered systems
- Solve simple boundary value problems in linear elastostatics (tension, torsion, beam bending)

Rules & Requirements

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

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

Hours & Format

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

Summer:
- 6 weeks - 7.5 hours of web-based lecture and 2.5 hours of web-based discussion per week
- 8 weeks - 6 hours of web-based lecture and 2 hours of web-based discussion per week
- 10 weeks - 4.5 hours of web-based lecture and 1.5 hours of web-based discussion per week

Online: This is an online course.

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructor: Govindjee

Also listed as: CIV ENG W30

Introduction to Solid Mechanics: Read Less [-]
MEC ENG 100 Electronics for the Internet of Things 4 Units
Terms offered: Spring 2020, Fall 2019
Electronics and Electrical Engineering has become pervasive in our lives as a powerful technology with applications in a wide range of fields including healthcare, environmental monitoring, robotics, or entertainment. This course offers a broad survey of Electrical Engineering ideas to non-majors. In the laboratory students will learn in-depth how to design and build systems that exchange information with or are controlled from the cloud. Examples include solar harvesters, robots, and smart home devices. In the course project, the students will integrate what they have learned and build an Internet-of-Things application of their choice. The course has a mandatory lab fee.

Electronics for the Internet of Things: Read More [+]

Objectives & Outcomes

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

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

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

Rules & Requirements

Prerequisites: ENGIN 7, COMPSCI 10, COMPSCI 61A, COMPSCI C8, or equivalent background in computer programming; MATH 1A or equivalent background in calculus; PHYSICS 7A or equivalent background in physics

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

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructors: Dornfeld, McMains

Introduction to Lean Manufacturing Systems: Read Less [-]

MEC ENG 101 Introduction to Lean Manufacturing Systems 3 Units
Terms offered: Spring 2019, Spring 2018, Spring 2017
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.

Introduction to Lean Manufacturing Systems: Read More [+]

Objectives & Outcomes

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

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

Rules & Requirements

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

Hours & Format

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

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructors: Dornfeld, McMains

Introduction to Lean Manufacturing Systems: Read Less [-]
MEC ENG 102B Mechatronics Design 4 Units
Terms offered: Spring 2020, Fall 2019, Spring 2019
Introduction to design and realization of mechatronics systems. Micro computer architectures. Basic computer IO devices. Embedded microprocessor systems and control, IO programming such as analogue to digital converters, PWM, serial and parallel outputs. Electrical components such as power supplies, operational amplifiers, transformers and filters. Shielding and grounding. Design of electric, hydraulic and pneumatic actuators. Design of sensors. Design of power transmission systems. Kinematics and dynamics of robotics devices. Basic feedback design to create robustness and performance.

Mechatronics Design: Read More [+]

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

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

Rules & Requirements
Prerequisites: ENGIN 25, ENGIN 26, ENGIN 27; and EECS 16A or MEC ENG 100. Please note that junior transfer students are exempt from ENGIN 26

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.

Mechatronics Design: Read Less [-]

MEC ENG 103 Experimentation and Measurements 4 Units
Terms offered: Spring 2020, Fall 2019, Spring 2019
This course introduces students to modern experimental techniques for mechanical engineering, and improves students’ teamwork and communication skills. Students will work in a laboratory setting on systems ranging in complexity from desktop experiments with only a few instruments up to systems such as an internal combustion engine with a wide variety of sensors. State-of-the-art software for data acquisition and analysis will be introduced and used throughout the course. The role of error and uncertainty, and uncertainty propagation, in measurements and analysis will be examined. Design of experiments will be addressed through examples and homework. The role and limitations of spectral analysis of digital data will be discussed.

Experimentation and Measurements: Read More [+]

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

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

Rules & Requirements
Prerequisites: MEC ENG 40; MEC ENG C85 / CIV ENG C30; MEC ENG 100; MEC ENG 105 (can be taken concurrently), and MEC ENG 109 (can be taken concurrently)

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

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.

Instructors: Johnson, Makiharju, Chen

Experimentation and Measurements: Read Less [-]
MEC ENG 104 Engineering Mechanics II 3 Units
Terms offered: Summer 2020 10 Week Session, Spring 2020, Fall 2019
This course is an introduction to the dynamics of particles and rigid bodies. The material, based on a Newtonian formulation of the governing equations, is illustrated with numerous examples ranging from one-dimensional motion of a single particle to planar motions of rigid bodies and systems of rigid bodies.

Engineering Mechanics II: Read More [+]

Rules & Requirements

Prerequisites: C85 and Engineering 7

Hours & Format

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

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Engineering Mechanics II: Read Less [-]

MEC ENG 106 Fluid Mechanics 3 Units
Terms offered: Summer 2020 10 Week Session, Spring 2020, Fall 2019
This course introduces the fundamentals and techniques of fluid mechanics with the aim of describing and controlling engineering flows.

Fluid Mechanics: Read More [+]

Rules & Requirements

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

Hours & Format

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

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Fluid Mechanics: Read Less [-]

MEC ENG 108 Mechanical Behavior of Engineering Materials 4 Units
Terms offered: Spring 2020, Fall 2019, Spring 2019
This course covers elastic and plastic deformation under static and dynamic loads. Failure by yielding, fracture, fatigue, wear, and environmental factors are also examined. Topics include engineering materials, heat treatment, structure-property relationships, elastic deformation and multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, fracture, fatigue, and contact deformation.

Mechanical Behavior of Engineering Materials: Read More [+]

Objectives & Outcomes

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

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

Rules & Requirements

Prerequisites: MEC ENG C85 / CIV ENG C30

Hours & Format

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

Summer: 10 weeks - 4.5 hours of lecture, 1.5 hours of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Mechanical Behavior of Engineering Materials: Read Less [-]
MEC ENG 109 Heat Transfer 3 Units
Terms offered: Summer 2020 10 Week Session, Spring 2020, Fall 2019
This course covers transport processes of mass, momentum, and energy from a macroscopic view with emphasis both on understanding why matter behaves as it does and on developing practical problem solving skills. The course is divided into four parts: introduction, conduction, convection, and radiation.
Heat Transfer: Read More [+]
Rules & Requirements
Prerequisites: MEC ENG 40 and MEC ENG 106

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Summer:
8 weeks - 5.5 hours of lecture and 1.5 hours of discussion per week
10 weeks - 4.5 hours of lecture and 1.5 hours of discussion per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

MEC ENG 110 Introduction to Product Development 3 Units
Terms offered: Summer 2020 10 Week Session, Spring 2020, Summer 2019 10 Week Session
The course provides project-based learning experience in innovative new product development, with a focus on mechanical engineering systems. Design concepts and techniques are introduced, and the student's design ability is developed in a design or feasibility study chosen to emphasize ingenuity and provide wide coverage of engineering topics. Relevant software will be integrated into studio sessions, including solid modeling and environmental life cycle analysis. Design optimization and social, economic, and political implications are included.
Introduction to Product Development: Read More [+]
Rules & Requirements
Prerequisites: Junior or higher standing

Hours & Format
Fall and/or spring: 15 weeks - 3-3 hours of lecture and 0-1 hours of voluntary per week
Summer:
10 weeks - 4.5-4.5 hours of lecture and 0-1 hours of voluntary per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.

MEC ENG C115 Molecular Biomechanics and Mechanobiology of the Cell 4 Units
Terms offered: Spring 2020, Spring 2019, Spring 2016
This course applies methods of statistical continuum mechanics to subcellular biomechanical phenomena ranging from nanoscale (molecular) to microscale (whole cell and cell population) biological processes at the interface of mechanics, biology, and chemistry.
Molecular Biomechanics and Mechanobiology of the Cell: Read More [+]
Objectives & Outcomes
Course Objectives: This course, which is open to senior undergraduate students or graduate students in diverse disciplines ranging from engineering to biology to chemistry and physics, is aimed at exposing students to subcellular biomechanical phenomena spanning scales from molecules to the whole cell.
Student Learning Outcomes: The students will develop tools and skills to (1) understand and analyze subcellular biomechanics and transport phenomena, and (2) ultimately apply these skills to novel biological and biomedical applications
Rules & Requirements
Prerequisites: MATH 54 and PHYSICS 7A; BIO ENG 102, MEC ENG C85 / CIV ENG C30 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/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Mofrad
Also listed as: BIO ENG C112
Molecular Biomechanics and Mechanobiology of the Cell: Read Less [-]
MEC ENG C117 Structural Aspects of Biomaterials 4 Units
Terms offered: Spring 2019, Spring 2018, Spring 2016
This course covers the structure and mechanical functions of load bearing tissues and their replacements. Natural and synthetic load-bearing biomaterials for clinical applications are reviewed. Biocompatibility of biomaterials and host response to structural implants are examined. Quantitative treatment of biomechanical issues and constitutive relationships of tissues are covered in order to design biomaterial replacements for structural function. Material selection for load bearing applications including reconstructive surgery, orthopedics, dentistry, and cardiology are addressed. Mechanical design for longevity including topics of fatigue, wear, and fracture are reviewed. Case studies that examine failures of devices are presented.

