## 2018-2019 Academic Calendar

**Note:** Dates subject to change without notice.

### 2018 - 2019 Campus Holidays

<table>
<thead>
<tr>
<th>Holiday</th>
<th>Date 1</th>
<th>Date 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor Day</td>
<td>Monday, September 3, 2018</td>
<td></td>
</tr>
<tr>
<td>Veterans’ Day</td>
<td>Monday, November 12, 2018</td>
<td></td>
</tr>
<tr>
<td>Thanksgiving</td>
<td>Thursday &amp; Friday, November 22 &amp; 23, 2018</td>
<td></td>
</tr>
<tr>
<td>Christmas</td>
<td>Monday &amp; Tuesday, December 24 &amp; 25, 2018</td>
<td></td>
</tr>
<tr>
<td>New Year</td>
<td>Monday &amp; Tuesday, December 31, 2018 &amp; January 1, 2019</td>
<td></td>
</tr>
<tr>
<td>Martin Luther King, Jr. Day</td>
<td>Monday, January 21, 2019</td>
<td></td>
</tr>
<tr>
<td>Presidents’ Day</td>
<td>Monday, February 18, 2019</td>
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</tr>
<tr>
<td>Cesar Chavez Holiday</td>
<td>Friday, March 29, 2019</td>
<td></td>
</tr>
<tr>
<td>Memorial Day</td>
<td>Monday, May 27, 2019</td>
<td></td>
</tr>
<tr>
<td>Independence Day</td>
<td>Thursday, July 4, 2019</td>
<td></td>
</tr>
</tbody>
</table>

### Fall 2018

- **Quarter begins:** September 23, 2018
- **New Student Convocation:** September 24, 2018
- **First day of instruction:** September 27, 2018
- **Final examinations:** December 7, 2018
- **Quarter ends:** December 14, 2018

### Winter 2019

- **Quarter begins:** January 7, 2019
- **Pre-instruction Activities:** January 7, 2019
- **First day of instruction:** January 7, 2019
- **Final examinations:** March 15, 2019
- **Quarter ends:** March 22, 2019

### Spring 2019

- **Quarter begins:** April 1, 2019
- **Pre-instruction Activities:** April 1, 2019
- **First day of instruction:** April 1, 2019
- **Final examinations:** June 7, 2019
- **Quarter ends:** June 14, 2019

### General Engineering Academic Requirements

**College of Engineering • University of California • Santa Barbara**

**Volume 9, Summer 2018**

### Equal Opportunity and Non-Discrimination

The University of California, in accordance with applicable Federal and State law and University policy, does not discriminate on the basis of race, color, national origin, religion, sex, gender identity, pregnancy, disability, age, medical condition (cancer related), ancestry, marital status, citizenship, sexual orientation, or status as a Vietnam-era veteran or special disabled veteran. The University also prohibits sexual harassment. This nondiscrimination policy covers admission, access, and treatment in University programs and activities.

Inquiries regarding the University’s student-related nondiscrimination policies may be directed to the Director of Equal Opportunity at (805) 893-3089.

1 Pregnancy includes pregnancy, childbirth, and medical conditions related to pregnancy or childbirth.

**Produced by the College of Engineering, Student Advising Division**

Glenn Beltz, Associate Dean for Undergraduate Studies

Peter Allen, Publications Director

This publication is available at:

https://engineering.ucsb.edu/undergraduate/academic-advising/gear-publications

The information in this publication supersedes that in the UCSB General Catalog. All announcements herein are subject to revision without notice.

**Requirements and policies in the GEAR are subject to change each academic year.**
Welcome to the College of Engineering at UC Santa Barbara. There are many reasons we are one of the top engineering schools in the nation. We bring together an amazing faculty, the members of which are highly acclaimed in the scientific communities in which they work. UCSB professors are, in fact, among the most cited by their colleagues worldwide, a testament to the quality and creativity of their research. A high percentage of the faculty has been elected to the prestigious National Academy of Sciences and National Academy of Engineering. We have six Nobel Prize winners on this campus, five of whom are faculty in engineering and the sciences. We’re also home to an amazing group of smart, accomplished, high-energy students. These more than 1,400 undergraduates, pursuing a variety of interests, contribute greatly to the quality of the learning environment as well as to the overall richness of campus life.

We have crafted courses that balance theory and applied science so our students are well prepared for successful careers in academia and in industry. Students especially interested in engineering and industry can take advantage of our Technology Management Program. Through coursework and “real world” experiences, the program gives our students insight into the world of technology from a business perspective. We want our students to understand what transforms a good technical idea into a good business idea. We want to give them a head start at attaining leadership positions in the technology business sector.

With a thriving interdisciplinary environment, our campus culture fosters creativity and discovery. A truly interdisciplinary culture allows all sorts of ideas to cross-fertilize and makes it easy for faculty to work effectively between disciplines to tackle big questions. Visiting scholars tell us they don’t often see the kind of openness among departments and ease of collaboration that they find here.

As part of the prestigious and well-established University of California system, we have the resources as well as the breadth and depth of talent to pursue new fields of scientific inquiry. We also bring an entrepreneurial attitude to our research, focusing on applications as much as discovery.

Our leading programs in areas as diverse as biotechnology, communications, computer security, materials, nanotechnology, networking, and photonic devices attest to the success of this approach.

At the core of this activity are our students, our central purpose. We encourage you to pursue every opportunity, both inside and outside the classroom, to enhance your education. We have a talented and wise faculty and staff, equipped with extensive knowledge and diverse experience, to help you make decisions about courses and other activities as you pursue your degree. We look forward to having you in our classes, laboratories, and offices as you discover where your interests lead you.

Glenn Beltz
Associate Dean for Undergraduate Studies
The College of Engineering at UCSB is noted for its excellence in teach- ing, research, and service to the local community. The college has an enrollment of approximately 1,400 undergraduate stu- dents and 750 graduate students with a full-time, permanent faculty of 129. This results in an excellent student to faculty ratio and a strong sense of community in the college.

The curriculum offers the bachelor of sci- ence degree in five disciplines: chemical engineering, computer engineering, com- puter science, electrical engineering, and mechanical engineering. The college also offers graduate programs in chemical, computer, electrical, and mechanical engineering.

The college is accredited by the Engineering Accreditation Commission of ABET, and the computer science bachelor of science program is accredited by the Computing Accreditation Commission of ABET, Inc. (http://www.abet.org).

The campus is located in the Santa Barbara area, a region with an unusually mild climate, and is served by a variety of cultural and recreational activities.

The college offers a wide range of undergraduate and graduate programs in engineering, computer science, and related fields. The college has an enrollment of approximately 1,400 undergraduate and 750 graduate students with a full-time, permanent faculty of 129. This results in an excellent student to faculty ratio and a strong sense of community in the college.

The curriculum offers the bachelor of sci- ence degree in five disciplines: chemical engineering, computer engineering, computer science, electrical engineering, and mechanical engineering. The college also offers graduate programs in chemical, computer, electrical, and mechanical engineering.

The college is accredited by the Engineering Accreditation Commission of ABET, and the computer science bachelor of science program is accredited by the Computing Accreditation Commission of ABET, Inc. (http://www.abet.org).

The campus is located in the Santa Barbara area, a region with an unusually mild climate, and is served by a variety of cultural and recreational activities.
Minimal Progress Requirements

A student in the College of Engineering may be placed on academic probation if the total number of units passed at UCSB is fewer than what is prescribed by the prevailing academic senate regulation regarding Minimum Cumulative Progress. At least three-fourths of the minimum number of academic units passed must include courses prescribed for the major.

The following courses may be counted toward the unit minimums: courses repeated to raise C-, D, or F grades, courses passed by examination; courses graded IP (In Progress); courses passed during summer session at UCSB or at another accredited college or university and transferred to UCSB.

Students must obtain the approval of the Associate Dean for Undergraduate Studies to deviate from these requirements. Approval normally will be granted only in cases of medical disability, severe personal problems, or accidents. Students enrolled in dual-degree programs must submit their proposed programs of study to the Associate Dean for Undergraduate Studies in the College of Engineering for approval. The individual study to the Associate Dean must submit their proposed programs of study to the Associate Dean for Undergraduate Studies or the College of Letters and Science for approval. The individual study to the Associate Dean must submit their proposed programs of study to the Associate Dean for Undergraduate Studies or the College of Letters and Science for approval.

Students who think they may exceed both the quarter and unit limits noted above. Students who exceed the quarter and unit limits noted above must submit a Proposed Schedule for Graduation (Study Plan) for consideration by the Associate Dean for Undergraduate Studies, but they should understand that approval is granted in limited circumstances.

Note: The College of Engineering will not accept students who are pursuing a B.S. in Chemistry in the College of Letters and Science to complete an M.S. degree in Materials. Interested students should contact the Graduate Advisor in the Department of Chemistry & Biochemistry for additional information.

Five-Year B.S./M.S. Degree Programs

Five-Year B.S. / M.S. in Computer Science

A combined BS/MS Program in Computer Science provides an opportunity for outstanding undergraduates to earn both degrees in five years. Additional information about this program is available from the Computer Science graduate advisor. Interested students should make their interest known to the department early in their junior year. Advising and application materials are also available in the Department of Computer Science office.

Five-Year B.S. in Computer Engineering / M.S. in Computer Science

The Computer Engineering Program incorporates the design of computer hardware and software to meet the needs for various career applications. Students are trained to work with systems ranging from small integrated circuits to worldwide communications networks, from digital watches to supercomputers, and from single-line programs to operating systems. For more information on the program, please consult the Computer Engineering department.

Five-Year B.S. in Computer Engineering or Electrical Engineering / M.S. in Electrical and Computer Engineering

A combined BS/MS Program in Computer Science provides an opportunity for outstanding undergraduates to earn both degrees in five years. Additional information about this program is available from the Electrical and Computer Engineering graduate advisor. Interested students should make their interest known to the department early in their junior year. Advising and application materials are also available in the Department of Electrical and Computer Engineering office.

Five-Year B.S. in Chemical Engineering, Electrical Engineering, or Mechanical Engineering / M.S. in Materials

A combined B.S. Engineering/M.S. Materials program provides an opportunity for outstanding undergraduates in chemical, electrical, or mechanical engineering to earn both of these degrees in five years. This program enables students to develop all of the requisite knowledge in their core engineering disciplines and to complement this with a solid background in materials. This combination provides highly desirable training from an industrial employment perspective and capitalizes on the strengths of our internationally renowned materials departments.

