Mechanical Engineering

Bachelor of Science (BS)

Mechanical engineers serve society by solving problems in transportation, energy, the environment, and human health. The activity of mechanical engineers extends from the investigation of physical phenomena governing the behavior of our surroundings to the manufacture and evaluation of products. The mechanical engineering profession encompasses numerous technical areas, including acoustics, automatic control, bioengineering, combustion, cryogenics, design, dynamics, energy conversion, engines, environment, heat transfer, lubrication, mass transfer, manufacturing and sustainability, materials processing, mechanics of solids and fluids, mechanisms, plasma dynamics, propulsion, thermodynamics, vibration, and wave propagation.

The undergraduate program in mechanical engineering seeks to provide students with a broad education emphasizing an excellent foundation in scientific and engineering fundamentals. The objectives of the undergraduate program are to prepare undergraduate students for employment or advanced studies with four primary constituencies: industry, the national laboratories, state and federal agencies, and academia (graduate research programs).

Accreditation

Our programs are accredited by ABET (http://www.abet.org/accreditation), a non-profit and non-governmental accrediting agency for academic programs in the disciplines of applied science, computing, engineering, and engineering technology. ABET is a recognized accreditor in the United States (U.S.) by the Council for Higher Education Accreditation (http://www.chea.org). For information about how the program achieves ABET course outcomes, please see the Department's website (http://www.me.berkeley.edu/undergraduate/degree-program/program-objectives-and-outcomes-abet).

Admission to the Major

Prospective undergraduates in the College of Engineering will apply for admission to a specific program in the college. For further information, please see the College of Engineering's website (http://coe.berkeley.edu/students/prospective-students/admissions.html).

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

Five-Year BS/MS Program

This program is for Berkeley ME undergraduates who wish to broaden their education experiences at Berkeley. In contrast to the standard MS program, this BS/MS program is completely course-based. Students in the five-year BS/MS program are also able to take some courses in professional disciplines such as business or public policy. This two-semester program is not intended for students with the desire to continue to the PhD. For further information regarding this option, please see the department's website (http://www.me.berkeley.edu/graduate/degree-programs/five-year-bsms-program).

Minor Program

The department offers a minor program in Mechanical Engineering. For admission to the minor, students must have a minimum overall grade point average (GPA) of 3.00 as well as a minimum 3.00 GPA in the prerequisite courses. For information regarding the prerequisites, please see the Minor Requirements tab on this page.

After completion of the prerequisite courses, students will need to complete and submit to the Mechanical Engineering Student Services Office (Room 6189/6193 Etcheverry) a Petition for Admission form which can be found here (http://www.me.berkeley.edu/undergraduate/degree-program-requirements/me-minor-program). The department will verify the completion of the minor and send the paperwork to the appropriate parties after final grades are available.

Joint Majors

The Department of Mechanical Engineering also offers two joint majors with other departments in the College of Engineering. For further information on these programs, please click the links below:

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

Mechanical Engineering/Nuclear Engineering (http://guide.berkeley.edu/undergraduate/degree-programs/mechanical-engineering-nuclear) (Department of Nuclear Engineering)

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

General Guidelines

1. All technical courses taken in satisfaction of major requirements must be taken for a letter grade.

2. No more than one upper division course may be used to simultaneously fulfill requirements for a student's major and minor programs.

3. A minimum overall grade point average (GPA) of 2.0 is required for all work undertaken at UC Berkeley.

4. A minimum GPA of 2.0 is required for all upper division technical courses taken in satisfaction of major requirements.

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

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

Lower Division Requirements

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 1A</td>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1B</td>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 53</td>
<td>Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 54</td>
<td>Linear Algebra and Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 1A</td>
<td>General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 1AL</td>
<td>and General Chemistry Laboratory 1</td>
<td></td>
</tr>
<tr>
<td>or CHEM 4A</td>
<td>General Chemistry and Quantitative Analysis</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 7A</td>
<td>Physics for Scientists and Engineers</td>
<td>4</td>
</tr>
<tr>
<td>PHYSICS 7B</td>
<td>Physics for Scientists and Engineers</td>
<td>4</td>
</tr>
</tbody>
</table>
Upper Division Requirements

M.E. ENG 102A  Introduction to Mechanical Systems for Mechatronics  4
M.E. ENG 102B  Mechatronics Design  4
M.E. ENG 104  Engineering Mechanics II  3
M.E. ENG 106  Fluid Mechanics  3
M.E. ENG 107  Mechanical Engineering Laboratory  3
M.E. ENG 108  Mechanical Behavior of Engineering Materials  4
M.E. ENG 109  Heat Transfer  3
M.E. ENG 132  Dynamic Systems and Feedback  3

Technical electives, minimum 15 units 1,2,3

Select at least one course from the design elective list:
- ENGIN 128  Advanced Engineering Design Graphics  1
- M.E. ENG 101  Introduction to Lean Manufacturing Systems
- M.E. ENG 110  Introduction to Product Development
- M.E. ENG C11  Structural Aspects of Biomaterials
- M.E. ENG 119  Introduction to MEMS (Microelectromechanical Systems)
- M.E. ENG 130  Design of Planar Machinery
- M.E. ENG 135  Design of Microprocessor-Based Mechanical Systems
- M.E. ENG 146  Energy Conversion Principles
- M.E. ENG 165  Ocean-Environment Mechanics
- M.E. ENG C17  Orthopedic Biomechanics