Rules & Requirements
Prerequisites: BIOLOGY 1A and MAT SCI 45; CIV ENG 130, CIV ENG 130N, or BIO ENG 102
Credit Restrictions: Students will receive no credit for Mechanical Engineering C117 after completing Mechanical Engineering C215/ Bioengineering C222.

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Pruitt
Also listed as: BIO ENG C117

MEC ENG 118 Introduction to Nanotechnology and Nanoscience 3 Units
Terms offered: Spring 2020, Spring 2017, Spring 2015
This course introduces engineering students (juniors and seniors) to the field of nanotechnology and nanoscience. The course has two components: (1) Formal lectures. Students receive a set of formal lectures introducing them to the field of nanotechnology and nanoscience. The material covered includes nanofabrication technology (how one achieves the nanometer length scale, from "bottom up" to "top down" technologies), the interdisciplinary nature of nanotechnology and nanoscience (including areas of chemistry, material science, physics, and molecular biology), examples of nanoscience phenomena (the crossover from bulk to quantum mechanical properties), and applications (from integrated circuits, quantum computing, MEMS, and bioengineering), (2) Projects. Students are asked to read and present a variety of current journal papers to the class and lead a discussion on the various works.

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Lin, Sohn

MEC ENG 119 Introduction to MEMS (Microelectromechanical Systems) 3 Units
Terms offered: Fall 2019, Fall 2017, Fall 2015
Fundamentals of microelectromechanical systems including design, fabrication of microstructures; surface-micromachining, bulk-micromachining, LIGA, and other micro machining processes; fabrication principles of integrated circuit device and their applications for making MEMS devices; high-aspect-ratio microstructures; scaling issues in the micro scale (heat transfer, fluid mechanics and solid mechanics); device design, analysis, and mask layout.

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Introduction to MEMS (Microelectromechanical Systems): Read Less [-]
MEC ENG 120 Computational Biomechanics Across Multiple Scales 3 Units
Terms offered: Fall 2016, Spring 2015, Spring 2014
This course applies the methods of computational modeling and continuum mechanics to biomedical phenomena spanning various length scales ranging from molecular to cellular to tissue and organ levels. The course is intended for upper level undergraduate students who have been exposed to undergraduate continuum mechanics (statics and strength of materials.)
Prerequisites: MEC ENG C85 / CIV ENG C30

MEC ENG 122 Processing of Materials in Manufacturing 3 Units
Terms offered: Spring 2020, Spring 2018, Spring 2017
Fundamentals of manufacturing processes (metal forming, forging, metal cutting, welding, joining, and casting); selection of metals, plastics, and other materials relative to the design and choice of manufacturing processes; geometric dimensioning and tolerancing of all processes.
Prerequisites: MEC ENG C85 / CIV ENG C30 and MEC ENG 108

MEC ENG 125 Industry-Associated Capstones in Mechanical Engineering (iACME) 4 Units
Terms offered: Spring 2018
iACME provide opportunities for Mechanical Engineering undergraduates to tackle real-world engineering problems. Student teams, consisting of no more than four students, will apply to work on specific industry-initiated projects. Teams will be selected based on prior experience in research/internships, scholastic achievements in ME courses, and most importantly, proposed initial approaches toward tackling the specific project. ME faculty, alumni of the Mechanical Engineering Department, and industry participants will mentor selected teams. Projects fall within a wide range of mechanical engineering disciplines, e.g. biomedical, automotive/transportation, energy, design, etc.
Prerequisites: Senior standing and a minimum GPA of 3.0

Course Objectives: The purpose of this course is to:
• learn the fundamental concepts of approaching practical engineering problems;
• enhance skills in communication with clients and other engineers;
• enhance skills in design, prototyping, testing, and analysis.

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

Rules & Requirements
Prerequisites: Senior standing and a minimum GPA of 3.0

Industry-Associated Capstones in Mechanical Engineering (iACME):
Read Less [-]
MEC ENG 130 Design of Planar Machinery 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
Synthesis, analysis, and design of planar machines. Kinematic structure, graphical, analytical, and numerical analysis and synthesis. Linkages, cams, reciprocating engines, gear trains, and flywheels.
Design of Planar Machinery: Read More [+]
Rules & Requirements
Prerequisites: MEC ENG 104
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of laboratory per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Youssefi
Design of Planar Machinery: Read Less [-]

MEC ENG 131 Vehicle Dynamics and Control 4 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
Physical understanding of automotive vehicle dynamics including simple lateral, longitudinal and ride quality models. An overview of active safety systems will be introduced including the basic concepts and terminology, the state-of-the-art development, and basic principles of systems such as ABS, traction control, dynamic stability control, and roll stability control. Passive, semi-active and active suspension systems will be analyzed. Concepts of autonomous vehicle technology including drive-by-wire and steer-by-wire systems, adaptive cruise control and lane keeping systems. Design of software control systems for an actual 1/10 scale race vehicle.
Vehicle Dynamics and Control: Read More [+]
Objectives & Outcomes
Course Objectives: At the end of the course the students should be able to:
(a) Formulate simple but accurate dynamic models for automotive longitudinal, lateral and ride quality analysis.
(b) Assess the stability of dynamic systems using differential equation theory, apply frequency-response methods to assess system response to external disturbances, sensor noise and parameter variations.
(c) Have a basic understanding of modern automotive safety systems including ABS, traction control, dynamic stability control and roll control.
(d) Follow the literature on these subjects and perform independent design, research and development work in this field.
(e) Expected to design feedback control systems for an actual 1/010 scaled vehicle platform which will be distributed to every group of two students in the class
Student Learning Outcomes: (a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
Rules & Requirements
Prerequisites: MATH 1B, MATH 53, MATH 54, PHYSICS 7A, PHYSICS 7B, ENGIN 7 (or alternate programming course), and MEC ENG 132
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Borrelli
MEC ENG 132 Dynamic Systems and Feedback 3 Units
Terms offered: Summer 2020 10 Week Session, Spring 2020, Fall 2019

Rules & Requirements

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

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of laboratory per week
Summer: 10 weeks - 4.5 hours of lecture and 1.5 hours of laboratory per week

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Dynamic Systems and Feedback: Read Less [-]

MEC ENG 133 Mechanical Vibrations 3 Units
Terms offered: Spring 2020, Spring 2019, Fall 2016
An introduction to the theory of mechanical vibrations including topics of harmonic motion, resonance, transient and random excitation, applications of Fourier analysis and convolution methods. Multidegree of freedom discrete systems including principal mode, principal coordinates and Rayleigh's principle. Mechanical Vibrations: Read More [+]

Objectives & Outcomes

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

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

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

Rules & Requirements

Prerequisites: MEC ENG 104

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer: 10 weeks - 5 hours of lecture per week

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Mechanical Vibrations: Read Less [-]
MEC ENG C134 Feedback Control Systems 4 Units
Terms offered: Spring 2020, Fall 2019, Spring 2019
Analysis and synthesis of linear feedback control systems in transform and time domains. Control system design by root locus, frequency response, and state space methods. Applications to electro-mechanical and mechatronics systems.
Feedback Control Systems: Read More [+]

Rules & Requirements
Prerequisites: EECS 16A or MEC ENG 100; MEC ENG 132 or EL ENG 120

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Also listed as: EL ENG C128
Feedback Control Systems: Read Less [-]

MEC ENG 135 Design of Microprocessor-Based Mechanical Systems 4 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
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: ENGIN 7

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week
Summer: 10 weeks - 4.5 hours of lecture and 4.5 hours of laboratory per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.
Instructor: Kazerooni
Design of Microprocessor-Based Mechanical Systems: Read Less [-]

MEC ENG 136 Introduction to Control of Unmanned Aerial Vehicles 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
This course introduces students to the control of unmanned aerial vehicles (UAVs). The course will cover modeling and dynamics of aerial vehicles, and common control strategies. Laboratory exercises allow students to apply knowledge on a real system, by programming a microcontroller to control a UAV.
Introduction to Control of Unmanned Aerial Vehicles: Read More [+]

Objectives & Outcomes
Course Objectives: Introduce the students to analysis, modeling, and control of unmanned aerial vehicles. Lectures will cover:
- Principle forces acting on a UAV, including aerodynamics of propellers
- The kinematics and dynamics of rotations, and 3D modeling of vehicle dynamics
- Typical sensors, and their modeling
- Typical control strategies, and their pitfalls
- Programming a microcontroller
During the laboratory sessions, students will apply these skills to create a model-based controller for a UAV.