There is a five-year option for students who are pursuing a B.S. in Chemistry in the College of Letters and Science to complete an M.S. degree in Materials. Interested students should contact the Graduate Advisor in the Department of Chemistry & Biochemistry for additional information.

Five-Year B.S. / M.S. in Mechanical Engineering

A combined B.S./M.S. program in Mechanical Engineering provides an opportunity for outstanding undergraduates to earn both degrees in five years. Additional information about this program is available from the Mechanical Engineering Undergrad Advising office. Interested students should contact the office fall quarter of their junior year. In addition to fulfilling undergraduate degree requirements, B.S./M.S. degree candidates must meet Graduate Division degree requirements, including university requirements for academic residence and units of coursework.

Note: The College of Engineering will not accept students who are pursuing a B.S. in Chemistry in the College of Letters and Science to complete an M.S. degree in Materials. Interested students should contact the Graduate Advisor in the Department of Chemistry & Biochemistry for additional information.

Students who earn scores of 5, 6, or 7 on International Baccalaureate Higher Level (HL) Examinations taken after high school graduation will receive 8 units of credit toward graduation at UCSB for each such test completed with the required scores, provided official scores are submitted to the Office of Admissions. Students who complete the IB diploma with a score of 30 or above will receive 30 quarter units total. The university does not grant credit for Standard Level (SL) exams. The application of this credit to the General Education requirements and course equivalents for these exams are listed below.

International Baccalaureate Higher Level Examinations

<table>
<thead>
<tr>
<th>Exam</th>
<th>Units</th>
<th>GE Credit</th>
<th>UCSB Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>8</td>
<td>none</td>
<td>EEBM 22, MCB 30</td>
</tr>
<tr>
<td>Business Management</td>
<td>8</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Chemistry</td>
<td>8</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Computer Science</td>
<td>8</td>
<td>none</td>
<td>Computer Science 8</td>
</tr>
<tr>
<td>Dance</td>
<td>8</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Economics</td>
<td>D</td>
<td>2 courses</td>
<td>Economics 1, 2</td>
</tr>
<tr>
<td>English A Literature</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>English B Language</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>English C Language</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Film</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Geography</td>
<td>D</td>
<td>1 course</td>
<td>none</td>
</tr>
<tr>
<td>Global Politics</td>
<td>D</td>
<td>1 course</td>
<td>none</td>
</tr>
<tr>
<td>History</td>
<td>E</td>
<td>1 course*</td>
<td>none</td>
</tr>
<tr>
<td>History of Africa</td>
<td>D</td>
<td>1 course</td>
<td>none</td>
</tr>
<tr>
<td>History of the Americas</td>
<td>D</td>
<td>1 course</td>
<td>none</td>
</tr>
<tr>
<td>History of Asian and Oceanian</td>
<td>D</td>
<td>1 course*</td>
<td>none</td>
</tr>
<tr>
<td>History of Europe and the Middle East</td>
<td>D</td>
<td>1 course*</td>
<td>none</td>
</tr>
<tr>
<td>Languages Other</td>
<td>none</td>
<td>See department for level placement</td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>B</td>
<td>none</td>
<td>Mathematics 2A, 3B, 3A, 3B, 34A, 34B, or equivalent</td>
</tr>
<tr>
<td>Mathematics, Further</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>Music</td>
<td>F</td>
<td>1 course</td>
<td>none</td>
</tr>
<tr>
<td>Philosophy</td>
<td>E</td>
<td>1 course</td>
<td>none</td>
</tr>
<tr>
<td>Physics</td>
<td>none</td>
<td>Physics 10</td>
<td></td>
</tr>
<tr>
<td>Psychology</td>
<td>D</td>
<td>1 course</td>
<td>none</td>
</tr>
<tr>
<td>Social &amp; Cultural Anthropology</td>
<td>D</td>
<td>1 course</td>
<td>Anthropology 2</td>
</tr>
<tr>
<td>Theatre</td>
<td>F</td>
<td>1 course</td>
<td>none</td>
</tr>
<tr>
<td>Visual Arts</td>
<td>F</td>
<td>1 course</td>
<td>none</td>
</tr>
</tbody>
</table>

* course also satisfies the European Traditions Requirement
+ course also satisfies the World Cultures Requirement

Note: International Baccalaureate credit earned prior to entering the university will not be counted toward maximum unit limitations or for selection of a major or for graduation.
### College Board Advanced Placement Credit

Students who earn scores of 3, 4, or 5 on College Board Advanced Placement Examinations taken before high school graduation will receive 2, 4, or 8 units of credit toward graduation at UCSB for each such exam completed with the required scores; provided official scores are submitted to the Office of Admissions. Students should be advised that college courses taken before or after attending UC may duplicate AP, IB and/or A-Level examinations. Additionally, exams may duplicate each other (for example, and AP or IB exam in the same subject area). If the student does duplicate an exam with another exam of the same subject content, and/or an exam with a college course, we will award credit only once.

Note: Advanced Placement credit earned prior to entering the university will not be counted toward maximum unit limitations either for selection of a major or for graduation.

<table>
<thead>
<tr>
<th>Advanced Placement Exam</th>
<th>Units Awarded</th>
<th>General Ed. Course Credit</th>
<th>UCSB Course Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(You may not enroll in these courses for credit at UCSB)</td>
</tr>
<tr>
<td>Art History</td>
<td>8</td>
<td>F: 1 course</td>
<td>Art History 1</td>
</tr>
<tr>
<td>*Art Studio 2D Design</td>
<td>8</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>*Art Studio 3D Design</td>
<td>8</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>*Art Studio Drawing</td>
<td>8</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>8</td>
<td>none</td>
<td>EEMB 22, MCD 20</td>
</tr>
<tr>
<td>Chemistry</td>
<td>8</td>
<td>none</td>
<td></td>
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<tr>
<td>Chinese Language Culture</td>
<td>8</td>
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<td></td>
<td>8</td>
<td>none</td>
<td>See department for level placement</td>
</tr>
<tr>
<td>Chemistry</td>
<td>8</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>Comparative Government</td>
<td>4</td>
<td>D: 1 course none</td>
<td></td>
</tr>
<tr>
<td>and Politics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Computer Science A</td>
<td>8</td>
<td>none</td>
<td>Computer Science 6</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td>Computer Science 8</td>
</tr>
<tr>
<td>Computer Science Principles</td>
<td>8</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td>Computer Science 8</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>Economics – Macroeconomics</td>
<td>4</td>
<td>D: 1 course none</td>
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</tr>
<tr>
<td>Economics – Microeconomics</td>
<td>4</td>
<td>D: 1 course none</td>
<td></td>
</tr>
<tr>
<td>*English – Composition and Literature</td>
<td>8</td>
<td>E: 1 course none</td>
<td></td>
</tr>
<tr>
<td>or Language and Composition</td>
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<tr>
<td></td>
<td>8</td>
<td>Entry Level Writing 1, 1E</td>
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<tr>
<td></td>
<td>8</td>
<td>Writing 1, 1E 2E, 2LK</td>
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<td></td>
<td>8</td>
<td>Writing 1, 1E 2E, 2L, 50, 50E</td>
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<td>Environmental Science</td>
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<td>Environmental Studies 2</td>
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<tr>
<td>European History</td>
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<td>E: 1 course none</td>
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<tr>
<td>French Language and Culture</td>
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<td></td>
</tr>
<tr>
<td></td>
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<td>none</td>
<td>French 1-3</td>
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<td>French 1-4</td>
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<td>8</td>
<td>none</td>
<td>French 1-5</td>
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<td>German Language and Culture</td>
<td></td>
<td>none</td>
<td>German 1-3</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td>German 1-4</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td>German 1-5</td>
</tr>
<tr>
<td>Human Geography</td>
<td>4</td>
<td>D: 1 course Geography 5</td>
<td></td>
</tr>
<tr>
<td>Italian Language and Culture</td>
<td></td>
<td>none</td>
<td>Italian 1-3</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td>Italian 1-5</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td>Italian 1-6</td>
</tr>
<tr>
<td>Japanese Language &amp; Culture</td>
<td></td>
<td>none</td>
<td>See department for level placement</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td>Latex 1-3</td>
</tr>
<tr>
<td>Latin</td>
<td>8</td>
<td>none</td>
<td>Mathematics 2A, 3A, 3AA, or equivalent</td>
</tr>
<tr>
<td>*Mathematics – Calculus AB</td>
<td>4</td>
<td>none</td>
<td>Mathematics 2A, 2B, 3A, 3B, 3AA, 3AB, or equivalent</td>
</tr>
<tr>
<td>*Music – Theory</td>
<td>8</td>
<td>F: 1 course Music 11</td>
<td></td>
</tr>
<tr>
<td>*Physics 1 (effective ’15)</td>
<td>8</td>
<td>none</td>
<td>Mathematics 2A, 2B, 3A, 3B, 3AA, 3AB, or equivalent</td>
</tr>
<tr>
<td>*Physics 2 (effective ’15)</td>
<td>8</td>
<td>none</td>
<td>Mathematics 2A, 2B, 3A, 3B, 3AA, 3AB, or equivalent</td>
</tr>
<tr>
<td>*Physics – B (last offered ’14)</td>
<td>8</td>
<td>none</td>
<td>Mathematics 2A, 2B, 3A, 3B, 3AA, 3AB, or equivalent</td>
</tr>
<tr>
<td>*Physics – C (Electricity and Magnetism)</td>
<td>4</td>
<td>none</td>
<td>Mathematics 2A, 2B, 3A, 3B, 3AA, 3AB, or equivalent</td>
</tr>
<tr>
<td>Psychology</td>
<td>4</td>
<td>D: 1 course Psychology</td>
<td></td>
</tr>
<tr>
<td>Spanish Language and Culture</td>
<td></td>
<td>none</td>
<td>Spanish 1-3</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td>Spanish 1-4</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td>Spanish 1-5</td>
</tr>
<tr>
<td>Spanish Literature and Culture</td>
<td></td>
<td>none</td>
<td>Spanish 1-6</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
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<td>8</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>none</td>
<td></td>
</tr>
</tbody>
</table>

### College Board Advanced Placement Credit Cont.

### A Level Examination Credit

Students who earn grades of A, B, or C on UC-approved GCE and Hong Kong A-Level examinations will receive 12 units of credit toward graduation at UCSB for each exam, provided that official grades are submitted to the Office of Admissions. Any general education credit or UCSB course equivalents listed in the chart below will be awarded only for Cambridge International A-Level exams taken in 2013 or later, not for exams administered by any other agency. (Student may petition for GE or course credit for Cambridge International exams taken prior to 2013 or for exams administered by other agencies.)