Select at least one course from quantitative science elective list:
- ENGIN 117  Methods of Engineering Analysis  1
- ENGIN 177  Advanced Programming with MATLAB  1
- M.E. ENG 120  Computational Biomechanics Across Multiple Scales
- M.E. ENG C18  Engineering Analysis Using the Finite Element Method

1  CHEM 4A is intended for students majoring in chemistry or a closely-related field.
2  All junior transfer admits are exempt from completing ENGIN 26.
3  Technical electives cannot include:
   • Any course taken on a Pass/No Pass basis
   • Courses numbered 24, 39, 84, or 88
   • Any of the following courses: BIO ENG 100, COMPSCI C79, COMPSCI 195, COMPSCI H195, DES INV courses (except DES INV 15, DES INV 22, DES INV 90E, DES INV 90E), ENGIN 125, ENGIN 157AC, ENGIN 180, IND ENG 95, IND ENG 171, IND ENG 185, IND ENG 186, IND ENG 190 series, IND ENG 191, IND ENG 192, IND ENG 195, M.E. ENG 191AC, M.E. ENG 190K, and M.E. ENG 191K

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

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

General Guidelines

1. All courses taken to fulfill the minor requirements must be taken for graded credit.
2. A minimum overall grade point average (GPA) of 3.0 and a minimum GPA of 3.0 in the prerequisite courses is required for acceptance into the minor program.
3. A minimum grade point average (GPA) of 2.0 is required for courses used to fulfill the minor requirements.
4. No more than one upper division course may be used to simultaneously fulfill requirements for a student’s major and minor programs.
5. Completion of the minor program cannot delay a student’s graduation.
Requirements

Prerequisites

<table>
<thead>
<tr>
<th>Course</th>
<th>Course Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 7A</td>
<td>Physics for Scientists and Engineers</td>
<td>4</td>
</tr>
<tr>
<td>MEC ENG 40</td>
<td>Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>MEC ENG 104</td>
<td>Engineering Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>MEC ENG C85</td>
<td>Introduction to Solid Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

Upper Division Requirements

Select three additional upper division technical courses in mechanical engineering.

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

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

Humanities and Social Science (H/SS) Requirement

To promote a rich and varied educational experience outside of the technical requirements for each major, the College of Engineering has a six-course Humanities and Social Sciences breadth requirement (http://engineering.berkeley.edu/student-services/degree-requirements/humanities-and-social-sciences), which must be completed to graduate. This requirement, built into all the engineering programs of study, includes two reading and composition courses (R&C), and four additional courses within which a number of specific conditions must be satisfied. Follow these guidelines to fulfill this requirement:

1. Complete a minimum of six courses from the approved Humanities/Social Sciences (H/SS) lists (http://coe.berkeley.edu/hssreq).
2. Courses must be a minimum of 3 semester units (or 4 quarter units).
3. Two of the six courses must fulfill the college's Reading and Composition (R&C) requirement. These courses must be taken for a letter grade (C- or better required) and must be completed by no later than the end of the sophomore year (fourth semester of enrollment). The first half of R&C, the “A” course, must be completed by the end of the freshman year; the second half of R&C, the “B” course, must be completed by no later than the end of the sophomore year. View a detailed list of courses (http://ls-advise.berkeley.edu/requirement/rccourses.html) that fulfill Reading and Composition requirements, or use the College of Letters and Sciences search engine (http://ls-breadth.berkeley.edu) to view R&C courses offered in a given semester.
4. The four additional courses must be chosen within College of Engineering guidelines from the H/SS lists (see below). These courses may be taken on a Pass/Not Passed basis (P/NP).
5. Two of the six courses must be upper division (courses numbered 100-196).
6. One of the six courses must satisfy the campus American Cultures requirement. For detailed lists of courses that fulfill American Cultures requirements, visit the American Cultures (http://guide.berkeley.edu/undergraduate/colleges-schools/engineering/american-cultures-requirement) site.
7. A maximum of two exams (Advanced Placement, International Baccalaureate, or A-Level) may be used toward completion of the H/SS requirement. View the list of exams (http://engineering.berkeley.edu/academics/undergraduate-guide/exams) that can be applied toward H/SS requirements.
8. Courses may fulfill multiple categories. For example, if you complete CY PLAN 118AC (http://guide.berkeley.edu/search/?P=CY%20PLAN%20118AC) that would satisfy the American Cultures requirement and one upper division H/SS requirement.
9. No courses offered by any engineering department other than BIO ENG 100 (http://guide.berkeley.edu/search/?P=BIO%20ENG%20100), COMPSCI C79 (http://guide.berkeley.edu/search/?P=COMPSCI%20C79), ENGIN 125 (http://guide.berkeley.edu/search/?P=ENGIN%20125), ENGIN 157AC (http://guide.berkeley.edu/search/?P=ENGIN%20157AC), MEC ENG 191K (http://guide.berkeley.edu/search/?P=MEC%20ENG%20191K) and MEC ENG 191AC (http://guide.berkeley.edu/search/?P=MEC%20ENG%20191AC) may be used to complete H/SS requirements.
10. Foreign language courses may be used to complete H/SS requirements. View the list of language options (http://ls-advise.berkeley.edu/requirement/fl.html).
11. Courses numbered 97, 98, 99, or above 196 may not be used to complete any H/SS requirement.
12. The College of Engineering uses modified versions of five of the College of Letters and Science (L&S) breadth requirements lists to provide options to our students for completing the H/SS requirement. No courses on the L&S Biological Sciences or Physical Sciences breadth lists may be used to complete H/SS requirements. Within the guidelines above, choose courses from any of the lists below.
   - Arts and Literature (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/breadth-requirement-arts-literature)
   - Foreign Language (http://ls-advise.berkeley.edu/requirement/fl.html)
   - Historical Studies (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/breadth-requirement-historical-studies)
• International Studies (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/breadth-requirement-international-studies)
• Philosophy and Values (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/breadth-requirement-philosophy-values)
• Social and Behavioral Studies (http://guide.berkeley.edu/undergraduate/colleges-schools/letters-science/breadth-requirement-social-behavioral-sciences)