Student Learning Outcomes: (a) an ability to apply knowledge of mathematics, science, and engineering (b) an ability to design and conduct experiments, as well as to analyze and interpret data (g) an ability to communicate effectively (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Rules & Requirements
Prerequisites: MEC ENG 104 is recommended. Corequisite: MEC ENG 132
Credit Restrictions: Student will not receive credit for this course if they have taken Mechanical Engineering 236U.

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Mueller
Introduction to Control of Unmanned Aerial Vehicles: Read Less [-]
MEC ENG 138 Introduction to Micro/Nano Mechanical Systems Laboratory 3 Units
Terms offered: Spring 2018, Spring 2015, Spring 2013
This hands-on laboratory course focuses on the mechanical engineering principles that underlie the design, fabrication, and operation of micro/nanoscale mechanical systems, including devices made by nanowire/nanotube syntheses; photolithography/soft lithography; and molding processes. Each laboratory will have different focuses for basic understanding of MEMS/NEMS systems from prototype constructions to experimental testings using mechanical, electrical, or optical techniques.

Introduction to Micro/Nano Mechanical Systems Laboratory: Read More

Rules & Requirements

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

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

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.

Introduction to Micro/Nano Mechanical Systems Laboratory: Read Less

MEC ENG 140 Combustion Processes 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2016
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.

Combustion Processes: Read More

Rules & Requirements

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

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Carey

Combustion Processes: Read Less

MEC ENG 146 Energy Conversion Principles 3 Units
Terms offered: Fall 2018, Spring 2018, Fall 2016
This course covers the fundamental principles of energy conversion processes, followed by development of theoretical and computational tools that can be used to analyze energy conversion processes. The course also introduces the use of modern computational methods to model energy conversion performance characteristics of devices and systems. Performance features, sources of inefficiencies, and optimal design strategies are explored for a variety of applications, which may include conventional combustion based and Rankine power systems, energy systems for space applications, solar, wind, wave, thermoelectric, and geothermal energy systems.

Energy Conversion Principles: Read More

Rules & Requirements

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

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Carey

Energy Conversion Principles: Read Less
MEC ENG 150A Solar-Powered Vehicles: Analysis, Design and Fabrication 3 Units
Terms offered: Summer 2015 10 Week Session, Summer 2014 10 Week Session, Spring 2014
This course addresses all aspects of design, analysis, construction and economics of solar-powered vehicles. It begins with an examination of the fundamentals of photovoltaic solar power generation, and the capabilities and limitations that exist when using this form of renewable energy. The efficiency of energy conversion and storage will be evaluated across an entire system, from the solar energy that is available to the mechanical power that is ultimately produced. The structural and dynamic stability, as well as the aerodynamics, of vehicles will be studied. Safety and economic concerns will also be considered. Students will work in teams to design, build and test a functioning single-person vehicle capable of street use.

Solar-Powered Vehicles: Analysis, Design and Fabrication: Read More [+]

Objectives & Outcomes

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

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

Rules & Requirements

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

Hours & Format

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

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Advanced Heat Transfer: Read Less [-]

MEC ENG 151 Advanced Heat Transfer 3 Units
Terms offered: Spring 2017, Spring 2014, Spring 2008
Basic principles of heat transfer and their application. Subject areas include steady-state and transient system analyses for conduction, free and forced convection, boiling, condensation and thermal radiation.

Advanced Heat Transfer: Read More [+]

Rules & Requirements

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

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Advanced Heat Transfer: Read Less [-]
**MEC ENG 151A Conductive and Radiative Transport 3 Units**

Terms offered: Fall 2019, Fall 2018


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

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

**Rules & Requirements**

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

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

**Hours & Format**

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

**Additional Details**

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructor: Grigopoulos

Conductive and Radiative Transport: Read More [+]

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

Terms offered: Spring 2020, Spring 2019

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.

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

**Student Learning Outcomes:**

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

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

(d) an ability to function on multi-disciplinary teams

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

(g) an ability to communicate effectively

(j) a knowledge of contemporary issues

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

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

**Rules & Requirements**

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

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

**Hours & Format**

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

**Additional Details**

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructor: Carey

Convective Transport and Computational Methods: Read Less [-]
MEC ENG 153 Applied Optics and Radiation 3 Units
Terms offered: Not yet offered
Applied Optics and Radiation: Read More [+]

Objectives & Outcomes
Course Objectives: The course will provide students with knowledge of the fundamental principles of optics to analyze optical phenomena and develop the background and skills to design optical instrumentation applied to engineering fields, including additive manufacturing, radiometry and spectroscopy.
Student Learning Outcomes: ABET Outcomes
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Students will gain knowledge of the EM theory, optical properties of materials, principles of spectroscopy for gases, liquids and solids, principles and applications of lasers and optical diagnostics. Students will develop the ability to design optical instrumentation systems in the context of key industrial applications, including additive manufacturing, materials processing, bio-optics, semiconductor industry applications, reacting systems, forensics.

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

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Grigoropoulos

MEC ENG 154 Thermophysics for Applications 3 Units
Terms offered: Fall 2019, Spring 2019
Development of classical thermodynamics from statistical treatment of microscale molecular behavior; Boltzmann distribution; partition functions; statistical-mechanical evaluation of thermodynamic properties; equilibrium; chemical equilibrium; phase transitions; molecular collisions; Maxwell-Boltzmann distribution; collision theory; elementary kinetic theory; molecular dynamics simulation of molecular collisions; kinetic Monte Carlo simulations of gas-phase and gas-surface reactions.
Implications are explored for a variety of applications, which may include advanced combustion systems, renewable power systems, microscale transport in high heat flux electronics cooling, aerospace thermal management, and advanced materials processing.
Thermophysics for Applications: Read More [+]

Objectives & Outcomes
Course Objectives: To introduce students to the statistical foundation of thermodynamics and provide skills to perform advanced calculations for analysis of advanced energy conversion processes and devices.
Student Learning Outcomes: a knowledge of contemporary issues
an ability to apply knowledge of mathematics, science, and engineering
an ability to communicate effectively
an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
an ability to function on multi-disciplinary teams
an ability to identify, formulate, and solve engineering problems
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Rules & Requirements
Prerequisites: MEC ENG 40
Credit Restrictions: Student will not receive credit for this course if they have taken ME 254.

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Frenklach, Carey
Thermophysics for Applications: Read Less [-]
MEC ENG 160 Ocean Engineering Seminar 2
Units
Terms offered: Spring 2020, Spring 2019
Lectures on new developments in ocean, offshore, and arctic engineering.
Ocean Engineering Seminar: Read More [+]
Objectives & Outcomes
Course Objectives: To provide exposure of the field of ocean engineering, arctic engineering and related subject areas to students with the intention to show the broad and interdisciplinary nature of this field, particularly recent or new developments.
Student Learning Outcomes: (f) an understanding of professional and ethical responsibility (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context (i) a recognition of the need for, and an ability to engage in life-long learning (j) a knowledge of contemporary issues
Students will learn of new developments in ocean, offshore, and arctic engineering, connecting much of what is learned in other courses to practical applications and active research topics.
Rules & Requirements
Repeat rules: Course may be repeated for credit with instructor consent.
Hours & Format
Fall and/or spring: 15 weeks - 2 hours of seminar per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Alternative to final exam.
Instructors: Makiharju, Alam
Ocean Engineering Seminar: Read Less [-]

MEC ENG 163 Engineering Aerodynamics 3
Units
Terms offered: Fall 2019, Fall 2018, Fall 2016
Introduction to the lift, drag, and moment of two-dimensional airfoils, three-dimensional wings, and the complete airplane. Calculations of the performance and stability of airplanes in subsonic flight.
Engineering Aerodynamics: Read More [+]
Rules & Requirements
Prerequisites: MEC ENG 106
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Savas
Engineering Aerodynamics: Read Less [-]

MEC ENG 164 Marine Statics and Structures
3 Units
Terms offered: Fall 2012, Fall 2011, Fall 2009
Terminology and definition of hull forms, conditions of static equilibrium and stability of floating submerged bodies. Effects of damage on stability. Structural loads and response. Box girder theory. Isotropic and orthotropic plate bending and bucking.
Marine Statics and Structures: Read More [+]
Rules & Requirements
Prerequisites: Civil and Environmental Engineering 130 or 130N or consent of instructor
Credit Restrictions: Students will receive no credit for 164 after taking C164/Ocean Engineering C164; 2 units after taking 151.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Mansour
Formerly known as: C164
Marine Statics and Structures: Read Less [-]
MEC ENG 165 Ocean-Environment Mechanics 3 Units
Terms offered: Spring 2020, Spring 2018, Spring 2017
Ocean-Environment Mechanics: Read More [+]
Rules & Requirements
Prerequisites: MEC ENG 106 or CIV ENG 100
Credit Restrictions: Students will receive no credit for 165 after taking C165/Ocean Engineering C165.