<table>
<thead>
<tr>
<th>A Level Exam With A Grade of A, B, or C</th>
<th>Units Awarded</th>
<th>General Ed. Credit</th>
<th>UCSB Course Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting</td>
<td>12</td>
<td></td>
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Note: A Level examination credit earned prior to entering the university will not be counted toward maximum unit limitation either for selection of a major or for graduation.

Students should be advised that college courses taken before or after attending UC may duplicate AP, IB and/or A-Level examinations. Additionally, exams may duplicate each other (for example, an AP or IB exam in the same subject area). If the student does duplicate an exam with another exam of the same subject content, and/or an exam with a college course, we will award credit only once.

Note: A Level examination credit earned prior to entering the university will not be counted toward maximum unit limitation either for selection of a major or for graduation.
General University Requirements
UC Entry Level Writing Requirement
All students entering the University of California must demonstrate their ability to write effectively by fulfilling the Entry Level Writing requirement. This requirement may be met in one of the following ways prior to admission:

1. 30 or better on the ACT, English Composition Sub-score
2. 30 or better on the ACT, Combined English/Writing (last administered June 2014 or earlier)
3. 680 or better on the SAT, Evidence-Based Reading and Writing
4. 680 or better on the SAT Reasoning Test, Writing (last administered January 2015 or earlier)
5. 3 or above on the Advanced Placement Examination in English, or
6. 5 or above on an International Baccalaureate Higher Level English A Literature Exam (sub-test known as Higher Level English A1 exam); or
7. Passing the University of California systemwide Analytical Writing Placement Exam (AWPE) while in high school; or
8. Entering the university with transcripts showing the completion of an accredited 4-year high school or 4-quarter unit course in English composition equivalent to Writing 2 at UCSC, with a grade of C- or better

*UCSC is accepting a score of 680 or better on the SAT, Evidence-Based Reading and Writing to satisfy the Entry Level Writing Requirement for the fall 2016 start, beginning with new students entering UC in Fall 2016. It is not required for students who have not taken the SAT.

Students who have not taken the Analytical Writing Placement exam and who have not met the UC Entry Level Writing Requirement in one of the other ways listed above will be required to take the examination during the first term at UCSC (check with Writing Program for examination time and location). An appropriate score on the exam will satisfy the requirement. Only one UC examination to fulfill the Entry Level Writing Requirement may be taken.

Students who enter UCSC without having fulfilled the university’s Entry Level Writing requirement (students are not previously taken the statewide Entry Level Examination while in high school or the examination given at UCSC; and new transfers may be required)

The American History and Institutions Requirement
The American History and Institutions requirement is based on the principle that American students enrolled at an American university should have some knowledge of the history and government of their country. You may meet this requirement in any one of the following ways:

1. by achieving a score of 3 or higher on the College Board Advanced Placement Examination in American History or American Government and Politics; or
2. by passing a non-credit examination in American history or American institutions, offered in the Department of History during the first week of each quarter. Consult the department for further information; or
3. by achieving a score of 650 or higher on SAT II: Subject Test in American History; or
4. by achieving one-four run course from the following list of courses:
   - Anthropology 131
   - Art History 121A-B-C, 139H
   - Asian American Studies 1, 2
   - Black Studies 1, 2, 20, 60A-B, 103, 137, 137E, 148A-B, 148C-B
   - Chicano Studies 1A-B-C, 168B, 174, 175A-B
   - Economics 113A-B, 119
   - English 133AA-ZZ, 134AA-ZZ, 191
   - Environmental Studies 173
   - Feminist Studies 155A, 159B
   - Military Science 27
   - Political Science 12, 115, 127, 151, 153, 155, 157, 158, 162, 165, 167, 180, 185

Religious Studies 7, 14, 61A-B, 151A-B, 152 Sociology 137E, 140, 144, 155A, Theater 180A-B

Courses used to fulfill the American History and Institutions requirement may also be applied to General Education major requirements, or both where appropriate. Equivalent courses taken at other schools or community colleges, or universities in UC Extension, or in summer session may count towards this requirement. Students who transfer to UCSC from another campus of the University of California where the American History and Institutions Requirement has been considered satisfied will automatically fulfill the requirement at UCSC.

International students on a nonimmigrant visa may petition for a waiver of this requirement through the Director of International Students and Scholars.

Courses of Engineering General Education Requirements
The aims of the General Education Program in the College of Engineering are to provide a body of knowledge of general intellectual value that will give the student a broad cultural base and to meet the objectives of the engineering profession. An appropriate understanding of the humanities and social sciences are important in making engineers aware of their social responsibilities and enabling them to consider related factors in the decision-making process.

Students in the College of Engineering must complete the General Education requirements in order to qualify for graduation. Students are reminded that other degree requirements exist and that they are responsible for familiarizing themselves with those degree requirements.

Not all of the courses listed in this publication are offered every quarter. Please see the GOLD system for General Education courses offered during a particular quarter.

It should be noted that for College of Engineering students who completed the IGEC (Intergovernmental General Education Transfer Curriculum), it may be used to substitute for either UCSC College of Engineering or College of Engineering of Undergraduate Office Degree requirements.

Students who have questions about the General Education requirements should consult with the advisors in College of Engineering Office of Undergraduate Education.

General Subject Area Requirements
A total of 8 courses is required to satisfy the General Education requirements of the College of Engineering. All students must follow the pattern of distribution shown below:

1. Area A: English Reading and Composition
2. Area B: Science, Technology, Engineering, and Mathematics
3. Area C: Social Studies
4. Area D: Science, Technology, Engineering, and Mathematics

Other Regulations:

A course listed in more than one general subject area can be applied to only one of these areas. (Example: Art History 6A cannot be applied to both Areas E and F.) However, a course can be applied towards a single general subject area and any special subject areas which that course fulfills. (Example: American Studies 4C can be applied to the Writing and Ethnicity requirement in addition to the Area F requirement.)

Some courses taken to satisfy the General Education requirements may also be applied simultaneously to the American History and Institutions requirements. Such courses must be on the list of approved General Education courses and on the list of approved General Education and Institutions courses.

Courses taken to fulfill a General Education requirement may be used for a P/NP basis, if the course is offered with that grading option (refer to GOLD for the grading option for a particular course).

World Cultures objective: To learn to identify, understand, and appreciate the history, thought, and practices of one or more cultures outside of the European Tradition. Courses that meet this requirement are marked with a plus sign (+) on the lists in this document.

At least one course of either these areas (European Traditions or World Cultures) is required.

Requirements may be met only with designated UCSC courses approved by the Academic Senate.

Notes: ENGR 101 may be used as a writing requirement (class, exam by those students for whom ENGR 101 is required). New transfer students should consult with the College Undergraduate Studies Office regarding this requirement.

Ethnicity Requirement: To provide a body of knowledge of the philosophical, intellectual, historical, and/or cultural experiences of African Americans, Native Americans, Asian Americans, Chicano/Latinos, or American Women. Students may take a course that provides a comparative and integrative context that involves the examination of oppressed and excluded racial minorities in the United States. At least one course that focuses on the history and the cultural, intellectual, and social experience of one of these minority groups. Alternatively, American experiences of one of these minority groups.

Writing Requirement: To provide a body of knowledge of the intellectual value that will give the student a broad cultural base and to meet the objectives of the engineering profession. Students will demonstrate abilities by producing written work totaling at least 1,800 words that is literate, thoughtful, and critical within analysis to written examinations. Assessment of written work must be a significant consideration in total assessment of student performance in the course. At least one designated General Education courses that meet the following criteria: (1) the course requires one to three papers totaling at least 1,800 words, exclusive of elements such as footnotes, equations, tables of contents, or references; (2) the required papers are independent of or in addition to written examinations; and (3) the paper(s) is a significant consideration in the assessment of student performance in the course. Courses marked with an asterisk (*) on the lists in this document apply to this writing requirement. The writing requirement may be met only with designated UCSC courses approved by the Academic Senate.

Area A: English Reading and Composition
Area B: Science, Technology, Engineering, and Mathematics
Area C: Social Studies
Area D: Science, Technology, Engineering, and Mathematics

The American History and Institutions and Requirements in one of the other ways listed above will be required to take the examination during the first term at UCSC (check with Writing Program for examination time and location). An appropriate score on the exam will satisfy the requirement. Only one UC examination to fulfill the Entry Level Writing Requirement may be taken.

Courses taken to fulfill a General Education requirement may be used for a P/NP basis, if the course is offered with that grading option (refer to GOLD for the grading option for a particular course).
This course applies toward the World Cultures requirement.

* This course applies toward the American History & Institutions requirement.

@ This course applies toward the European Traditions requirement.

This course applies toward the World Cultures requirement.

† This course applies toward the American History & Institutions requirement.

This course applies toward the European Traditions requirement.
**GENERAL EDUCATION • GENERAL EDUCATION • 21**

*   This course applies toward the Writing requirement.
@ This course applies toward the American History & Institutions requirement.
&  This course applies toward the Ethnicity requirement.
^  This course applies toward the European Traditions requirement.
+   This course applies toward the World Cultures requirement.

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**Checklist of General University and General Education Requirements**

**General University Requirements**

**UC Entry Level Writing Requirement** — (Must be fulfilled within three quarters of admission.)

Passed Exam _______ or Writing 1, 1E or Ling 12 ___________ or transferred appropriate course _________

**American History and Institutions*** — (Refer to page 8 for the list of acceptable courses.)

One course _______ or Advanced Placement _________ or International waiver __________

*This course may also apply to the General Education requirements, if appropriate.

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**General Education Requirements**

A course listed in more than one General Subject Area can be applied to only one area. Course total in Areas D, E, F, G, and H must be at least 6.

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**General Subject Areas**

1. **Area A: English Reading and Composition**
   
   Writing 2 or 2E ___________ and Writing 50, 50E, 107T or 109ST ___________

2. **Area D: Social Sciences** (2 courses minimum)
   
   ____________________________

3. **Area E: Culture and Thought** (2 courses minimum)
   
   ____________________________

4. **Area F: The Arts** (1 course minimum)
   
   ____________________________

5. **Area G: Literature** (1 course minimum)
   
   ____________________________

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**Special Subject Areas**

In the process of fulfilling the G.E. General Subject Area requirements, students must fulfill the following Special Subject Area requirements, as outlined on page 11. Only approved courses can be used to fulfill these requirements.

a. **Writing Requirement** — At least four courses which require the writing of one or more papers totaling at least 1,800 words.
   