Class Schedule Requirements
• Minimum units per semester: 12.0.
• Maximum units per semester: 20.5.
• Minimum technical courses: College of Engineering undergraduates must enroll each semester in no fewer than two technical courses (of a minimum of 3 units each) required of the major program of study in which the student is officially declared. (Note: for most majors, normal progress will require enrolling in 3-4 technical courses each semester).
• All technical courses (math, science, engineering), required of the major or not, must be taken on a letter-graded basis (unless only offered as P/NP).
• A student’s proposed schedule must be approved by a faculty adviser (or on approval from the dean or a designated staff adviser) each semester prior to enrolling in courses.

Minimum Academic (Grade) Requirements
• A minimum overall and semester grade point average of 2.00 (C average) is required of engineering undergraduates. A student will be subject to dismissal from the University if during any fall or spring semester their overall UC GPA falls below a 2.00, or their semester GPA is less than 2.00.
• Students must achieve a minimum grade point average of 2.00 (C average) in upper division technical courses required for the major curriculum each semester. A student will be subject to dismissal from the University if their upper division technical grade point average falls below 2.00.
• A minimum overall grade point average of 2.00, and a minimum 2.00 grade point average in upper division technical course work required for the major is needed to earn a Bachelor of Science in Engineering.

Unit Requirements
To earn a Bachelor of Science in Engineering, students must complete at least 120 semester units of courses subject to certain guidelines:
• Completion of the requirements of one engineering major program (http://engineering.berkeley.edu/academics/undergraduate-programs) of study.
• A maximum of 16 units of special studies coursework (courses numbered 97, 98, 99, 197, 198, or 199) is allowed towards the 120 units; a maximum of four is allowed in a given semester.
• A maximum of 4 units of physical education from any school attended will count towards the 120 units.
• Students may receive unit credit for courses graded P (including P/NP units taken through EAP) up to a limit of one-third of the total units taken and passed on the Berkeley campus at the time of graduation.

Normal Progress
Students in the College of Engineering must enroll in a full-time program and make normal progress each semester toward the bachelor’s degree. The continued enrollment of students who fail to achieve minimum academic progress shall be subject to the approval of the dean. (Note: students with official accommodations established by the Disabled Students’ Program, with health or family issues, or with other reasons deemed appropriate by the dean may petition for an exception to normal progress rules.)

University of California Requirements
Entry Level Writing (http://guide.berkeley.edu/undergraduate/colleges-schools/natural-resources/entry-level-writing-requirement)
All students who will enter the University of California as freshmen must demonstrate their command of the English language by fulfilling the Entry Level Writing Requirement. Fulfillment of this requirement is also a prerequisite to enrollment in all reading and composition courses at UC Berkeley.

American History and American Institutions (http://guide.berkeley.edu/undergraduate/colleges-schools/natural-resources/american-history-institutions-requirement)
The American History and Institutions requirements are based on the principle that a U.S. resident graduated from an American university should have an understanding of the history and governmental institutions of the United States.

Campus Requirement
American Cultures (http://guide.berkeley.edu/undergraduate/colleges-schools/natural-resources/american-cultures-requirement)
American Cultures (AC) is the one requirement that all undergraduate students at UC Berkeley need to take and pass in order to graduate. The requirement offers an exciting intellectual environment centered on the study of race, ethnicity and culture in the United States. AC courses offer students opportunities to be part of research-led, highly accomplished teaching environments, grappling with the complexity of American Culture.