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Yeung
Formerly known as: C165
Ocean-Environment Mechanics: Read Less [-]

MEC ENG 167 Microscale Fluid Mechanics 3 Units
Terms offered: Spring 2018, Spring 2016, Spring 2015
Phenomena of physical, technological, and biological significance in flows of gases and liquids at the microscale. The course begins with familiar equations of Newtonian fluid mechanics, then proceeds to the study of essentially 1-D flows in confined geometries with the lubrication equations. Next is a study of the flow of thin films spreading under gravity or surface tension gradients. Lubrication theory of compressible gases leads to consideration of air bearings. Two- and 3-D flows are treated with Stokes' equations. Less familiar physical phenomena of significance and utility at the microscale are then considered: intermolecular forces in liquids, slip, diffusion and bubbles as active agents. A review of relevant aspects of electricity and magnetism precedes a study of electrowetting and electrokinetically driven liquid flows.
Microscale Fluid Mechanics: Read More [+]
Rules & Requirements
Prerequisites: 40, 106, 109, (106 and 109 may be taken concurrently) Physics 7B or equivalent
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Morris, Szeri
Microscale Fluid Mechanics: Read Less [-]
MEC ENG 168 Mechanics of Offshore Systems 3 Units
Terms offered: Spring 2019, Fall 2017, Fall 2015
This course covers major aspects of offshore engineering including ocean environment, loads on offshore structures, cables and mooring, underwater acoustics and arctic operations.
Mechanics of Offshore Systems: Read More [+]
Objectives & Outcomes

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

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

Rules & Requirements

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

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Alam

Mechanics of Offshore Systems: Read Less [-]

MEC ENG 170 Engineering Mechanics III 3 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
This course builds upon material learned in 104, examining the dynamics of particles and rigid bodies moving in three dimensions. Topics include non-fixed axis rotations of rigid bodies, Euler angles and parameters, kinematics of rigid bodies, and the Newton-Euler equations of motion for rigid bodies. The course material will be illustrated with real-world examples such as gyroscopes, spinning tops, vehicles, and satellites. Applications of the material range from vehicle navigation to celestial mechanics, numerical simulations, and animations.
Engineering Mechanics III: Read More [+]
Rules & Requirements

Prerequisites: MEC ENG 104 or consent of instructor

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: O'Reilly, Casey

Engineering Mechanics III: Read Less [-]

MEC ENG 173 Fundamentals of Acoustics 3 Units
Terms offered: Spring 2017, Spring 2013, Spring 2011
Fundamentals of Acoustics: Read More [+]
Rules & Requirements

Prerequisites: MEC ENG 104

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Johnson

Fundamentals of Acoustics: Read Less [-]
MEC ENG 174 Nonlinear and Random Vibrations 3 Units

Terms offered: Not yet offered

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. Applications will be mentioned whenever feasible. A secondary purpose is to survey some topics of contemporary research.

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

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

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

Rules & Requirements

Prerequisites: MEC ENG 104

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructor: Ma

Nonlinear and Random Vibrations: Read Less [-]

MEC ENG 175 Intermediate Dynamics 3 Units

Terms offered: Fall 2019, Fall 2018, Fall 2017
This course introduces and investigates Lagrange's equations of motion for particles and rigid bodies. The subject matter is particularly relevant to applications comprised of interconnected and constrained discrete mechanical components. The material is illustrated with numerous examples. These range from one-dimensional motion of a single particle to three-dimensional motions of rigid bodies and systems of rigid bodies.

Intermediate Dynamics: Read More [+]

Objectives & Outcomes

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

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

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

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

h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.

j) A knowledge of contemporary issues.

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

Rules & Requirements

Prerequisites: MEC ENG 104

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

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructors: O'Reilly, Casey

Intermediate Dynamics: Read Less [-]
MEC ENG C176 Orthopedic Biomechanics 4 Units
Terms offered: Fall 2019, Spring 2019, Fall 2017
Statics, dynamics, optimization theory, composite beam theory, beam-on-elastic foundation theory, Hertz contact theory, and materials behavior. Forces and moments acting on human joints; composition and mechanical behavior of orthopedic biomaterials; design/analysis of artificial joint, spine, and fracture fixation prostheses; musculoskeletal tissues including bone, cartilage, tendon, ligament, and muscle; osteoporosis and fracture-risk predication of bones; and bone adaptation. MATLAB-based project to integrate the course material.

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

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

Orthopedic Biomechanics: Read More [+]

MEC ENG C178 Designing for the Human Body 4 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
The course provides project-based learning experience in understanding product design, with a focus on the human body as a mechanical machine. Students will learn the design of external devices used to aid or protect the body. Topics will include forces acting on internal materials (e.g., muscles and total replacement devices), forces acting on external materials (e.g., 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.

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

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

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

Rules & Requirements
Prerequisites: PHYSICS 7A, MATH 1A, and MATH 1B. Proficiency in MatLab or equivalent. Prior knowledge of biology or anatomy is not assumed.

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

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

Designing for the Human Body: Read More [+]

Orthopedic Biomechanics: Read Less [-]
**MEC ENG 179 Augmenting Human Dexterity**

4 Units

Terms offered: Spring 2020

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

**Objectives & Outcomes**

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

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

**Rules & Requirements**

**Prerequisites:** MEC ENG 132; MEC ENG C178 / BIO ENG C137 or MEC ENG C176 / BIO ENG C119; and proficiency with Matlab or equivalent program

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

**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/Undergraduate

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

**Instructor:** Stuart

**Augmenting Human Dexterity: Read More [+]**

**MEC ENG C180 Engineering Analysis Using the Finite Element Method**

3 Units

Terms offered: Spring 2020, Fall 2019, Spring 2019

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

**Rules & Requirements**

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

**Hours & Format**

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

**Additional Details**

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

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

**Also listed as:** CIV ENG C133

**Engineering Analysis Using the Finite Element Method: Read Less [-]**

**Augmenting Human Dexterity: Read Less [-]**
MEC ENG 185 Introduction to Continuum Mechanics 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
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.
Introduction to Continuum Mechanics: Read More [-]

Objectives & Outcomes

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

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

Rules & Requirements

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

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

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructors: Casey, Johnson, Papadopoulos, Steigmann

Introduction to Continuum Mechanics: Read Less [-]

MEC ENG 190L Practical Control System Design: A Systematic Loopshaping Approach 1 Unit
Terms offered: Spring 2018, Fall 2015, Spring 2014
After a review of basic loopshaping, we introduce the loopshaping design methodology of McFarlane and Glover, and learn how to use it effectively. The remainder of the course studies the mathematics underlying the new method (one of the most prevalent advanced techniques used in industry) justifying its validity.
Practical Control System Design: A Systematic Loopshaping Approach: Read More [-]

Rules & Requirements

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

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructor: Packard

Practical Control System Design: A Systematic Loopshaping Approach: Read Less [-]

MEC ENG 190M Model Predictive Control 1 Unit
Terms offered: Spring 2015, Fall 2009
Basics on optimization and polyhedra manipulation. Analysis and design of constrained predictive controllers for linear and nonlinear systems.
Model Predictive Control: Read More [-]

Rules & Requirements

Prerequisites: MEC ENG 132

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructor: Borrelli

Model Predictive Control: Read Less [-]
MEC ENG 190Y Practical Control System Design: A Systematic Optimization Approach
1 Unit
Terms offered: Spring 2013, Spring 2010, Spring 2009
The Youla-parametrization of all stabilizing controllers allows certain time-domain and frequency-domain closed-loop design objectives to be cast as convex optimizations, and solved reliably using off-the-shelf numerical optimization codes. This course covers the Youla parametrization, basic elements of convex optimization, and finally control design using these techniques.
Practical Control System Design: A Systematic Optimization Approach: Read More [+]

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

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Packard

Practical Control System Design: A Systematic Optimization Approach: Read Less [-]

MEC ENG 191K Professional Communication
3 Units
Terms offered: Summer 2020 First 6 Week Session, Summer 2020 Second 6 Week Session, Spring 2020
This course is designed to enhance students' written and oral communication skills. Written work consists of informal documents--correspondence, internal reports, and reviews--and formal work--proposals, conference papers, journal articles, and websites. Presentations consist of informal and formal reports, including job and media interviews, phone interviews, conference calls, video conferences, progress reports, sales pitches, and feasibility studies.
Professional Communication: Read More [+]

Rules & Requirements
Prerequisites: Reading and Composition parts A and B

Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Summer:
6 weeks - 8 hours of lecture per week
8 weeks - 5.5 hours of lecture per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Alternative to final exam.
Instructor: Faculty

Professional Communication: Read Less [-]

MEC ENG 193A Special Topics in Biomechanical Engineering 1 - 4 Units
Terms offered: Spring 2017
This 193 series covers current topics of research interest in biomechanical engineering. The course content may vary semester to semester. Check with the department for current term topics.
Special Topics in Biomechanical Engineering: Read More [+]

Objectives & Outcomes
Course Objectives: Course objectives will vary.
Student Learning Outcomes: Student outcomes will vary.