   ____________________________

b. **Ethnicity Requirement** — (1 course)
   
   ____________________________

c. **European Traditions or World Cultures Requirement** — (1 course)
   
   ____________________________
Chemical Engineering

Department of Chemical Engineering, Engineering IV, Room 3357.
Telephone (805) 893-3412
Web site: www.chemengr.ucsb.edu
Chair: Rachel A. Segelman
Vice-Chair: Todd A. James
M. Scott Shell

Faculty
Bradley Chmelka, Ph.D., UC Berkeley, Distinctive Professor Emeritus (surface science, polymer materials, heterogeneous catalysts, surface catalysis, nanotechnology, composite solids, magnetic resonance)
Phillip N. Christopher, Ph.D., University of Wisconsin, Associate Professor (catalysis, chemical engineering, materials science, polymer science)
Siddharth S. Day, Ph.D., UC Berkeley, Assistant Professor (systems biology, single-cell genomics, cell genomics, epigenetics, stem cell biology)
Michael F. Doherty, Ph.D., Massachusetts Institute of Technology, Professor Emeritus (surface chemistry, microfluidics)
Arnab Mukherjee, Ph.D., Massachusetts Institute of Technology, Professor (molecular simulation, statistical mechanics, computational materials, protein biophysics)
Matthew E. Helgeson, Ph.D., Harvard University, Professor (surface physics, scanning probe microscopy, polymer science, phase transitions, block copolymers, mechanical properties)
Sanjoy Banerjee, Ph.D., University of California, Santa Barbara, Professor (polymer design, self-assembly, and properties)
Duncan A. Mellichamp, Ph.D., Princeton University, Distinguished Professor Emeritus (theoretical methods, adhesion, friction)
L. Gary Leal, Ph.D., Stanford University, Schlumberger Distinguished Professor in Chemical Engineering (fluid mechanics, physics of complex fluids, rheology)
Barbara, Professor (polymer design, self-assembly, and properties)
N. K. Kottke, Ph.D., University of Minnesota, Professor, Center for Risk and Interdisciplinary Studies, School of Public Health (adhesion, friction)
D. D. Dill, Ph.D., University of California, Santa Barbara, Distinguished Professor (molecular simulation, complex materials, protein biophysics)

Emeriti Faculty
Sanjoy Banerjee, Ph.D., University of California, Santa Barbara, Professor Emeritus (molecular simulation, chemical engineering)
W. W. Graessley, D.Sc., University of California, Los Angeles, Professor Emeritus (biophysics, biophysics of membranes)
Kenneth, Professor Emeritus (molecular simulation, self-assembly, and properties)
John D. Ratner, Ph.D., University of California, San Diego, Associate Director, Center for Biofilm Engineering, Distinguished Professor Emeritus (biomaterials)
J. R. Deegan, D.Sc., University of California, San Diego, Professor Emeritus (molecular simulation, nanotechnology, self-assembly, and properties)

Affiliated Faculty
Christopher Bale, Ph.D. (Materials Engineering)
David Gay, Ph.D. (Chemical Engineering)
Song-I Han, Ph.D. (Chemistry)
Mahdi Abu Omar, Ph.D. (Chemistry)
Philip Alan Pincus, Ph.D. (Materials Engineering)

W. W. Graessley, D.Sc., University of California, Los Angeles, Professor Emeritus (molecular simulation, chemical engineering)

Mission Statement
The program in Chemical Engineering has as its dual mission:

Education: Our program seeks to produce chemical engineers who will continue to improve and expand the knowledge base in the field and to ensure that engineering education designed to meet the needs of a changing and rapidly developing technological environment.

Research: Our program seeks to develop and implement new theories and technology that addresses the needs of the industry, the society, and the environment.

Objectives for the Undergraduate Program

Educational Objectives

Our graduates will be innovative, competitive, and contributing chemical engineers. They will graduate with their health care at an affordable cost. Because of their breadth and depth, chemical engineers are uniquely qualified to make major contributions to the resolution of the world’s most pressing problems. Chemical engineers develop processes and products to transform raw materials into useful products.

The Department of Chemical Engineering offers the B.S., M.S., and Ph.D. degrees in chemical engineering. The B.S. degree is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

At the undergraduate level, emphasis is placed on a thorough background in the mathematical and physical sciences, which will prepare the students for advanced study. The students become familiar with the application of theory to practice. At the graduate level, students take advanced courses and are required to demonstrate competence in basic and applied sciences.

The B.S. degree provides excellent preparation for entry-level industrial jobs and graduate degree programs.

Interdisciplinary B.S./M.S. degree programs are also available which result in M.S. degrees in other fields. Students who complete a major in chemical engineering may be eligible to pursue a California teaching credential with the completion of specified courses.

Under the direction of the Associate Dean for Undergraduate Studies, academic advising services are jointly provided by advisors, who assist chemical engineering students as well as advisors in the department. Each undergraduate also is assigned a faculty advisor to assist with the selection of courses, plans academic programs, and provide academic and professional objectives. Undergraduates in other majors who plan to change to major in the Department of Chemical Engineering should consult the department academic advisor for the recommendation.

Sanjoy Banerjee, Professor (polymer design, self-assembly, and properties)

The major topics discussed include material and energy balance, chemical reaction rates, transport phenomena, and heat and mass transfer.

Transfer students who have completed a degree in a related area and have completed Chemical Engineering 102, 130A-B, 132, and 134A-B with grade of C- or better may be eligible for credit in any of these courses.

Admission to the major requires completion of the following courses with grade of C- or better:

Chemical Engineering 101 (or equivalent): Introduction to the basic principles of chemical engineering and the major fields of chemical engineering.

Chemical Engineering 102 (or equivalent): Thermodynamics

Chemical Engineering 104 (or equivalent): Transport Phenomena

Chemical Engineering 105: Elementary principles of chemical engineering. This course provides an introduction to the concepts and principles of chemical engineering. It is designed for students who have not had prior courses in chemical engineering. The course is intended to prepare students for further study in chemical engineering. It covers the basic principles of chemical engineering, including stoichiometry, unit operations, and thermodynamics. The course is intended to provide a foundation for students who are interested in pursuing a career in the chemical engineering field.
consumer products, foods, advanced materials, and biological systems. Real-world case studies and classroom exercises will be used to illustrate the influence of non-Newtonian rheology on mixing, processing, and product design. Emphasis will be on the physical properties and chemical fundamentals of energy conversion technologies.

146. Heterogeneous Catalysis
Prerequisite: Chemical Engineering 140A-B or consent of instructor.
Concepts and definitions. Physical and chemical phenomena characteristic of heterogeneous catalysis. Description, and surface reaction on well-defined solid catalysts. Thermodynamics and kinetics of overall reaction on uranium and nonuraniferous surfaces. Correlations and theoretical approaches in chemical engineering catalysis.

152A. Process Dynamics and Control I
Prerequisite: Chemical Engineering 140A-B and 148B.
Development of theoretical and empirical models for chemical and physical processes. Dynamic behavior of processes, transfer function and block diagram representation, process instrumentation, control system design and analysis, stability analysis, computer simulation of controlled systems. Introduction to on-line optimization.

154. Engineering Approaches to Systems Biology
Prerequisite: Chemical Engineering 170 or Biological Engineering 140A or 481B.
The theory, design, and experimental application of advanced process control strategies including feedback control, cascade control, enhanced single-loop strategies, and model predictive control. Analysis of multi-loop control systems. Introduction to on-line optimization.

158. Pharmaceutical Engineering
Prerequisite: Mathematics 4B or 4BI; Mathematics 6A or 6B.
Prerequisite: Applied engineering tools and methods to solve problems in systems biology. Emphasis is placed on integrative approaches to multi-scale and multi-rate phenomena in biological regulation systems. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

166. Introduction to Polymer Science
Prerequisite: Upper-division standing, completion of Mathematics 21A or 22B.
Prerequisites: Mathematics 4B or 4BI; Mathematics 6A or 6B.
Prerequisites: Applied engineering tools and methods to solve problems in systems biology. Emphasis is placed on integrative approaches to multi-scale and multi-rate phenomena in biological regulation systems. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

168. Analysis of Chemical Processes
Prerequisite: Applied engineering tools and methods to solve problems in systems biology. Emphasis is placed on integrative approaches to multi-scale and multi-rate phenomena in biological regulation systems. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

169. Design of Chemical Processes
Prerequisite: Applied engineering tools and methods to solve problems in systems biology. Emphasis is placed on integrative approaches to multi-scale and multi-rate phenomena in biological regulation systems. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

170. Molecular and Cellular Biology for Engineers
Prerequisite: Applied engineering tools and methods to solve problems in systems biology. Emphasis is placed on integrative approaches to multi-scale and multi-rate phenomena in biological regulation systems. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

173. Internship in Industry 1
Prerequisite: Upper-division standing, completion of Mathematics 21A or 22B.
Prerequisite: Applied engineering tools and methods to solve problems in systems biology. Emphasis is placed on integrative approaches to multi-scale and multi-rate phenomena in biological regulation systems. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

186. Undergraduate Research
Prerequisite: Upper-division standing, completion of 2 years of chemistry. Consent of instructor:
Course instructor must complete and sign: [name of professor] 2-year teaching experience, May be taken once for a maximum of 6 units. Not more than 3 units may be repeated for a total of 12 units. Consent of instructor.

188. Independent Studies in Chemical Engineering
Prerequisite: Applied engineering tools and methods to solve problems in systems biology. Emphasis is placed on integrative approaches to multi-scale and multi-rate phenomena in biological regulation systems. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

190. Undergraduate Research Laboratory
Prerequisite: Undergraduate instructor's consent.
Course involves two-dimensional experimental study.
These courses will be offered under the auspices of the University of California, Irvine (UCI), efficient mobile program transfer formats, and software computational tools for automated analysis of concurrent systems. Computer-aided understanding, model checking, validation, and computer system design automation, using symbolic techniques in high level synthesis. A course in design automation methods; single electron computing, computer aided design of microprocessors. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

193. Internship in Industry 2
Prerequisite: Upper-division standing, completion of Mathematics 21A or 22B.
Prerequisite: Applied engineering tools and methods to solve problems in systems biology. Emphasis is placed on integrative approaches to multi-scale and multi-rate phenomena in biological regulation systems. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

199. Internship in Industry 3
Prerequisite: Upper-division standing, completion of Mathematics 21A or 22B.
Prerequisite: Applied engineering tools and methods to solve problems in systems biology. Emphasis is placed on integrative approaches to multi-scale and multi-rate phenomena in biological regulation systems. An introduction to the concepts of gene expression, signal transduction, and systems-level analyzing and sensitivity analysis tools are introduced.