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Units</th>
<th>Spring</th>
<th>Freshman Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 4A or 1A and 1AL</td>
<td>4</td>
<td>MATH 1B</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MATH 1A</td>
<td>4</td>
<td>PHYSICS 7A</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ENGIN 25</td>
<td>2</td>
<td>ENGIN 7</td>
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<tr>
<td>Reading &amp; Composition course from List A</td>
<td>4 Reading &amp; Composition course from List B</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td>Optional Freshman Seminar or ENGIN 92</td>
<td>0-1 Optional Freshman Seminar</td>
<td>0-1</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Units</th>
<th>Spring</th>
<th>Sophomore Units</th>
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</thead>
<tbody>
<tr>
<td>MATH 53</td>
<td>4</td>
<td>MATH 54</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>PHYSICS 7B</td>
<td>4</td>
<td>MEC ENG 40</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ENGIN 26</td>
<td>2</td>
<td>MEC ENG C85</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
ENGIN 27
2 Humanities/Social Sciences course 3-4

Humanities/Social Sciences course 3-4 Free Elective 1

15-16 14-15

Fall Units Spring Units

MEC ENG 104 3 EL ENG 16A or 49 4
MEC ENG 106 3 MEC ENG 10f 3
MEC ENG 108 4 MEC ENG 132 3
Technical Elective3,4,5 3 Technical Elective3,4,5 3

Humanities/Social Sciences course 3-4 Humanities/Social Sciences course

16-17 16-17

Fall Units Spring Units

MEC ENG 102A 4 MEC ENG 102B 4
Technical Electives3,4,5 6 MEC ENG 10f 3
Free Electives 6 Technical Elective3,4,5 3

Free Elective 3

16 13

Total Units: 120-126

1 CHEM 4A is intended for students majoring in chemistry or a closely-related field.
2 All junior transfer admits are exempt from completing ENGIN 26.
3 Technical electives: 15 units of technical electives (http://www.me.berkeley.edu/undergraduate/course-information/undergraduate-technical-electives) are required, of which at least 9 units must be upper division mechanical engineering courses. Of these 9 units, 3 units must be a design course selected from the following: ENGIN 128, MEC ENG 101, MEC ENG 110, MEC ENG C117, MEC ENG 119, MEC ENG 130, MEC ENG 135, MEC ENG 146, MEC ENG 165, MEC ENG 191AC, MEC ENG 190K, and MEC ENG 191K.
4 Up to three units of lower division coursework can count toward the technical elective requirement. Approved lower division courses include: ASTRON 7A, ASTRON 7B, BIO ENG 10, BIOLOGY 1A plus BIOLOGY 1B, CHEM 3A, CHEM 3B, CHEM 4B, COMPSCI 61C, COMPSCI 70, DES INV 15, DES INV 22, DES INV 90E, DES INV 190E, ENGIN 125, ENGIN 157AC, ENGIN 180, IND ENG 95, IND ENG 171, IND ENG 185, IND ENG 186, IND ENG 190 series, IND ENG 191, IND ENG 192, IND ENG 195, MEC ENG 191AC, MEC ENG 190K, and MEC ENG 191K.
5 Technical electives cannot include:
   - Any course taken on a Pass/No Pass basis
   - Courses numbered 24, 39, 84, or 88
   - Any of the following courses: BIO ENG 100, CHM ENG 185, COMPSCI C79, COMPSCI 195, COMPSCI H195, DES INV courses (except DES INV 15, DES INV 22, DES INV 90E, DES INV 190E), ENGIN 125, ENGIN 157AC, ENGIN 180, IND ENG 95, IND ENG 171, IND ENG 185, IND ENG 186, IND ENG 190 series, IND ENG 191, IND ENG 192, IND ENG 195, MEC ENG 191AC, MEC ENG 190K, and MEC ENG 191K.

Learning Goals for the Major

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

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

Skills

The Department of Mechanical Engineering has adopted the ABET Outcomes as its Program Outcomes. Mechanical Engineering graduates have the following:

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

Students in Mechanical Engineering have a number of advising options, listed in sequential order:
College of Engineering (COE)

All undergraduates have an adviser at the College referred to as the Engineering Student Services (ESS) Adviser. ESS advisers assist students in a variety of ways including course selection (primarily for freshmen, sophomores and transfer students), explaining graduation requirements and college policies, monitoring progress toward the degree, suggesting enrichment opportunities, and providing support (or referrals to campus resources) to help students reach their academic goals. They are also the first stop for students who wish to file a petition. Advising assignments are made alphabetically. Students who are unsure of who their adviser is should refer to the COE's undergraduate advising information page (http://coe.berkeley.edu/students/current-undergraduates/advising/student-affairs-advising.html).

ME Student Services Office

This office is students' primary source of department-specific administrative information.

ME Faculty Adviser

Faculty advisers for new students will be assigned by the beginning of October and a listing will be available online. Faculty are great sources for information regarding classes, research opportunities, and career planning. Furthermore, all ME students are required to see their faculty advisers (or go to drop-in advising) to get their advising codes before signing up for the next semester's courses.

Vice Chair for Undergraduate Matters

The vice chair handles all undergraduate student petitions and can serve as a liaison between students and their respective advisers as well as students and the ME chair. He is also responsible for the ME undergraduate curriculum and heads the Committee on Undergraduate Study.

Department Chair

In rare instances when issues cannot be resolved by the vice chair, the ME chair may become involved.

Advising Staff and Hours

Undergraduate Student Services Adviser
Shareena Samson
shareena@me.berkeley.edu
6193 Etcheverry Hall
510-642-4094
Monday, Tuesday, Wednesday, and Friday: 9 to noon and 1 to 4 p.m.
Thursday: 1 to 4 p.m.