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

Hours & Format
Fall and/or spring:
6 weeks - 2.5-10 hours of lecture per week
8 weeks - 2-7.5 hours of lecture per week
10 weeks - 1.5-6 hours of lecture per week
15 weeks - 1-4 hours of lecture per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Faculty

Special Topics in Biomechanical Engineering: Read Less [-]
MEC ENG 193B Special Topics in Controls 1 - 4 Units
Terms offered: Fall 2019, Fall 2018
This 193 series covers current topics of research interest in controls. The course content may vary semester to semester. Check with the department for current term topics.
Special Topics in Controls: Read More [+]

Objectives & Outcomes
Course Objectives: Will vary with course.
Student Learning Outcomes: Will vary with course.

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

Hours & Format
Fall and/or spring:
6 weeks - 2.5-10 hours of lecture per week
8 weeks - 2-7.5 hours of lecture per week
10 weeks - 1.5-6 hours of lecture per week
15 weeks - 1-4 hours of lecture per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

MEC ENG 193C Special Topics in Design 1 - 4 Units
Terms offered: Fall 2018, Fall 2016
This 193 series covers current topics of research interest in design. The course content may vary semester to semester. Check with the department for current term topics.
Special Topics in Design: Read More [+]

Objectives & Outcomes
Course Objectives: Will vary with course.
Student Learning Outcomes: Will vary with course.

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

Hours & Format
Fall and/or spring:
6 weeks - 2.5-10 hours of lecture per week
8 weeks - 2-7.5 hours of lecture per week
10 weeks - 1.5-6 hours of lecture per week
15 weeks - 1-4 hours of lecture per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Faculty
MEC ENG 193D Special Topics in Dynamics 1 - 4 Units
Terms offered: Prior to 2007
This 193 series covers current topics of research interest in dynamics. The course content may vary semester to semester. Check with the department for current term topics.

Objectives & Outcomes
Course Objectives: Will vary with course.
Student Learning Outcomes: Will vary with course.

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

Hours & Format
Fall and/or spring:
6 weeks - 2.5-10 hours of lecture per week
8 weeks - 2-7.5 hours of lecture per week
10 weeks - 1.5-6 hours of lecture per week
15 weeks - 1-4 hours of lecture per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Faculty

Special Topics in Dynamics: Read Less [-]

MEC ENG 193E Special Topics in Energy Science and Technology 1 - 4 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
This 193 series covers current topics of research interest in energy science and technology. The course content may vary semester to semester. Check with the department for current term topics.

Objectives & Outcomes
Course Objectives: Will vary with course.
Student Learning Outcomes: Will vary with course.

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

Hours & Format
Fall and/or spring:
6 weeks - 2.5-10 hours of lecture per week
8 weeks - 2-7.5 hours of lecture per week
10 weeks - 1.5-6 hours of lecture per week
15 weeks - 1-4 hours of lecture per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Faculty

Special Topics in Energy Science and Technology: Read Less [-]
MEC ENG 193F Special Topics in Fluids 1 - 4 Units
Terms offered: Prior to 2007
This 193 series covers current topics of research interest in fluids. The course content may vary semester to semester. Check with the department for current term topics.
Objectives & Outcomes
Course Objectives: Will vary with course.
Student Learning Outcomes: Will vary with course.
Rules & Requirements
Repeat rules: Course may be repeated for credit when topic changes.
Hours & Format
Fall and/or spring:
6 weeks - 2.5-10 hours of lecture per week
8 weeks - 2-7.5 hours of lecture per week
10 weeks - 1.5-6 hours of lecture per week
15 weeks - 1-4 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Faculty
Special Topics in Fluids: Read Less [-]

MEC ENG 193G Special Topics in Manufacturing 1 - 4 Units
Terms offered: Prior to 2007
This 193 series covers current topics of research interest in manufacturing. The course content may vary semester to semester. Check with the department for current term topics.
Objectives & Outcomes
Course Objectives: Will vary by course.
Student Learning Outcomes: Will vary by course.
Rules & Requirements
Repeat rules: Course may be repeated for credit when topic changes.
Hours & Format
Fall and/or spring:
6 weeks - 2.5-10 hours of lecture per week
8 weeks - 2-7.5 hours of lecture per week
10 weeks - 1.5-6 hours of lecture per week
15 weeks - 1-4 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Faculty
Special Topics in Manufacturing: Read Less [-]
MEC ENG 193H Special Topics in Materials 1
- 4 Units

Terms offered: Spring 2020
This 193 series covers current topics of research interest in materials.
The course content may vary semester to semester. Check with the
department for current term topics.

Special Topics in Materials: Read More [+]

Objectives & Outcomes

Course Objectives: Will vary with course.

Student Learning Outcomes: Will vary with course.

Rules & Requirements

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

Hours & Format

Fall and/or spring:
6 weeks - 2.5-10 hours of lecture per week
8 weeks - 2-7.5 hours of lecture per week
10 weeks - 1.5-6 hours of lecture per week
15 weeks - 1-4 hours of lecture per week

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructor: Faculty

Special Topics in Materials: Read Less [-]

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

Terms offered: Prior to 2007
This 193 series covers current topics of research interest in mechanics.
The course content may vary semester to semester. Check with the
department for current term topics.

Special Topics in Mechanics: Read More [+]

Objectives & Outcomes

Course Objectives: Will vary with course.

Student Learning Outcomes: Will vary with course.

Rules & Requirements

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

Hours & Format

Fall and/or spring:
6 weeks - 2.5-10 hours of lecture per week
8 weeks - 2-7.5 hours of lecture per week
10 weeks - 1.5-6 hours of lecture per week
15 weeks - 1-4 hours of lecture per week

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Instructor: Faculty

Special Topics in Mechanics: Read Less [-]
MEC ENG 193J Special Topics in MEMS/Nano  
1 - 4 Units
Terms offered: Prior to 2007
This 193 series covers current topics of research interest in MEMS/nano. The course content may vary semester to semester. Check with the department for current term topics.
Special Topics in MEMS/Nano: Read More [+]

Objectives & Outcomes

Course Objectives: Will vary with course.
Student Learning Outcomes: Will vary with course.

Rules & Requirements

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

Hours & Format

Fall and/or spring:  
6 weeks - 2.5-10 hours of lecture per week  
8 weeks - 2-7.5 hours of lecture per week  
10 weeks - 1.5-6 hours of lecture per week  
15 weeks - 1-4 hours of lecture per week

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Faculty

Special Topics in MEMS/Nano: Read Less [-]

MEC ENG 193K Special Topics in Ocean Engineering 1 - 4 Units
Terms offered: Prior to 2007
This 193 series covers current topics of research interest in ocean engineering. The course content may vary semester to semester. Check with the department for current term topics.
Special Topics in Ocean Engineering: Read More [+]

Objectives & Outcomes

Course Objectives: Will vary by course.
Student Learning Outcomes: Will vary by course.

Rules & Requirements

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

Hours & Format

Fall and/or spring:  
6 weeks - 2.5-10 hours of lecture per week  
8 weeks - 2-7.5 hours of lecture per week  
10 weeks - 1.5-6 hours of lecture per week  
15 weeks - 1-4 hours of lecture per week

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Faculty

Special Topics in Ocean Engineering: Read Less [-]
MEC ENG H194 Honors Undergraduate Research 2 - 4 Units
Terms offered: Summer 2020 8 Week Session, Spring 2020, Fall 2019
Final report required. Students who have completed a satisfactory number of advanced courses may pursue original research under the direction of one of the members of the faculty. A maximum of three units of H194 may be used to fulfill technical elective requirements in the Mechanical Engineering program (unlike 198 or 199, which do not satisfy technical elective requirements). Students can use a maximum of three units of graded research units (H194 or 196) towards their technical elective requirement.

Honors Undergraduate Research: Read More [+]

Rules & Requirements
Prerequisites: 3.3 cumulative GPA or higher, consent of instructor and adviser, and senior standing
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 2-4 hours of independent study per week
Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 4-8 hours of independent study per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.

Honors Undergraduate Research: Read Less [-]

MEC ENG 196 Undergraduate Research 2 - 4 Units
Terms offered: Spring 2020, Fall 2019, Spring 2019
Students who have completed a satisfactory number of advanced courses may pursue original research under the direction of one of the members of the staff. A maximum of three units of 196 may be used to fulfill technical elective requirements in the Mechanical Engineering program (unlike 198 or 199, which do not satisfy technical elective requirements). Students can use a maximum of three units of graded research units (H194 or 196) towards their technical elective requirement. Final report required.