COMPUTER ENGINEERING • 2524 • CHEMICAL ENGINEERING
The Computer Science Department seeks to prepare undergraduate and graduate students for productive careers in industry, academia, and government, by providing an outstanding environment for teaching and research in the core and emerging areas of computer science, and the places high priority on establishing and maintaining innovative research programs that enhance educational opportunity.

The Department of Computer Science offers programs leading to the degree of Bachelor of Science in computer science, and the M.S. and Ph.D. in computer science. The B.S. degree program in computer science is accredited by the Commission on Accreditation of Engineering Education (ABET). One of the most important aspects of the Computer Science program at UCSD is the wealth of “hands-on” opportunities for students. UCSD has excellent computer facilities. Campus Instructional Computing makes accounts available to all students. Include Computer Science majors and premajors who use the workstations in the Computer Science Instructional Lab and Engineering Computing Infrastructure computing facilities. Students doing special projects can gain remote access to machines at the NSF Supercomputing Centers. Additional computing facilities are available for graduate students in the Graduate Student Laboratory. Students working with faculty have access to further specialized research facilities within the Department of Computer Science.

The undergraduate major in computer science has a dual purpose: to prepare students for advanced studies and research and to provide training for a variety of careers in business, industry, and government. Under the direction of the Associate Dean for Undergraduate Studies, academic advising services are jointly provided by the advisors in the College of Engineering, as well as advisors in the department. A faculty advisor is also available to each undergraduate class for further academic program planning.
Admission to the Major

Students interested in computer science may apply to UCSB without declaring a major. Students are strongly encouraged to complete Computer Science once the minimum requirements are completed.

Program Goals for Undergraduate Programs

Critical analysis applies to fundamental concepts in the construction of software systems of varying complexity.

Program Outcomes for Undergraduate Programs

The primary computer science departmental emphasis is on problem solving using computer program design, analysis and implementation, with both a theoretical and implementation, with both a theoretical

Computer Science Courses

LOWER DIVISION

4. Computer Science Boot Camp (4)

NOT open to CMPSC or CMPSC Majors. An introduction to computational thinking using computers, computing, data management, and problem solving using computers, for non-majors. Topics include

5. Advanced Programming (4-6)

CMPSC 32 is a liberal arts course designed for students planning to attend a school of law, college of medicine, or graduate school. Computer Science 60.

Computer Science 218A. Advanced Topics in Formal Languages and Automata Theory (4-6) (4) COSTANZO

Foundations of Computer Science II (3-4)

Mandatory completion of Computer Science 110A.

Computer Science 130A. Introduction to the architecture of computer systems. Topics include: central processing units, memory systems, channels and controllers, peripheral devices, input/output systems, operating systems, and system programming. Introduction to programming languages, numerical integration, statistical analysis, and other applications.

Computer Science 174A. Fundamentals of Database Systems (4)

Prerequisite: Computer Science 176 or ECE 155 or equivalent.

No credit for students who have received credit in EMC 154, ECS 154, or ECS 154E. Introduction to the architecture of computer systems. Topics include: central processing units, memory systems, channels and controllers, peripheral devices, input/output systems, operating systems, and system programming. Introduction to programming languages, numerical integration, statistical analysis, and other applications.

12. Memory Management (4)

Computer Science 170. Distributed Systems (4)

Study of the structure of compilers. Topics include instruction set design, Link and LL linkers; parsing: token, syntax, and semantic analysis; and assembler and compiler construction.

Computer Science 130B. Introduction to Compiler Design and Construction (4)

Computer Science 171. Distributed Systems (4)

Introduction to the field of artificial intelligence, which includes machine learning, natural language processing, planning, and knowledge representation. Topics include intelligent agents, architecture of the Cognitive system, and machine learning.

Computer Science 641A. Artificial Intelligence (4)

Prerequisite: Computer Science 110B.

Prerequisite: Computer Science 24 with a grade of C or better.

Prerequisite: Computer Science 40 with a grade of C or better.

Prerequisite: Computer Science 16 with a grade of C or better.

Prerequisite: Mathematics 5A or 4B with a grade of C or better.

Computer Science 16. CMPSC 8 is not taken for letter grades.

Prerequisite: Computer Science 8.

Prerequisite: Computer Science 130A with a grade of C or better.

Prerequisite: Computer Science 176 or ECE 155 or equivalent.

Prerequisite: Computer Science 130A.

Prerequisite: Computer Science 130A.

Requirements: Open to pre-computer science and computer science students.

Introduction to the field of artificial intelligence, which includes machine learning, natural language processing, planning, and knowledge representation. Topics include intelligent agents, architecture of the Cognitive system, and machine learning.

Computer Science 642A. Machine Learning (4-6)

Prerequisite: Computer Science 130A.

Prerequisite: Computer Science 30 with a grade of C or better.

Prerequisite: Computer Science 32 with a grade of C or better.

Prerequisite: Computer Science 60.

Prerequisite: Computer Science 176 or ECE 155 or equivalent.

Prerequisite: Computer Science 176 or ECE 155 or equivalent.

Prerequisite: Computer Science 130A.

Prerequisite: Computer Science 60.

Prerequisite: Computer Science 176 or ECE 155 or equivalent.

Prerequisite: Computer Science 130A.

Introduction to database systems, including data manipulation languages, data modeling, and database management systems. Study of the structure of compilers. Topics include instruction set design, Link and LL linkers; parsing: token, syntax, and semantic analysis; and assembler and compiler construction.

Prerequisite: Computer Science 60.

Prerequisite: Computer Science 176 or ECE 155 or equivalent.

Prerequisite: Computer Science 130A with a grade of C or better.

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Computer Science 130A.

Prerequisite: Computer Science 5A or 4B with a grade of C or better.

Prerequisite: Computer Science 32 with a grade of C or better.

Prerequisite: Computer Science 64 with a grade of C or better.

Prerequisite: Computer Science 176 or ECE 155 or equivalent.

Introduction to computational thinking, using computers, for non-majors. Topics include

Introduction to the theoretical underpinnings of computer science. Topics include: propositional algebra, set theory, relations, counting, mathematical induction and recursion (proof strategies). Computer Science 110A: Advanced Topics in Formal Languages and Automata Theory (4-6) (4) COSTANZO

Introduction to the field of artificial intelligence, which includes machine learning, natural language processing, planning, and knowledge representation. Topics include intelligent agents, architecture of the Cognitive system, and machine learning.

Computer Science 641A. Artificial Intelligence (4-6)

Prerequisite: Computer Science 24 with a grade of C or better.

Introduction to database systems, including data manipulation languages, data modeling, and database management systems. Study of the structure of compilers. Topics include instruction set design, Link and LL linkers; parsing: token, syntax, and semantic analysis; and assembler and compiler construction.

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Prerequisite: Computer Science 60.
Electrical & Computer Engineering

Department of Electrical and Computer Engineering, Building 380, Room 101; Telephone (805) 893-2249 or (805) 893-3821 Web site: www.ece.ucsb.edu

Chair, Joao Hespanha
Vice Chair, B.S. Manjunath
Faculty

Rod C. Aferness, Ph.D., University of Michigan, Distinguished Professor and Dean, (integrative photonics, deep sub-wavelength imaging, photonics in the biological sciences)

Kavast Banerjee, Ph.D., UC Berkeley, Professor (high performance VLSI and mixed signal design, single electron transistors, 3D and optoelectronic integration)

Ilan Ben-Yaacov, Ph.D., UC Santa Barbara, Lecturer (semiconductor device physics, electronics and electrical devices, power electronics, engineering education)

Daneil Kirsch, Ph.D., University of Colorado Boulder, Professor (fiber-optic networks, wavelength and subcarrier division multiplexing, optical packet switching, signal processing in semiconductor optical devices, wavelength conversion, microwave photonics)

John E. Bowes, Ph.D., Stanford University, Distinguished Professor and Center Director (electronics, computer engineering, and electronic devices and integrated circuits, fiber optic communication, semiconductors, laser physics, microwave photonics, compound semiconductor materials and processes)

Forrest D. Brown, Ph.D., University of Illinois Urbana-Champaign, Professor (multimedia systems, VLSI and computer system design automation, theory of design and design representations, symbolic execution, high-level synthesis, James Buckwalter, Ph.D., California Institute of Technology, Professor (Signal Processing, computer networks, computer system design, high-speed computer architecture, computer networks, computer interface)

Kati A. Byl, Ph.D., Massachusetts Institute of Technology, Associate Professor (computer vision, computer graphics, mobile robotics, computer vision, robotic manipulation, locomotion, machine learning)

Shivkumar Chandrasekharan, Ph.D., Yale University, Professor (numerical analysis, linear algebra, scientific computing, high-performance computing)

Nadig Dagli, Ph.D., Massachusetts Institute of Technology, Professor (design, fabrication, and modeling of photonic integrated circuits, ultralow electrically modulated solid state microphotonic devices, experimental study of ballistic transport in quantum confined structures)

Steve P. DenBaars, Ph.D., Stanford University, Distinguished Professor (LEDs, optoelectronic, electronic devices and circuits, quasi-optics, antennas, semiconductor device physics, microwave and millimeter wave devices, integrated devices and circuits, in situ processing and integration techniques)

Yasuo Tanaka, Ph.D., Stanford University, Professor (mobile sensor networks, wireless networks, networked control systems)

Behzad Parhami, Ph.D., UC Los Angeles, Professor (parallel algorithms and architectures, computer architecture, computer design, dependable and fault-tolerant computer systems)

Ramin Pedarsani, Ph.D., UC Berkeley, Assistant Professor (information and coding theory, machine learning, applied network control, transportation systems, game theory)

Mark J.W. Rodwell, Ph.D., Stanford University, Distinguished Professor (RF and microwave circuits, radio frequency and microwave photonic technology and planar technology)

Joy Pederson, Ph.D., Stanford University, Professor Emeritus (quantum electronics, photocurrents, light scattering, interaction with charged particles)

Allen Gersho, Ph.D., Cornell University, Professor Emeritus, Director of Center for Information Processing Research (information theory, source and channel coding, image coding, communications, pattern recognition, statistical signal processing)

Clint Schow, Ph.D., Texas A&M University, Austin, Professor (radiofrequency-electronic co-design, digital transmission techniques for high-speed optical links, photonic integration, photonic integrated circuits, integrated transceiver packaging)

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Robert York, Ph.D., Cornell University, Professor (high-power/high-frequency devices and circuits, materials, electronics, electromagnetic theory, nonlinear circuits and devices, nonlinear electronic devices, microwave electronics, analog VLSI, and data analysis and Machine Learning; Magnetic Resonance Imaging (MRI))

Emeriti Faculty

Steven E. Butner, Ph.D., Stanford University, Professor (computer architecture, VLSI design of digital signal processors, emphasis on distributed organizations and fault-tolerant computing)

Kwang-Ting (Tim) Cheng, Ph.D., UC Berkeley, Distinguished Professor (parallel and distributed systems, design, synthesis, design verification, algorithm)

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Stephen L. Long, Ph.D., Cornell University, Professor Emeritus of Electrical Engineering, was honored for his contributions to the understanding of the photovoltaic effects in organic materials and organic light-emitting diodes, and his leadership in the field of photovoltaics.