Student Groups and Organizations

Aerodynamic Society of Automotive Engineers (https://callink.berkeley.edu/organization/asae) (ASAE)
American Institute of Aeronautics and Astronautics at Cal (http://aiaa.berkeley.edu) (AIAA-Cal)
American Society of Mechanical Engineers Student Chapter (http://asme.berkeley.edu) (ASME)
Berkeley Energy and Resources Collaborative (http://berc.berkeley.edu) (BERC)
The Black Engineering and Science Students Association (http://ucbessa.berkeley.edu) (BESSA)
Black Graduate Engineering and Science Students Association (BGESS)
Cal Human Powered Vehicle (http://calhpv.berkeley.edu) (CalHPV)
Design + Engineering Collaborative (http://dec.berkeley.edu) (DEC)
Formula SAE at Berkeley (http://fsae.berkeley.edu)
Graduate Women of Engineering (http://www.me.berkeley.edu/gwe) (GWE)
Hispanic Engineers and Scientists (http://hes.berkeley.edu) (HES)
Korean Graduate Student Association (http://www.kgsa.net/web) (KGSA)
Latino Association of Graduate Students in Engineering and Science (http://lagses.berkeley.edu) (LAGSES)
Mechanical Engineering Graduate Student Council (http://best.berkeley.edu/%7Emfuge/megsco/wiki/index.php/Main_Page) (MEGSCO)
Out in Science, Technology, Engineering, and Mathematics (http://berkeley.ostem.org) (oSTEM)
Pi Tau Sigma (http://pts.berkeley.edu)--The Mechanical Engineering Honor Society
Pioneers in Engineering (https://pioneers.berkeley.edu)
Society of Asian Scientists and Engineers (http://www.saseconnect.org) (SASE)
Society of Naval Architects and Marine Engineers (http://www.sname.org/ucb/home) (Cal_SNAME)
Society of Women Engineers (http://swe.berkeley.edu) (SWE)
Super Mileage Vehicle Team (http://smv.berkeley.edu) (SMV)
Tau Beta Pi (https://tbp.berkeley.edu)
UC Berkeley Solar Vehicle Team (http://calsol.berkeley.edu) (CalSol)

Mechanical Engineering

MEC ENG 24 Freshman Seminars 1 Unit

Terms offered: Fall 2017, Spring 2017, Fall 2016

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

Freshman Seminars: Read More [+]

Rules & Requirements

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

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

Freshman Seminars: Read Less [-]
MEC ENG 40 Thermodynamics 3 Units
Terms offered: Spring 2018, Fall 2017, Summer 2017 10 Week Session
This course introduces the fundamentals of energy storage, thermophysical properties of liquids and gases, and the basic principles of thermodynamics which are then applied to various areas of engineering related to energy conversion and air conditioning.

Thermodynamics: Read More [+]

Rules & Requirements

Prerequisites: Chemistry 1A, Engineering 7, Mathematics 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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Thermodynamics: Read Less [-]

MEC ENG C85 Introduction to Solid Mechanics 3 Units
Terms offered: Spring 2018, Fall 2017, Summer 2017 10 Week Session
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
Also listed as: CIV ENG C30
Introduction to Solid Mechanics: Read Less [-]
MEC ENG W85 Introduction to Solid Mechanics 3 Units
Terms offered: Summer 2016, Summer 2016 10 Week Session, Summer 2015 10 Week Session, Summer 2015 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: Mathematics 53 and 54 (may be taken concurrently); Physics 7A

Credit Restrictions: Students will receive no credit for Mechanical Engineering W85/Civil and Environmental Engineering W30 after completing Mechanical Engineering C85/Civil and Environmental Engineering C30. A deficient grade in Mechanical Engineering C85/Civil and Environmental Engineering C30 may be removed by taking Mechanical Engineering W85/Civil and Environmental Engineering W30.

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 98 Supervised Independent Group Studies 1 - 4 Units
Terms offered: Fall 2016, Summer 2016 10 Week Session, Spring 2016
Organized group study on various topics under the sponsorship and direction of a member of the Mechanical Engineering faculty.
Supervised Independent Group Studies: Read More [+]

Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit.

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.

Supervised Independent Group Studies: Read Less [-]
MEC ENG 101 Introduction to Lean Manufacturing Systems 3 Units
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 102A Introduction to Mechanical Systems for Mechatronics 4 Units
Terms offered: Fall 2017, Spring 2017, Fall 2016
The objectives of this course are to introduce students to modern experimental techniques for mechanical engineering, and to improve students' written and oral communication skills. Students will be provided exposure to, and experience with, a variety of sensors used in mechatronic systems including sensors to measure temperature, displacement, velocity, acceleration and strain. The role of error and uncertainty in measurements and analysis will be examined. Students will also be provided exposure to, and experience with, using commercial software for data acquisition and analysis. The role and limitations of spectral analysis of digital data will be discussed.

Introduction to Mechanical Systems for Mechatronics: 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 used in mechatronic systems, including sensors 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 and report writing.