Undergraduate Research: Read More [+]

Rules & Requirements
Prerequisites: Consent of instructor and adviser; junior or senior standing
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 2-4 hours of independent study per week
Summer:
6 weeks - 5-10 hours of independent study per week
8 weeks - 4-8 hours of independent study per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.

Undergraduate Research: Read Less [-]
MEC ENG 197 Undergraduate Engineering Field Studies 1 - 4 Units
Terms offered: Fall 2015, Summer 2015 10 Week Session
Supervised experience relative to specific aspects of practice in engineering. Under guidance of a faculty member, the student will work in industry, primarily in an internship setting or another type of short-time status. Emphasis is to attain practical experience in the field.

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

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

Hours & Format
Fall and/or spring: 15 weeks - 3-12 hours of internship per week
Summer:
6 weeks - 8-30 hours of internship per week
10 weeks - 5-18 hours of internship per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

MEC ENG 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
Group study of a selected topic or topics in Mechanical Engineering. Credit for 198 or 199 courses combined may not exceed 4 units in any single term. See College for other restrictions.

Rules & Requirements
Prerequisites: Upper division standing and good academic standing
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week
Summer: 10 weeks - 1.5-6 hours of directed group study per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

MEC ENG 199 Supervised Independent Study 1 - 4 Units
Terms offered: Spring 2020, Fall 2019, Spring 2018
Supervised independent study. Enrollment restrictions apply; see the introduction to Courses and Curricula section of this catalog.

Rules & Requirements
Prerequisites: Consent of instructor and major adviser
Repeat rules: Course may be repeated for credit without restriction.

Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of independent study per week
Summer:
6 weeks - 1-5 hours of independent study per week
8 weeks - 1-4 hours of independent study per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Supervised Independent Study: Read Less [-]
MEC ENG C200 Design, Evaluate, and Scale Development Technologies 3 Units

Terms offered: Fall 2019, Spring 2019, Fall 2018, Fall 2017

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.

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 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.

Objectives & Outcomes

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

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

Rules & Requirements

Prerequisites: An undergraduate course in strength of materials or 122

Rules & Requirements

Prerequisites: An undergraduate course in strength of materials or 122

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.

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructors: Agogino, Levine

Also listed as: DEV ENG C200

Modeling and Simulation of Advanced Manufacturing Processes: Read More [+]

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/NUC ENG C226

Modeling and Simulation of Advanced Manufacturing Processes: Read Less [-]
MEC ENG C201 Modeling and Simulation of Advanced Manufacturing Processes 3 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
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. Terms offered: Prior to 2007
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.
Modeling and Simulation of Advanced Manufacturing Processes: Read More [+]

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/NUC ENG C226
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.
Computational Design of Multifunctional/Multiphysical Composite Materials: Read More [+]

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: Fall 2019
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

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.

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Advanced Manufacturing Systems Analysis, AMS: Read Less
MEC ENG C205 Critical Making 4 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
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 [+]

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
MEC ENG C210 Advanced Orthopedic Biomechanics 4 Units
Terms offered: Fall 2019, Spring 2019, Fall 2017

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-
foundation 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
OK. Proficiency in MatLab or equivalent. Prior knowledge of biology or
anatomy is not assumed

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 and 1 hour of
discussion per week

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: O'Connell, Keaveny

The Cell as a Machine: Read Less [-]

MEC ENG 211 The Cell as a Machine 3 Units
Terms offered: Fall 2019, 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.

The Cell as a Machine: Read More [+]

Rules & Requirements

Prerequisites: Mathematics 54; Physics 7A; graduate standing

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: 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.

Heat and Mass Transport in Biomedical Engineering: Read More [+]

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.
Formerly known as: Mechanical Engineering 212
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 2019, Spring 2016, Spring 2014
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.
Fluid Mechanics of Biological Systems: Read More [+]
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.
Advanced Tissue Mechanics: Read More [+]
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 2019, Spring 2018, Spring 2016
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 2020, Spring 2019, Spring 2016
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 cytoskelton 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 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.
Biomimetic Engineering -- Engineering from Biology: Read More [+]

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

Biomimetic Engineering -- Engineering from Biology: Read Less [-]
MEC ENG 218N Introduction to Nanotechnology and Nanoscience 3 Units  
Terms offered: Spring 2020  
UG and Grad. introduction to nanotechnology and nanoscience. The course has two components: 1) Students receive a set of formal lectures introducing nanotechnology and nanoscience, covering nanofabrication technology (how one achieves the nanometer length scale, from “bottom up” to “top down” technologies), the interdisciplinary nature of nanotechnology and nanoscience (including areas of chemistry, material science, physics, and molecular biology), examples of nanoscience phenomena (the crossover from bulk to quantum mechanical properties) and applications from integrated circuits, quantum computing, MEMS, and bioengineering. 2) Projects. Students are asked to present on a variety of current journal papers to the class & lead discussion.  
Introduction to Nanotechnology and Nanoscience: Read More [+]

Objectives & Outcomes

Course Objectives: To introduce and provide a broad view of the nascent field of nanoscience and nanotechnology to undergraduates. To introduce students to inter- and multi-disciplinary science and engineering.

Student Learning Outcomes: A recognition of the need for, and an ability to engage in life-long learning. A knowledge of contemporary issues. An ability to apply knowledge of mathematics, science, and engineering. An ability to function on multidisciplinary teams. An ability to identify, formulate, and solve engineering problems. An ability to communicate effectively. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Rules & Requirements

Prerequisites: Chem 1A, Physics 7B, Physics 7C, Engineering 45. BIO 1A and Chem 1B preferred

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

Introduction to Nanotechnology and Nanoscience: Read Less [-]

MEC ENG C218 Introduction to MEMS Design 4 Units  
Terms offered: Spring 2020, Spring 2019, Spring 2018  
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.  
Introduction to MEMS Design: Read More [+]

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

Formerly known as: Electrical Engineering C245, Mechanical Engineering C218

Also listed as: EL ENG C247B

Introduction to MEMS Design: Read Less [-]
MEC ENG 219 Introduction to Microelectromechanical Systems 3 Units
Terms offered: Spring 2001, Spring 2000
Fundamentals of microelectromechanical systems including design, fabrication of microstructures; surface micromachining, bulk-micromachining, LIGA, and other micro machining processes; fabrication principles of integrated circuit device and their applications for making MEMS devices; high-aspect-ratio microstructures; scaling issues in the micro scale (heat transfer, fluid mechanics and solid mechanics); device design, analysis, and mask layout.

Introduction to Microelectromechanical Systems: Read More [+]

Objectives & Outcomes

Course Objectives: The course aims to provide basic understanding of micromachining processes, including surface micromachining, bulk micromachining and LIGA. Students should learn the design and fabrication aspects of MEMS by using computer-aided-design tools to design and draw their own microstructures.

Student Learning Outcomes: ABET: A recognition of the need for, and an ability to engage in life-long learning; a knowledge of contemporary issues; an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ABET: An ability to apply knowledge of mathematics, science, and engineering; an ability to design a system, component, or process to meet desired needs; an ability to identify, formulate, and solve engineering problems.

Students completing this course will have: The ability to identify, formulate, and solve problems relating to MEMS manufacturing.

Students should be able to design micro-machining process flows by using fundamental skills learned in the class and combine with knowledge from other courses to construct their own micro-machines.

The ability to apply mathematics, basic science, and engineering science to the solution of MEMS manufacturing problems.

The ability to design a component and select a fabrication process or sequence of processes suitable for production of a MEMS device.

The ability to identify, formulate, and solve problems relating to MEMS manufacturing.

The ability to interpret the results of engineering investigations.

Rules & Requirements

Prerequisites: MEC ENG 100 and PHYSICS 7B
Credit Restrictions: Students will receive no credit for MEC ENG 219 after completing MEC ENG 219, or MEC ENG 219. A deficient grade in MEC ENG 219 may be removed by taking MEC ENG 219, or MEC ENG 219.

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

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.
Parametric and Optimal Design of MEMS: Read More [+]

Rules & Requirements

Prerequisites: Graduate standing or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

MEC ENG 220 Precision Manufacturing 3 Units
Terms offered: Fall 2015, Fall 2013, Fall 2012
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Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

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

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.

Precision Manufacturing: Read More [+]

Rules & Requirements

Prerequisites: 101, 102B, or consent of instructor

Hours & Format
**MEC ENG C220D Input/Output Methods for Compositional System Analysis 2 Units**

Terms offered: Prior to 2007

Introduction to input/output concepts from control theory, systems as operators in signal spaces, passivity and small-gain theorems, dissipativity theory, integral quadratic constraints. Compositional stability and performance certification for interconnected systems from subsystems input/output properties. Case studies in multi-agent systems, biological networks, Internet congestion control, and adaptive control.