Malgorzata D. Moskal, Ph.D., Technical University of Warsaw, Poland, was recognized for her contributions to the field of optical fiber communications and her work on optical interconnects and reconfigurable interconnects.

P. Michael Melliar-Smith, Ph.D., University of Cambridge, Professor Emeritus of Computer Science, was honored for his contributions to the development of computer architectures and his work on computer systems.

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10. Foundations of Analog and Digital Circuits and Systems (4) SAWICKI
Prerequisite: ECE 10B (may be taken concurrently) with a C- or better grade. Lecture: 4 hours.
Not open for credit for those who have received a C- or better grade in ECE 10C.
The goal of 10B is to provide the student with a hands-on introduction to the design of digital and analog circuits, and to familiarize students with basic mathematical and electrical engineering tools.

10B. Foundations of Analog and Digital Circuits and Systems (4) BREWER
Prerequisite: ECE 10B with a C- or better grade. Lecture: 3 hours.
Not open for credit for those who have received a C- or higher in ECE 2B.
The objective of the course is to introduce the importance of system-level design, and to provide students with a hands-on understanding of the physical phenomena in digital circuits. The course will cover basic digital design, digital design, and basic digital circuit design.

122. VLII Architecture and Design (4) SAWICKI
Prerequisite: ECE 124A or ECE 123 or ECE 124 with a grade of C- or better. Lecture: 3 hours; Laboratory: 2 hours.
Practical issues in VLII circuit design, pipeline design, pipelining, clocking, and synchronization issues in digital circuits. On-chip and off-chip clocking, clock skew, and clock distribution. Circuit design constraints, interconnect limitations and trade-offs. The goal of 10CL is to provide the student with a hands-on introduction to the design of digital and analog circuits, and to familiarize students with basic mathematical and electrical engineering tools.

123. High Speed Digital High-Speed Circuit Design (4) BREWER
Prerequisite: ECE 124A or ECE 123 or ECE 124 with a grade of C- or better. Lecture: 3 hours; Laboratory: 2 hours.
Introduction to high-speed digital-performance circuit design techniques. Basic devices of physics, including sub-threshold effect, device scaling, and logic effect. Designing circuits that are sensitive to both the design of individual transistors and the overall system design. The goal of 10CL is to provide the student with a hands-on introduction to the design of digital and analog circuits, and to familiarize students with basic mathematical and electrical engineering tools.

124. Digital Circuit Design and Fabrication (4) STAFF
Prerequisite: ECE 124A or ECE 124 or ECE 123 with a grade of C- or better. Lecture: 3 hours; Laboratory: 3 hours.
Not open for credit for those who have taken ECE 124B.

125. The Practice of Science (4) STAFF
Prerequisite: Consent of instructor.
Same course as Physics 125A.
Provides experience in pursuing careers within science, engineering and technology through directed research with scientists, engineers, and technologists. Advanced study, professional and commercial experience is required and the student is expected to provide the student with a hands-on application of the concepts discussed in ECE 10C. The course will cover basic digital design, digital design, and basic digital circuit design.

126. Projects in Electrical and Computer Engineering (4) STAFF
Prerequisite: Consent of instructor for Electrical Engineering and Computer Engineering majors only or consent of instructor for advanced undergraduate students.

24. ELECTRICAL AND COMPUTER ENGINEERING ELECTRICAL AND COMPUTER ENGINEERING • 35
153A. Hardware/Software Interface

Prerequisite: Upper-division standing in Computer Engineering.

Software as a component of Computer Science 153A.

Topics in interfacing computing systems and software to practical I/O interfaces, real-time events and management of tasks, threads, and scheduling of processes. Concepts of embedded software and systems is discussed. Techniques for hardware-software cooperation are explored.

153B. Sensor and Interface Design

Prerequisite: ECE 152A with a minimum grade of C-. Lecture: 3 hours. Laboratory: 2 hours. Hardware description languages—field-programmable logic and ASIC design. Mixed-signal techniques: A/D and D/A converters including design, digital signal processing, and communication and network interfaces.

154A. Introduction to Computer Architecture

Prerequisite: ECE 152A with a minimum grade of C-. Lecture: 3 hours; Discussion: 1 hour.

Instruction-set architecture (ISA) and computer performance; Machine instructions, assembly language, software bugs, compiler analysis, program structure; Procedure calls; Number formats; Simple ALUs; Data path, cache, pipeline; Design of performant computer processors, programming interface; Pipelined data paths and control schemes.

154B. Advanced Computer Architecture

Prerequisites: ECE 154A with a C- or better; Open to EE and CMPEN majors only. Lecture: 3 hours; Laboratory: 3 hours.

Computer architecture (ISA) and computer performance; Memory hierarchies, memory management, virtual memory, processor specification and control; Addressing modes; Cache and virtual memory; Processors and their interfaces; Operating systems; Cache and virtual memory; Processors and their interfaces; Operating systems; Cache and virtual memory; Processors and their interfaces; Operating systems.

189B. Senior Electrical Engineering Project

Prerequisite: Consent of instructor. Variable hours. Group study intended for small number of advanced students, not open to students who have previously taken the course.

189P. Introduction to Robotics: Planning and Control

Prerequisites: ECE 181A or ECE 179P. Lecture: 3 hours; Laboratory: 3 hours. Students who have taken ECE 189A and have received a grade of C- or better, may take this course for credit.

192. Projects in Electrical and Computer Engineering

Prerequisite: Consent of instructor. Field, 1-8 hours. Projects are conducted in cooperation with industrial and research firms, under direct faculty supervision.

198/99/198/199/199DC/199RA courses combined. Students who have taken this course may not receive credit for student research.

Students who have taken ECE 189A and have a grade of C- or better, may take this course for credit.

198/99/198/199/199DC/199RA courses combined. Students who have taken this course may not receive credit for student research.

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198/99/198/199/199DC/199RA courses combined. Students who have taken this course may not receive credit for student research.

Students who have taken ECE 189A and have a grade of C- or better, may take this course for credit.

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Materials

Department of Materials Engineering

Room 1355, University of California, Santa Barbara, CA 93106-6114

Web site: www.materials.ucsb.edu

Chair: Michael L. Chabinyc

Faculty

Christopher M. Bates, PhD, University of Austin Texas, Assistant Professor (polymer microelectronics, nonlinear optical materials, energy storage, and crystalization)

Guillermo C. Bazan, PhD, Massachusetts Institute of Technology, Distinguished Professor (polymer synthesis, photophysics)

Robert M. McMeeking, PhD, Brown University, Distinguished Professor in MEMS Technology (mechanics of materials, fracture mechanics, computational mechanics, process mechanical, composites)

Irene J. Beyerlein, PhD, Cornell University, Professor (computational materials science, microstructure-property relationships, deformation mechanisms, composite)

John Bowers, PhD, Stanford University, Distinguished Professor (energy-efficient, optoelectronic devices and networks, silicon photonics)

Michael Chabinyc, PhD, Stanford University, Associate Professor (organic semiconductors, thin film electronics, energy conversion using photovoltaics, characterization of thin films, x-ray scattering from polycrystalline films)

Raphaëlle J. Clément, PhD, University of Cambridge, Assistant Professor (energy storage and conversion using batteries and photoelectrochemical cells, characterization of inorganic (photo)electrochemical materials using magnetic resonance imaging and first principles calculations)

Steve P. DenBaars, PhD, University of Southern California, Distinguished Professor (metallorganic chemical vapor deposition (MOCVD) of semiconductors, IR to blue lasers and LEDs, high power electronic materials and devices)

David S. Ginotla, PhD, Johns Hopkins University, Associate Professor (nanomechanical behavior and deformation mechanisms in ultra-strong materials, modeling and characterization of biological materials, strain engineering of transport phenomena controllable and efficient solid state fuel cell conversion, interface engineering of nanocrystalline materials for mechanical stability and damage tolerance, control of residual stress in epitaxial growth, measurements of relative strain)

John W. Farkas, PhD, Cornell University, Assistant Professor (quantum materials, unconventional superconductors, topologically-correlated materials, nonlinear optical spectroscopy, angle-resolved photoemission spectroscopy)

Craig Hawker, PhD, University of California at Irvine, Distinguished Professor, Director of Materials Research Laboratory (synthetic polymer chemistry, nanotechnology, materials science)

Carlos G. Levi, PhD, University of Illinois at Urbana-Champaign, Professor (processing, and microstructure evolution, coatings, composites, functional & intelligent materials)

Anton Van der Ven, PhD, Massachusetts Institute of Technology (first principles prediction of thermodynamic, kinetic and mechanical properties of alloys, nanostructured and thin film semiconductors, static and dynamic mechanical methods development, electrochemical energy storage materials, high temperature structural materials, computational mechanics)

Claude Weibuchi, PhD, Université Paris VII, Ecole Polytechnique-Palaiseau, Professor (fundamental and advanced applied optical studies of quantum dot and quantum well materials and photonic-controlled structures; electron spin resonance, magnetic properties of semiconductor microcavities, photonic bandgap)

Stephen Wilson, PhD, University of Technology Sydney, Assistant Professor (Magnetism in correlated electron systems and quantum materials, spin-orbit coupled quantum materials, quantum criticality, neutron, and x-ray scattering of materials)

Francis W. Zoll, PhD, McMasters University, Professor (mechanical and thermal properties of materials and structures)

Emeriti Faculty

Anthony K. Chestna, PhD, Oxford University, Emeritus (catalysis, optical materials, X-ray, neutron diffraction)

Larry A. Coldren, PhD, University of Cambridge, Emeritus (optoelectronics, microelectronic devices, semiconductor microcavities, semiconductor devices)

A. V. Heeger, PhD, University of California, Santa Barbara, Emeritus (organic semiconductors, optoelectronic devices, polymer electronics)

Ram Seshadri, PhD, University of California, Santa Barbara, Emeritus (nanomaterials, spin-orbit coupled materials, materials processing paths, ultrafast laser processing, advances in nanotechnology)