Student Learning Outcomes: By the end of this course, students should: Know how to use, what can be measured with, and what the limitations are of the basic instruments found in the laboratory: oscilloscope, multimeter, counter/timer, analog-to-digital converter; know how to write a summary laboratory report; understand the relevance of uncertainty in measurements, and the propagation of uncertainty in calculations involving measurements; understand the physics behind the instruments and systems used in the laboratory; know how to program effectively using LabVIEW for data acquisition and analysis; understand the use of spectral analysis for characterizing the dynamic response of an instrument or of a system.

Rules & Requirements

Prerequisites: Engineering 26 (waived for Junior Transfers), Mechanical Engineering C85, ME 104, ME 132 (can be taken as a co-requisite if the course schedule allows) Electrical Engineering 16A or 40. Reading and Composition courses completed

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate

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

Introduction to Mechanical Systems for Mechatronics: Read Less [-]
MEC ENG 102B Mechatronics Design 4 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
Introduction to design and realization of mechatronics systems. Micro computer architectures. Basic computer IO devices. Embedded microcontroller 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.

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: E 25, E 26 (junior transfers students are exempt from this requirement), E 27, as well as EE 16A or EE 40

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

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

MEC ENG 103 Experimentation and Measurements 4 Units
Terms offered: Not yet offered
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.

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: MEC85, ME40, EE 100/EE 49

Credit Restrictions: Students will not receive credit for this course if they have taken both ME 102A and ME 107.
MEC ENG 104 Engineering Mechanics II 3 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
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.

MEC ENG 106 Fluid Mechanics 3 Units
Terms offered: Spring 2018, Fall 2017, Summer 2017 10 Week Session
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: C85 and 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 not required.

MEC ENG 107 Mechanical Engineering Laboratory 3 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
Experimental investigation of engineering systems and of phenomena of interest to mechanical engineers. Design and planning of experiments. Analysis of data and reporting of experimental results.

Mechanical Engineering Laboratory: Read More [+]

Objectives & Outcomes
Course Objectives: Through a series of three experiments from a number of experiments students design, perform, analyze, and report on complex prototypical engineering systems as a group.

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
(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively
(i) a recognition of the need for, and 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: 102A; senior standing

Hours & Format
Fall and/or spring: 15 weeks - 2-2 hours of lecture, 0-1 hours of discussion, and 3-3 hours of laboratory per week

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.
MEC ENG 108 Mechanical Behavior of Engineering Materials 4 Units
Terms offered: Spring 2018, Fall 2017, Spring 2017
This course covers elastic and plastic deformation under static and dynamic loads. Failure by yielding, fracture, fatigue, wear, and environmental factors are also examined. Topics include engineering materials, heat treatment, structure-property relationships, elastic deformation and multiaxial loading, plastic deformation and yield criteria, dislocation plasticity and strengthening mechanisms, creep, stress concentration effects, fracture, fatigue, and contact deformation.

Objectives

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: C85

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 More [+]

MEC ENG 109 Heat Transfer 3 Units
Terms offered: Spring 2018, Fall 2017, Summer 2017 10 Week Session
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.

Objectives

Rules & Requirements

Prerequisites: 40 and 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

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

Heat Transfer: Read Less [-]

MEC ENG 110 Introduction to Product Development 3 Units
Terms offered: Summer 2017 10 Week Session, Spring 2017, Summer 2016 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.

Objectives

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.

Mechanical Behavior of Engineering Materials: Read Less [-]
MEC ENG C115 Molecular Biomechanics and Mechanobiology of the Cell 4 Units
Terms offered: Spring 2016, Spring 2015, Spring 2014
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; Physics 7A; BioE102 or MEC85 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 2018, Spring 2016, Fall 2013
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.
Structural Aspects of Biomaterials: Read More [+]
Rules & Requirements
Prerequisites: Biology 1A, Engineering 45, Civil and Environmental Engineering 130 or 130N or Bioengineering 102, and Engineering 190
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. Final exam not required.
Instructor: Pruitt
Also listed as: BIO ENG C117
Structural Aspects of Biomaterials: Read Less [-]
MEC ENG 118 Introduction to Nanotechnology and Nanoscience 3 Units
Terms offered: Spring 2017, Spring 2015, Spring 2013
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. Introduction to Nanotechnology and Nanoscience: Read More [+]
Rules & Requirements
Prerequisites: Chemistry 1A and Physics 7B, Physics 7C and Engineering 45 (or the equivalent) recommended
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Lin, Sohn
Introduction to Nanotechnology and Nanoscience: Read Less [-]

MEC ENG 119 Introduction to MEMS (Microelectromechanical Systems) 3 Units
Terms offered: Fall 2017, Fall 2015, Fall 2013
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 MEMS (Microelectromechanical Systems): Read More [+]
Rules & Requirements
Prerequisites: EE 16A or EE 40, and Physics 7B
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
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.) Computational Biomechanics Across Multiple Scales: Read More [+]
Rules & Requirements
Prerequisites: Mechanical Engineering C85
Hours & Format
Fall and/or spring: 15 weeks - 2 hours of lecture and 3 hours of laboratory per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.
Instructor: Mofrad
Computational Biomechanics Across Multiple Scales: Read Less [-]