Input/Output Methods for Compositional System Analysis: Read More [+]

**Objectives & Outcomes**

Course Objectives: Standard computational tools for control synthesis and verification do not scale well to large-scale, networked systems in emerging applications. This course presents a compositional methodology suitable when the subsystems are amenable to analytical and computational methods but the interconnection, taken as a whole, is beyond the reach of these methods. The main idea is to break up the task of certifying desired stability and performance properties into subproblems of manageable size using input/output properties. Students learn about the fundamental theory, as well as relevant algorithms and applications in several domains.

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, Packard

**Also listed as:** EL ENG C220D

Input/Output Methods for Compositional System Analysis: Read Less [-]

**MEC ENG 221 Graduate Introduction to Lean Manufacturing Systems 3 Units**

Terms offered: Spring 2019, Spring 2018, Fall 2006

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.

Graduate Introduction to Lean Manufacturing Systems: Read More [+]

**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

Graduate Introduction to Lean Manufacturing Systems: Read Less [-]
MEC ENG C223 Polymer Engineering 3 Units
Terms offered: Fall 2019, Fall 2017, Fall 2015
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

MEC ENG C224 Mechanical Behavior of Engineering Materials 3 Units
Terms offered: Spring 2020, Fall 2018, Fall 2016
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.

MEC ENG C225 Deformation and Fracture of Engineering Materials 4 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
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
Formerly known as: Materials Science and Engineering C212, Mechanical Engineering C225
Also listed as: MAT SCI C212

MEC ENG C226 Tribology 3 Units
Terms offered: Spring 2019, Fall 2016, Spring 2016

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

MEC ENG 227 Mechanical Behavior of Composite Materials 3 Units
Terms offered: Spring 2013, Fall 2010, Fall 2008
Mechanical Behavior of Composite Materials: Read More [+]
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 2020, Spring 2019, Spring 2018
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: Prior to 2007
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.

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.

MEC ENG C231A Experiential Advanced Control Design I 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
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.

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

Also listed as: EL ENG C220B

MEC ENG C231B Experiential Advanced Control Design II 3 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
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.

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

Also listed as: EL ENG C220C
MEC ENG C232 Advanced Control Systems I 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
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
Terms offered: Spring 2020, Spring 2019, Spring 2018
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 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 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: Packard, Poolla
Multivariable Control System Design: Read Less [-]

MEC ENG 235 Design of Microprocessor-
Based Mechanical Systems 4 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
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 236U Control and Dynamics of Unmanned Aerial Vehicles 3 Units

Terms offered: Fall 2019

This course is a room share with ME136, and teaches students the dynamic analysis and control of unmanned aerial vehicles (UAVs). The course covers modeling and dynamics of aerial vehicles, common control strategies, sensing and estimation. A laboratory sequence allows students to apply knowledge on a real quadcopter system, by programming a microcontroller to control a UAV.

Control and Dynamics of Unmanned Aerial Vehicles: Read More [+]

Objectives & Outcomes

Course Objectives: Introduce the students to analysis, modeling, and control of unmanned aerial vehicles. Lectures will cover:

• Principle forces acting on a UAV, including aerodynamics of propellers
• The kinematics and dynamics of rotations, and 3D modeling of vehicle dynamics
• Typical sensors, and their modeling
• Typical control strategies, and their pitfalls
• Programming a microcontroller During the laboratory sessions, students will apply these skills to create a model-based controller for a UAV.

Rules & Requirements

Prerequisites: Introductory control (Mechanical Engineering 132 or similar), Dynamics (Mechanical Engineering 104 or similar). Taken concurrently: a graduate controls class (Mechanical Engineering C232/Electrical Engineering C220A or similar)

Credit Restrictions: Student will not receive credit for this course if they have taken Mechanical Engineering 136.

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: Mueller

Control and Dynamics of Unmanned Aerial Vehicles: Read Less [-]

MEC ENG C236 Control and Optimization of Distributed Parameters Systems 3 Units

Terms offered: Fall 2017, Spring 2016, Spring 2015, Spring 2014


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.

MEC ENG C237 Nonlinear Systems 3 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
Nonlinear Systems: Read More [+]

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
Nonlinear Systems: Read Less [-]

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.
Advanced Micro/Nano Mechanical Systems Laboratory: Read More [+]

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.
Advanced Micro/Nano Mechanical Systems Laboratory: Read Less [-]
MEC ENG 239 Advanced Design and Automation 4 Units
Terms offered: Fall 2019, Fall 2018, Fall 2014
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

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.

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
MEC ENG 241A Marine Hydrodynamics I 3 Units
Terms offered: Fall 2016, Fall 2015, Spring 2014

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

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 242 Ocean-Environment Fluid Mechanics 3 Units
Terms offered: Spring 2020

Objectives & Outcomes

Course Objectives: To provide training of mechanical engineers to understand the unique characteristics of the ocean environment, local and global scale, and to provide background on engineering and design tools that are commonly used by engineers working with system and component designs of ocean, marine energy, and ship systems.

Student Learning Outcomes: At the end of the course, the students should understand general scientific properties that characterize the main body of the oceans; understand components of drags that contribute to the resistance of a marine vehicle and the associated engineering skills in model-testing that quantify the drag characteristics of a ship hull; comprehend simple harmonic surface-wave theory, with strong realization of the underlying concepts of wave kinematics, wave energy, and group velocity.

Rules & Requirements

Prerequisites: ME 106 OR CEE 100 OR equivalent fluids/hydro undergraduate class

Hours & Format

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

MEC ENG 243 Advanced Methods in Free-Surface Flows 3 Units
Terms offered: Spring 2016, Fall 2012, Spring 2009

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
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.

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.

Oceanic and Atmospheric Waves: Read Less [-]

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: Fall 2019, Fall 2018

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

MEC ENG 250B Advanced Convective Transport and Computational Methods 3 Units

Terms offered: Spring 2020, Spring 2019
The transport of heat and mass in fluids in motion; free and forced convection in laminar and turbulent flow over surfaces and within ducts. Fundamentals of computational methods used for solving the governing transport equations will also be covered.

Objectives & Outcomes

Course Objectives: This course will provide students with knowledge of the physics of convective transport and an introduction to computational tools that can model convective processes in important applications such as electronics cooling, aerospace thermal management. The course also teaches students to construct computational models of natural and forced convection processes in boundary layers 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
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 Graduate Applied Optics and Radiation 3 Units
Terms offered: Spring 2018, Fall 2015, Fall 2013
Graduate Applied Optics and Radiation: Read More [+]
Objectives & Outcomes
Course Objectives: The course will provide students with knowledge of the fundamental principles of optics to analyze optical phenomena and develop the background and skills to design optical instrumentation applied to engineering fields, including additive manufacturing, radiometry and spectroscopy.
Student Learning Outcomes: Students will gain knowledge of the EM theory, optical properties of materials, principles of spectroscopy for gases, liquids and solids, principles and applications of lasers and optical diagnostics. Students will develop the ability to design optical instrumentation systems in the context of key industrial applications, including additive manufacturing, materials processing, bio-optics, semiconductor industry applications, reacting systems, forensics.
Rules & Requirements
Prerequisites: Undergraduate courses in physics (e.g. 7A,B,C). Each student must have access to a PC, Macintosh or workstation machine with scientific programming capabilities for use in homework and projects
Credit Restrictions: Students will not receive credit for this course if they have taken ME 153.
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
Graduate Applied Optics and Radiation: Read Less [-]
MEC ENG 254 Advanced Thermophysics for Applications 3 Units
Terms offered: Fall 2019, Spring 2019, Spring 2018
Development of classical thermodynamics from statistical treatment of microscale molecular behavior; Boltzmann distribution; partition functions; statistical-mechanical evaluation of thermodynamic properties; equilibrium; chemical equilibrium; phase transitions; molecular collisions; Maxwell-Boltzmann distribution; collision theory; elementary kinetic theory; molecular dynamics simulation of molecular collisions; kinetic Monte Carlo simulations of gas-phase and gas-surface reactions. Implications are explored for a variety of applications, which may include advanced combustion systems, renewable power systems, microscale transport in high heat flux electronics cooling, aerospace thermal management, and advanced materials processing.
Advanced Thermophysics for Applications: Read More [+]

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

Student Learning Outcomes: Students ability to calculate partition functions, perform equilibrium calculations, and undertake molecular-dynamics and Monte-Carlo simulations of non-equilibrium systems. This course will provide a foundation for design analysis of energy conversion systems and transport phenomena encountered in a variety of applications.

Rules & Requirements
Prerequisites: Mechanical Engineering 40
Credit Restrictions: Students will not receive credit for this course if they have taken ME 154.

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, Frenklach

Advanced Thermophysics for Applications: Read Less [-]

MEC ENG 255 Advanced Combustion Processes 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2016
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.
Instructors: Chen, Fernandez-Pello

Advanced Combustion Processes: Read Less [-]
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

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.