Noel C. MacDonald, PhD, UC Berkeley, Emeritus (advanced electronic materials, microelectromechanical systems, applied physics, nano-fabrication, electron optics, materials development, organic semiconductors)

Frederik F. Miente, PhD, UC Los Angeles, Emeritus (solid state physics, magnetic, bonding, defects, mechanical properties of the condensed matter)

Gary R. Gobbe, PhD, Massachusetts Institute of Technology, Emeritus (Science of materials in extreme environments, structural reliability, and improved performance compositions)

Pierre M. Pettit, PhD, UC Berkeley, Emeritus (semiconductor interfaces, defects physics, epitaxy of self-assembled quantum structures, quantum dots and nanowire, spectroscopy of semiconductor nanostructures)

Affiliated Faculty

David Austin, PhD (Electrical and Computer Engineering)

Glenn H. Frederickson, PhD (Chemical Engineering)

Mahn Won Kim, PhD (Physics)

Gary Leal, PhD (Chemical Engineering)

Gene Lucas, PhD (Chemical Engineering)

UPPER DIVISION

101. Ethics in Engineering

Principles of professional practice, a general introduction to ethical behavior, and an overview of the profession. The development of major areas of engineering and their role in society. The concept of professional codes of ethics and their role in engineering career choice. Cote of ethics. Case studies will form the basis for conceptualization of the concepts introduced. (W.S.M)

103. Advanced Engineering Writing

5 credits

Prerequisites: Writing 50 or 50E, upper-division standing

Practice in the forms of communication characteristic of engineering professional practice, particularly in the writing of reports and proposals. Prerequisites: experience in communicating science and engineering and knowledge of the roles of the components of the discourse are developed in writing. The course is designed to build the communication and writing skills that students will need to succeed as engineers in the field.

106. Science for the Public

4 credits

Prerequisite: consent of instructor

Same course as Physics 106X. Open to graduate students in science and engineering disciplines and to undergraduate science and engineering majors. Provides experience in communicating science to the public. Prerequisites: experience in communicating science.

107. Art and Science of Aerospace Culture (Quarters)

5 credits

Prerequisites: upper-division standing; consent of instructor

Same course as Art 107. Interdisciplinary course introducing practice for artists, scientists, and engineers who work in the field of aerospace.

118. Introduction to Energy and Environment

4 credits

Same course as Environmental Studies 118. Introduction to the science of energy use and production, the environment, and their role in society.

126. Materials and Society

5 credits

128. Materials and Biosystems

5 credits

The department has major research efforts that emphasize the transfer of materials science and engineering results into the life sciences and medicine. This course is designed to introduce the students to the interdisciplinary nature of the materials science and engineering results into the life sciences and medicine. This course is designed to introduce the students to the interdisciplinary nature of the materials science and engineering results into the life sciences and medicine.

135A, 135B, 135C. Introduction to the Structure and Properties of Materials

4 credits

135A. Structure and Properties I

[Staff]

Prerequisites: Chemistry 4A-B, Physics 4 A-B, and Mathematics 4B. Lecture, 3 hours. An introduction to materials in modern technology. The internal structure of materials and the underlying principles: bonding, the behavior of atoms and molecules, structure, defects, phase transformations, optical properties of materials, and their relationship with structure.

135B. Structure and Properties II

[Staff]

Prerequisites: Materials 101A and 101B. Students who take Matrl 101 & 101B will only receive major credit for one of these courses.

138. Materials and Society

5 credits

The department has major research efforts that emphasize the transfer of materials science and engineering results into the life sciences and medicine. This course is designed to introduce the students to the interdisciplinary nature of the materials science and engineering results into the life sciences and medicine.

101. Introduction to the Structure and Properties of Materials

5 credits

Prerequisite: upper-division standing

Same course as Materials 101A and 101B. An introduction to the problems of bonding, the behavior of atoms and molecules, structure, defects, phase transformations, optical properties of materials, and their relationship with structure.

102. Structure and Properties I

[Staff]

Prerequisites: Chemistry 4A-B, Physics 4 A-B, and Mathematics 4B. Lecture, 3 hours. An introduction to materials in modern technology. The internal structure of materials and the underlying principles: bonding, the behavior of atoms and molecules, structure, defects, phase transformations, optical properties of materials, and their relationship with structure.

103. Advanced Engineering Writing

5 credits

Prerequisites: Writing 50 or 50E, upper-division standing

Practice in the forms of communication characteristic of engineering professional practice, particularly in the writing of reports and proposals. Prerequisites: experience in communicating science and engineering and knowledge of the roles of the components of the discourse are developed in writing. The course is designed to build the communication and writing skills that students will need to succeed as engineers in the field.

106. Science for the Public

4 credits

Prerequisite: consent of instructor

Same course as Physics 106X. Open to graduate students in science and engineering disciplines and to undergraduate science and engineering majors. Provides experience in communicating science to the public. Prerequisites: experience in communicating science.

107. Art and Science of Aerospace Culture (Quarters)

5 credits

Prerequisites: upper-division standing; consent of instructor

Same course as Art 107. Interdisciplinary course introducing practice for artists, scientists, and engineers who work in the field of aerospace.

118. Introduction to Energy and Environment

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Same course as Environmental Studies 118. Introduction to the science of energy use and production, the environment, and their role in society.

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128. Materials and Biosystems

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The department has major research efforts that emphasize the transfer of materials science and engineering results into the life sciences and medicine. This course is designed to introduce the students to the interdisciplinary nature of the materials science and engineering results into the life sciences and medicine. This course is designed to introduce the students to the interdisciplinary nature of the materials science and engineering results into the life sciences and medicine.

135A, 135B, 135C. Introduction to the Structure and Properties of Materials

4 credits

135A. Structure and Properties I

[Staff]

Prerequisites: Chemistry 4A-B, Physics 4 A-B, and Mathematics 4B. Lecture, 3 hours. An introduction to materials in modern technology. The internal structure of materials and the underlying principles: bonding, the behavior of atoms and molecules, structure, defects, phase transformations, optical properties of materials, and their relationship with structure.

135B. Structure and Properties II

[Staff]

Prerequisites: Materials 101A and 101B. Students who take Matrl 101 & 101B will only receive major credit for one of these courses.

138. Materials and Society

5 credits

The department has major research efforts that emphasize the transfer of materials science and engineering results into the life sciences and medicine. This course is designed to introduce the students to the interdisciplinary nature of the materials science and engineering results into the life sciences and medicine.

101. Introduction to the Structure and Properties of Materials

5 credits

Prerequisite: upper-division standing

Same course as Materials 101A and 101B. An introduction to the problems of bonding, the behavior of atoms and molecules, structure, defects, phase transformations, optical properties of materials, and their relationship with structure.
160. Introduction to Polymer Science (4)
Same course as Chemistry 160.

161. Introduction to Mechanical Engineering (2)
Same course as Chemical Engineering 161.

162A. The Quantum Description of Electronic Structure (4)
Prerequisite: ECE 120A and 134 with a minimum grade of C- in all open E and Materials major course.

162B. Fundamentals of the Solid State (4)
Prerequisite: ECE 120A with a minimum grade of C- in all open E and Materials major course.

163. Materials in Engineering (4, p. later)
Same course as ME 163. Lecturer, 3 hours. This course introduces the student to the basic properties of materials and the principles behind their development, service, and processing. It covers the genesis of materials, ceramics, polymers, and composites in more detail. Additional laboratory applications. The relationship of properties to service and processing is emphasized in every case.

166. Manufacturing and Materials (4, p. later)
ME 168E; ME 161C, and ME 108B or 108C.

169. Advanced Engineering Mathematics (4, p. later)
Introduction to the fundamentals of common mathematical tools and techniques with the structure and properties of materials as they appear in practical problems. Emphasizes understanding the key physical concepts and mathematical tools that are involved in each of the processes discussed.

168. Topics in Materials (4, p. later)
ME 165B; IE 161C, and ME 108B or 108C.

Graduate Courses
Graduate courses for this major can be found in the UCSC General Catalog.

Mechanical Engineering
Department of Mechanical Engineering, Engineering 6, Room 2355
Phone (805) 893-2430
Web site: www.me.ucsb.edu
Chair: Frederic Gibou
Vice Chair: Jeffrey Moehlis
Faculty
Bassam Bamieh, Ph.D., Rice University, Professor (control systems design & applications to fluid flow problems)
Mark W. Blagney, Ph.D., University of California, Santa Barbara, Professor (mechanics of materials with applications to multiaxial devices such as microfluidics, MEMS and protective coatings)
Evan E. Buehler, Ph.D., Harvard, Professor (solid state mechanics, materials, aeronautics and engineering education)
Ted D. Benard, Ph.D., UC Berkeley, Associate Professor (thermomechanics, laser processing)
Irene J. Bauerfeind, Ph.D., Cornell University, Professor (structural mechanics of multi-phase micro- and nanostructured materials, design of metallic alloys) Joint Appointment: MATL
David Bothman, B.S., UC San Diego, Lecturer
Francesco Bullo, Ph.D., California Institute of Technology, Professor (motion planning and coordination control systems, distributed and adaptive control algorithms)
Otger Camps, Ph.D., Curie Institute (Paris) and University of Barcelona, Assistant Professor (physical biology, systems biology, quantitative biology, morphogenesis and self-organization of living matter)
Samantha H. Daly, Ph.D., California Institute of Technology, Professor (mechanics of materials, development of small-scale experimental methods, effects of microstructure on the meso and macroscopic properties of materials, active material composites, fatigue, plasticity, fracture)
Emile Dressaire, Ph.D., Harvard University, Assistant Professor (thermostatistics, genetic control, solar cells, high temperature coaters for turbines and engines)

Graduate Courses
Graduate courses for this major can be found in the UCSC General Catalog.