MEC ENG 122 Processing of Materials in Manufacturing 3 Units
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. Processing of Materials in Manufacturing: Read More [+]
Rules & Requirements
Prerequisites: Mechanical Engineering 108 and Mechanical Engineering C85/Civil Engineering C30
Hours & Format
Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week
Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Lin, Sohn
Processing of Materials in Manufacturing: Read Less [-]
MEC ENG 130 Design of Planar Machinery 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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: 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 3 Units
Terms offered: Spring 2018, Spring 2016, Spring 2015
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. Upon completion of this course, students should be able to follow the literature on these subjects and perform independent design, research, and development work in this field.
Vehicle Dynamics and Control: Read More [+]
Rules & Requirements
Prerequisites: Engineering 7, Math 53 and 54, and Physics 7A-7B

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: Hedrick
Vehicle Dynamics and Control: Read Less [-]

MEC ENG 132 Dynamic Systems and Feedback 3 Units
Terms offered: Spring 2018, Fall 2017, Summer 2017 10 Week Session
Dynamic Systems and Feedback: Read More [+]
Rules & Requirements
Prerequisites: Math 53, 54, Physics 7A-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: Fall 2016, Spring 2014, Spring 2013
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
(k) a knowledge of contemporary issues
(l) 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: 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 2018, Fall 2017, Spring 2017
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: EE 16A and either ME 132 or EE 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
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: Engineering 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 2017, Fall 1998, Fall 1996
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 [+]

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: Mechanical Engineering 132 (or equivalent), Mechanical Engineering 104 (or equivalent), recommended: Mechanical Engineering 106

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, fabricator, 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: 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/Undergraduate
Grading/Final exam status: Letter grade. Final exam not required.

Introduction to Micro/Nano Mechanical Systems Laboratory: Read Less [-]

MEC ENG 140 Combustion Processes 3 Units

Terms offered: Fall 2016, Fall 2015, Fall 2014
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: 40, 106, and 109 (106 and 109 may be taken concurrently)

Hours & Format

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

Additional Details

Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructors: Fernandez-Pello, Chen

Combustion Processes: Read Less [-]
**MEC ENG 146 Energy Conversion Principles**

**3 Units**

Terms offered: Spring 2018, Fall 2016, Spring 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.

**Rules & Requirements**

**Prerequisites:** 40, 106, and 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 [-]

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**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; 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.

Solar-Powered Vehicles: Analysis, Design and Fabrication: 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: 40, 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/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Advanced Heat Transfer: Read Less [-]

MEC ENG 163 Engineering Aerodynamics 3 Units
Terms offered: Fall 2016, Fall 2014, Fall 2013
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: 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 2018, Spring 2017, Fall 2015
Ocean-Environment Mechanics: Read More [+]
Rules & Requirements
Prerequisites: 106 or Civil and Environmental Engineering 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.

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: Fall 2017, Fall 2015, Fall 2014
This course covers major aspects of offshore engineering including ocean environment, loads on offshore structures, cables and mooring, underwater acoustics and arctic operations.

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

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

Rules & Requirements
Prerequisites: Mechanical Engineering 106 and Mechanical Engineering C85 (or Civil Engineering C30). Mechanical Engineering 165 is recommended

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Instructor: Alam
Mechanics of Offshore Systems: Read Less [-]
MEC ENG 170 Engineering Mechanics III 3 Units
This course builds upon material learned in 104, examining the dynamics of particles and rigid bodies moving in three dimensions. Topics include non-fixed axis rotations of rigid bodies, Euler angles and parameters, kinematics of rigid bodies, and the Newton-Euler equations of motion for rigid bodies. The course material will be illustrated with real-world examples such as gyroscopes, spinning tops, vehicles, and satellites. Applications of the material range from vehicle navigation to celestial mechanics, numerical simulations, and animations.

Rules & Requirements
Prerequisites: 104 or consent of instructor

MEC ENG 173 Fundamentals of Acoustics 3 Units
Terms offered: Spring 2017, Spring 2013, Spring 2011

Rules & Requirements
Prerequisites: 104

MEC ENG 175 Intermediate Dynamics 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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.

Rules & Requirements
Prerequisites: 104 or equivalent

MEC ENG C176 Orthopedic Biomechanics 4 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
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: Mechanical Engineering C85, Civil Engineering C30, or Bioengineering 102, or equivalent; concurrent enrollment OK. Proficiency in MatLab or equivalent. Prior knowledge of biology or anatomy is not assumed
MEC ENG C178 Designing for the Human Body 3 Units
Terms offered: 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., protheses and crash pads), design/analysis of devices aimed to improve or fix the human body, muscle adaptation, and soft tissue injury. Weekly laboratory projects will incorporate EMG sensing, force plate analysis, and interpretation of data collection (e.g., MATLAB analysis) to integrate course material to better understand contemporary design/analysis/problems.