Instructors: Carey, Majumdar

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 2019, Fall 2018, Fall 2017
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.
Advanced Fluid Mechanics I: Read Less [-]

MEC ENG 260B Advanced Fluid Mechanics II
3 Units
Terms offered: Spring 2020, Spring 2019, Spring 2018
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 per week 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 2019, Spring 2017, Fall 2012
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 2019, Spring 2015, Spring 2013
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

MEC ENG 270 Advanced Augmentation of Human Dexterity 4 Units
Terms offered: Spring 2020
This course provides hands-on experience in designing prostheses and assistive technologies using user-centered design. Students will develop a fundamental understanding of the state-of-the-art, design processes and product realization. Teams will prototype a novel solution to a disabilities-related challenge, focusing on upper-limb mobility or dexterity. Lessons will cover biomechanics of human manipulation, tactile sensing and haptics, actuation and mechanism robustness, and control interfaces. Readings will be selected from texts and academic journals available through the UCB online library system and course notes. Guest speakers will be invited to address cutting edge breakthroughs relevant to assistive technology and design.

Advanced Augmentation of Human Dexterity: Read More [+]

Objectives & Outcomes
Course Objectives: The course objectives are to:
- Learn the fundamental principles of biomechanics, dexterous manipulation, and electromechanical systems relevant for non-invasive, cutting-edge assistive device and prosthesis design
- Enhance skill in the areas of human-centered design, teamwork and communication through the practice of conducting labs and a project throughout the semester

Rules & Requirements
Prerequisites: ME 132, or equivalent. Designing for the Human Body (ME C178) or Orthopedic Biomechanics (ME C176), or equivalent. Proficiency with Matlab, or equivalent program

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

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: Stuart

Also listed as: CHM ENG C268

Physicochemical Hydrodynamics: 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 271 Intermediate Dynamics 3 Units
Terms offered: Fall 2019
This course introduces and investigates Lagrange's equations of motion for particles and rigid bodies. The subject matter is particularly relevant to applications comprised of interconnected and constrained discrete mechanical components. The material is illustrated with numerous examples. These range from one-dimensional motion of a single particle to three-dimensional motions of rigid bodies and systems of rigid bodies. Intermediate Dynamics: Read More [+]

Objectives & Outcomes

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

Rules & Requirements

Prerequisites: ME 104 or equivalent
Credit Restrictions: Students will receive no credit for MEC ENG 271 after completing MEC ENG 175, or MEC ENG 271. A deficient grade in MEC ENG 271 may be removed by taking MEC ENG 271.

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: O'Reilly, Casey
Intermediate Dynamics: 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
Oscillations in Linear Systems: Read Less [-]

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

Rules & Requirements

Prerequisites: 104 and 133

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
Random Oscillations of Mechanical Systems: Read Less [-]
MEC ENG 275 Advanced Dynamics 3 Units
Terms offered: Spring 2017, Spring 2015, Spring 2012
Review of Lagrangian dynamics. Legendre transform and Hamilton’s equations. Cyclic coordinates, Canonical transformations, Hamilton-Jacobi theory, integrability. Dynamics of asymmetric systems. Approximation theory. Current topics in analytical dynamics. 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.

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

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

MEC ENG C278 Adv Designing for the Human Body 4 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017
The course provides project-based learning experience in understanding product design, with a focus on the human body as a mechanical machine. Students will learn the design of external devices used to aid or protect the body. Topics will include forces acting on internal materials (e.g., muscles and total replacement devices), forces acting on external materials (e.g., 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.

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 2020, Spring 2017, Fall 2013

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

MEC ENG 280A Introduction to the Finite Element Method 3 Units
Terms offered: Fall 2019, Fall 2018, Fall 2017

Introduction to the Finite Element Method: Read More [+]

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

Instructors: Papadopoulos, Zohdi

Formerly known as: 280

MEC ENG 280B Finite Element Methods in Nonlinear Continua 3 Units
Terms offered: Spring 2019, Spring 2016, Spring 2013

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

Instructor: Papadopoulos

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

Instructor: Papadopoulos

Formerly known as: 280

Methods of Tensor Calculus and Differential Geometry: Read Less [-]
MEC ENG 282 Theory of Elasticity 3 Units
Terms offered: Spring 2020, Spring 2018, Spring 2016
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 More [+]

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: Casey

Wave Propagation in Elastic Media: Read More [+]

MEC ENG 284 Nonlinear Theory of Elasticity 3 Units
Terms offered: Spring 2019, Spring 2017, Spring 2014

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

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

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 More [+]

MEC ENG 285A Foundations of the Theory of Continuous Media 3 Units
Terms offered: Spring 2020, Spring 2018, Spring 2016
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.

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

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

MEC ENG 285C Electrodynamics of Continuous Media 3 Units
Terms offered: Spring 2019, Spring 2015, Spring 2013
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

Electrodynamics of Continuous Media: Read Less [-]
**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.

**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.

**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 More [+]

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**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 [-]

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**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.

**Rules & Requirements**

**Prerequisites:** 185

**Hours & Format**

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

**Instructors:** Casey, Papadopoulos

Theory of Plasticity: Read Less [-]
MEC ENG 287 Graduate Introduction to Continuum Mechanics 3 Units
Terms offered: Fall 2019, Fall 2018, Spring 2008
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.
Graduate Introduction to Continuum Mechanics: Read More [+]

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 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 2020, Spring 2015, Fall 2010
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.

Solid Modeling and CAD/CAM Fundamentals: Read More [+]

Objectives & Outcomes

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

Solid Modeling and CAD/CAM Fundamentals: Read Less [-]
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.
Laser Processing and Diagnostics: Read More [+]
Rules & Requirements
Prerequisites: Graduate standing or undergraduate elective upon completion of ME109
Repeat rules: Course may be repeated for credit when topic changes.
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructor: Grigoropoulos

MEC ENG 290H Green Product Development: Design for Sustainability 3 Units
Terms offered: Spring 2019, Spring 2017, Spring 2013
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
Green Product Development: Design for Sustainability: 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. Predictive Control for Linear and Hybrid Systems: Read More [+] 

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

Predictive Control for Linear and Hybrid Systems: Read Less [-]
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

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.

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
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. Expert Systems in Mechanical Engineering: Read More [+]

Rules & Requirements

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

Expert Systems in Mechanical Engineering: Read Less [-]

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. System Identification: Read More [+]

Rules & Requirements

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

System Identification: Read Less [-]
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.

New Product Development: Design Theory and Methods: Read More [+]

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.

Rules & Requirements
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

New Product Development: Design Theory and Methods: Read Less [-]

MEC ENG 290Q Dynamic Control of Robotic Manipulators 3 Units
Terms offered: Fall 2008, Spring 2007, Fall 2001

Dynamic Control of Robotic Manipulators: Read More [+]

Rules & Requirements
Prerequisites: 230, 232, or consent of instructor

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.
Instructors: Horowitz, Kazerooni

Dynamic Control of Robotic Manipulators: Read Less [-]

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.
Topics in Manufacturing: Read More [+]

Rules & Requirements
Prerequisites: Consent of instructor
Repeat rules: Course may be repeated for credit when topic changes.

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

Additional Details
Subject/Course Level: Mechanical Engineering/Graduate
Grading: Letter grade.
Instructors: Dornfeld, McMains, Wright

Topics in Manufacturing: Read Less [-]
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.  
Plasmonic Materials: Read More [+]

Rules & Requirements

Prerequisites: Physics 110A or consent of instructor

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

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Graduate

Grading: Letter grade.

Instructor: Zhang

Plasmonic Materials: Read Less [-]

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.  
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

Prerequisites: Instructor consent

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: Hartmann, Wright

Interactive Device Design: 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.

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 2020, Spring 2018, Spring 2016

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.

MEC ENG 292A Advanced Special Topics in Bioengineering 1 - 4 Units
Terms offered: Spring 2020, Spring 2018, Fall 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.

MEC ENG 292B Advanced Special Topics in Controls 1 - 4 Units
Terms offered: Fall 2019, Fall 2018, Spring 2018
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.
MEC ENG 292C Advanced Special Topics in Design 1 - 4 Units
Terms offered: Spring 2020, Fall 2019, Spring 2019
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.
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.
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 2019, Spring 2019, Spring 2018
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.

Advanced Special Topics in Energy Science and Technology: 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.

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.

Advanced Special Topics in Fluids: 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.

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.

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.

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 More [+]

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.

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.

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.

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.

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.

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.

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: Spring 2019
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.
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 2020, Fall 2019, Spring 2019
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 [+]
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: Spring 2020, Fall 2019, Spring 2019
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: Spring 2020, Fall 2019, Spring 2019
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: Spring 2020, Fall 2019, Spring 2019
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.
Teaching of Mechanical Engineering at the University Level: Read More [+]

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 [-]