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

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

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

Rules & Requirements
Prerequisites: Proficiency in MatLab or equivalent. Prior knowledge of biology or anatomy is not assumed. Physics 7A, Math 1A and 1B
Credit Restrictions: There will be no credit given for MEC ENG C178 / BIO ENG C137 after taking MEC ENG 178.<BR/>

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate

MEC ENG C180 Engineering Analysis Using the Finite Element Method 3 Units
This is an introductory course on the finite element method and is intended for seniors in engineering and applied science disciplines. The course covers the basic topics of finite element technology, including domain discretization, polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems. Finite element formulations for several important field equations are introduced using both direct and integral approaches. Particular emphasis is placed on computer simulation and analysis of realistic engineering problems from solid and fluid mechanics, heat transfer, and electromagnetism. The course uses FEMLAB, a multiphysics MATLAB-based finite element program that possesses a wide array of modeling capabilities and is ideally suited for instruction. Assignments will involve both paper- and computer-based exercises. Computer-based assignments will emphasize the practical aspects of finite element model construction and analysis.

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

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

Additional Details
Subject/Course Level: Mechanical Engineering/Undergraduate
Grading/Final exam status: Letter grade. Final exam required.
Also listed as: CIV ENG C133

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

MEC ENG 185 Introduction to Continuum Mechanics 3 Units
Terms offered: Fall 2017, Fall 2016, Fall 2015
Kinematics of deformation, the concept of stress, conservation of mass and balance of linear momentum, angular momentum and energy. Mechanical constitutive equations for ideal fluid, linear elastic solid. Field equations are introduced using both direct and integral approaches. Particular emphasis is placed on computer simulation and analysis of realistic engineering problems from solid and fluid mechanics, heat transfer, and electromagnetism. The course uses FEMLAB, a multiphysics MATLAB-based finite element program that possesses a wide array of modeling capabilities and is ideally suited for instruction. Assignments will involve both paper- and computer-based exercises. Computer-based assignments will emphasize the practical aspects of finite element model construction and analysis.

Rules & Requirements
Prerequisites: Physics 7A; Mathematics 53, 54

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.

Introduction to Continuum Mechanics: Read Less [-]
MEC ENG 190K Professional Communication for Mechanical Engineers 1 Unit
Terms offered: Prior to 2007
The course emphasizes understanding of and performance in professional speaking situations, including presentations, meetings, interviews, and informal business conversations. It emphasizes collaborative projects with distance partners. It combines theory and practice, integrating extensive speaking practice and individual critiques from instructor and students. The purpose is to advance students' ability to collaborate and communicate effectively in a variety of professional environments.

MEC ENG 190L Practical Control System Design: A Systematic Loopshaping Approach 1 Unit
Terms offered: Fall 2015, Spring 2014, Fall 2012
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.

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.

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.
MEC ENG 191AC Cases and Conflicts in Engineering Ethics 3 Units

Terms offered: Summer 2011 10 Week Session, Summer 2011 8 Week Session
Engineer is challenged by issues of security, poverty and under-development, and environmental sustainability. These issues intersect with those of race, class, and culture in U.S. society. This course focuses on engineering ethics case studies as they apply to issues of workplace diversity, sustainable practices, economic impacts on neighborhoods and nations, and issues of security and identity. The goal of this course is to broaden the understanding of engineering ethics from individual and business-based practices to those affecting communities and nations. This class cannot be used to satisfy any Engineering requirement (technical electives, engineering units, or courses).

Cases and Conflicts in Engineering Ethics: Read More [+]

Hours & Format
Summer: 8 weeks - 6 hours of lecture per week

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

Cases and Conflicts in Engineering Ethics: Read Less [-]

MEC ENG 191K Professional Communication 3 Units

Terms offered: Spring 2018, Fall 2017, Summer 2017 Second 6 Week Session
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: English R1A-R1B or equivalent

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. Final exam not required.
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: Prior to 2007
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.

Special Topics in Controls: Read Less [-]

MEC ENG 193C Special Topics in Design 1 - 4 Units
Terms offered: 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

Special Topics in Design: Read Less [-]
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.
Special Topics in Dynamics: Read More [+]

Objectives

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 2017
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.
Special Topics in Energy Science and Technology: Read More [+]

Objectives

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.
Special Topics in Fluids: 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 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.
Special Topics in Manufacturing: 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 Manufacturing: Read Less [-]
MEC ENG 193H Special Topics in Materials 1
- 4 Units
Terms offered: Prior to 2007
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: Spring 2016, Spring 2015, Spring 2014
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.
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 2016, Fall 2015, Spring 2015
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.
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.
Undergraduate Engineering Field Studies: Read More [+]
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.
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.
Undergraduate Engineering Field Studies: Read Less [-]

MEC ENG 198 Directed Group Studies for Advanced Undergraduates 1 - 4 Units
Terms offered: Fall 2017, Spring 2017, Fall 2016
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.
Directed Group Studies for Advanced Undergraduates: Read More [+]
Rules & Requirements
Prerequisites: Upper division standing and good academic standing
Repeat rules: Course may be repeated for credit.
Hours & Format
Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week
Summer: 10 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.
Directed Group Studies for Advanced Undergraduates: Read Less [-]

MEC ENG 199 Supervised Independent Study 1 - 4 Units
Terms offered: Spring 2017, Summer 2016 8 Week Session, Spring 2016
Supervised independent study. Enrollment restrictions apply; see the introduction to Courses and Curricula section of this catalog.
Supervised Independent Study: Read More [+]
Rules & Requirements
Prerequisites: Consent of instructor and major adviser
Repeat rules: Course may be repeated for credit.
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 [-]