Paolo Luzzatto-Fegiz, Ph.D., Cornell University, Associate Professor (fluid mechanics, wind energy and instrument engineering)
Eric W. Lyons, Ph.D., California Institute of Technology, Professor (heat transfer, fluid mechanics)
Robert R. McKeever, Ph.D., Brown University, Distinguished Professor (thermodynamics, fracture mechanics, plasticity, computational mechanics)
Eckart Weber, Ph.D., University of Karlsruhe, Distinguished Professor (computational fluid dynamics, fluid mechanics)
Carl D. Meinert, Ph.D., University of Illinois at Urbana-Champaign, Distinguished Professor (fluid turbulence, microflows, in complex geometries)
Igor Mezić, Ph.D., California Institute of Technology, Professor (applied mechanics, non-linear dynamics, fluid mechanics, applied mathematics)
Sumita Pennathur, Ph.D., Stanford University, Associate Professor (application of microfabrication techniques and micro and nanofluidic flow processes)
Linda M. McCauley, Ph.D., University of Illinois at Urbana-Champaign, Distinguished Professor (biomechanics, Science and Engineering Graduate Empires, computational engineering science, systems biology)
Belt Pruett, Ph.D., Stanford University, Professor
Alban Sauver, Ph.D., IRPHE, Aix-Marseille University, Assistant Professor (single-molecule biophysical mechanics, motor proteins, biomaterials)
Henry T. Yang, Ph.D., Cornell University, Distinguished Professor (aerodynamics, structural dynamics, fluid structure interaction, and stability, propulsion, turbomachinery, aeroacoustics, intelligent flying machines)

Emreti Faculty
John C. Bode, Ph.D., Stanford University, Professor Emeritus (electrical engineering, numerical solutions and analysis)
David R. Clarke, Ph.D., University of California, Santa Cruz, Professor Emeritus (thermodynamics, thermal barrier coatings, piezoelectricity, mechanics of microcrystals)
Roy B. Coale, Ph.D., UC Berkeley, Professor Emeritus (fluid mechanics, physical gas dynamics, vibrating and rotating equipment)
George Homay, Ph.D., University of Illinois, Professor Emeritus (hydrodynamics, thermal hydraulics, fluid dynamics, flow in microstructures and in porous media, polydispersed flows)
Keith T. Kedward, Ph.D., University of Wales, Professor (design of composite systems)
Walter J. Lick, Ph.D., Rensselaer Polytechnic Institute, Professor Emeritus (ooze mechanics, oil in emulsions and applied geology)

Grandes cosas, Ph.D., Massachusetts Institute of Technology, Professor (mechanical properties of materials in response to environmental effects, structural reliability)
Noel C. MacDonald, Ph.D., UC Berkeley, Professor (thermochemical, microelectromechanical systems, applied physics, materials, mechanics, nanofabrication) Joint Appointment: MATL
Ekkhard P. Marschall, Dr. Ing., Technische Hochschule Darmstadt, Professor (thermodynamics, heat and mass transfer, desalination, evaporation, sorption, environmental techniques)
Stephen R. McKearn, Ph.D., University of Washington, Professor Emeritus (fluid mechanics, physical oceanography, sediment transport) Joint Appointment: MATL
Fredrick Mitchen, Ph.D., UC Los Angeles, Professor Emeritus (mechanical properties of materials) Joint Appointment: MATL
Thomas P. Mitchell, Ph.D., California Institute of Technology, Professor Emeritus (theoretical and applied mechanics) Joint Appointment: MATL

Professor Emeritus, Director of Computational Science and Engineering Laboratory Director (theoretical and applied mechanics)

Research Opportunities
1. Should possess a solid foundation in, and be able to apply the principles of, mathematics, science, and engineering to solve problems and have the ability to lead the engineering science and laboratory chosen career.
2. Should be able to conduct and analyze data from experiments in dynamics, fluid dynamics, thermal science and materials, and should be engaged in experimental design in at least one of the following areas.
3. Should have experienced the use of current software in problem solving and design.
4. Should demonstrate the ability to design useful products, systems, and processes.
5. Should be able to work effectively on teams.
6. Should have an understanding of professional and ethical responsibilities.
7. Should be able to write lab reports and give effective oral presentations.
8. Should have the broad background in science and the social sciences, which provides an awareness of contemporary issues and facilitates an understanding of the societal and economic impact of engineering problems and solutions.
9. Should be willing to participate in a professional society.

Undergraduate Program
Bachelor of Science—Mechanical Engineering
A minimum of 120 units is required for graduation. A complete list of requirements for the major can be found in the undergraduate catalog. Courses are offered to both undergraduate students and those who are not enrolled in the Mechanical Engineering major.

The undergraduate program in mechanical engineering is accredited by the Engineering Accreditation Commission of ABET. For more information, visit: http://www.abet.org. We offer a balanced curriculum in theory and applications, involving: preparation in basic science, mathematics, computing and writing; a comprehensive set of engineering design and laboratory experiences; and a series of engineering design courses starting in the freshman year and concluding with a three course sequence in the senior year. Our students gain hands-on experience in the use of state-of-the-art tools of computational design, analysis, and simulation that are increasingly used in industry, government, and academic institutions. In the spring of their junior year, students participate in a 15-credit project program that allows them to gain depth in specific areas of interest, while maintaining appropriate breadth in the basic STEM areas of the discipline. All students participate in a widely recognized design project program which includes projects sponsored by industry, universities, and professional organizations. The project program has been expanded to emphasize entrepreneurial product-oriented projects.

Mission Statement
We offer an education that prepares our students to become leaders of the engineering profession and one who will allow them to engage in a lifetime of learning and achievement.

Educational Objectives for the Undergraduate Program
It is the objective of the Mechanical Engineering Program to produce graduates who:
1. Successfully practice in either the traditional or the emerging technologies comprising mechanical engineering.
2. Are successful in a range of emerging lower division mechanical engineering courses.
3. Are engaged in research in the fundamentals of engineering allowing them to form and implement elements of Engineering examination.
4. Engage in life-long learning opportunities such as professional growth and activity in professional societies.

Student Outcomes
Upon graduation, students in the mechanical engineering program will:
1. Demonstrate the ability to solve complex problems.
2. Demonstrate the ability to think critically and creatively.
3. Demonstrate the ability to work effectively in teams.
4. Demonstrate the ability to communicate effectively in writing and speaking.
5. Demonstrate the ability to apply the principles of science, mathematics, and engineering to solve engineering problems.
6. Demonstrate the ability to use current software in problem solving and design.
7. Demonstrate the ability to design and synthesis in the various fields of mechanical engineering.
8. Demonstrate the ability to apply the principles of science, mathematics, and engineering to solve engineering problems.
9. Demonstrate the ability to work effectively in teams.
10. Demonstrate the ability to communicate effectively in writing and speaking.
Prerequisites: Physics 2: ME 14 with a minimum grade of C-; and Mathematics 5C or above (may be taken concurrently); open to ME majors only.
Vibrational kinematics of particles and systems. Coriolis forces and other forces derived from angular momentum. Conservative forces and energy. Problems of bars in tension, compression, and bending. Application to engineering structures, including trusses and beams; distributed forces; friction.

17. Mathematics of Engineering 3 (3 hr.)
Prerequisites: Mathematics 5B or 5B (may be taken concurrently); open to ME majors only.
Introduction to fundamental engineering mathematics concepts and report writing skills. Experiments from thermodynamics; fluid mechanics; and materials science and engineering. Introduction to modern data analysis techniques. Applications to problems described by ordinary differential equations (ODEs) of the form $\frac{dy}{dt} = f(t,y)$.

18. Advanced Topical Courses 4-4-4-4-4
Scheduling: Varies
Prerequisites: Consent of instructor.
May be repeated for credit to a maximum of 8 units. Topics may include (but are not limited to) design project plus the ASME student design project. For students who have completed ME 225CM or ME 251. May not be taken for credit by students who have completed ME 125CM or ME 251.

19. Transferable Electives 4-4-4-4-4
Scheduling: Varies
Prerequisites: Consent of instructor.
May be repeated for credit to an additional 4 units for students who have completed ME 125CM or ME 251. Not open for credit to students who have completed ME 125CM or ME 251.

20. Introduction to Mechanical Engineering 4 (4 hr.)
Prerequisites: Consent of instructor; may be repeated for credit to a maximum of 6 units.
Participates in projects in the laboratory or machine shop. Projects may be student- or faculty-originated dependant upon student interest and faculty member.

21. Introduction to Machine Design 4 (4 hr.)
Prerequisites: ME 15/5A.
Course work required. Students learn to work safely in a machine shop. Students are limited to 5 units per quarter and 30 units total in all 98/99/198/199/199AA-ZZ courses combined.

22. Analysis of statically determinate and indeterminate beams and frames with rotation of engineering reports and drawings. Codes and standards. Topics covered are applied in practice. Does not count toward growth.

157. Introduction to Multiphysics Simulation (3 units)
Prerequisites: Mechanical Engineering 151AE (or equivalent), Mechanical Engineering 125A-B (or equivalent), and Computer Science 164B (or equivalent). Open to students who have completed ME 225CM or ME 251. Not open for credit to students who have completed ME 125CM or ME 251.

158. Fluid Mechanics 4 (4 hr.)
Prerequisites: ME 15A; open to ME majors only. Course materials fee required. Course work required. Design of systems using mechanics, fluid analysis, circuit elements, and programming techniques to realize feasible control design. Introduction to the field of Energetics. Topics include applications to bars, beams, trusses, frames, and solids.

159. Control System Design 4 (4 hr.)
Prerequisites: ME 15A. Dynamic simulation modeling using state-space methods. Controlling the external world: state-space methods for control design including pole placement, loop-transfer, and linear quadratic regulator methods. Observers and observer-based feedback controllers. Students complete hands-on laboratory exercises using MATLAB for simulation and control design.

160. Control and Dynamic Systems 4 (4 hr.)
Prerequisites: ME 15A. Advanced laboratory experiments with exercises in dynamical systems and feedback control design. Students complete experiments, develop Matlab and simulation models for control design. Not open for credit to students who have completed ME 138B.

161. Advanced Structural Analysis 4 (4 hr.)
Prerequisites: ME 14 with a minimum grade of C-; and Mathematics 5C or above (may be taken concurrently); open to ME majors only.
May be taken for credit to an additional 4 units for students who have completed ME 125CM or ME 251. Not open for credit to students who have completed ME 125CM or ME 251.

162. Introduction to Elasticity (4 units)

163. Engineering Mechanics: Vibrations (4 units)
Prerequisites: ME 15A and 15B. Advanced laboratory experiments with exercises in dynamical systems and feedback control design. Students complete experiments, develop Matlab and simulation models for control design. Not open for credit to students who have completed ME 138B.

164. Structures of Engineering 4 (4 hr.)
Prerequisites: ME 14 with a minimum grade of C-; and Mathematics 5C or above (may be taken concurrently). Introduction to the field of Energetics. Topics include applications to bars, beams, trusses, frames, and solids.

165. Fluid Mechanics 4 (4 hr.)
Prerequisites: ME 15A; open to ME majors only. Course materials fee required. Course work required. Design of systems using mechanics, fluid analysis, circuit elements, and programming techniques to realize feasible control design. Introduction to the field of Energetics. Topics include applications to bars, beams, trusses, frames, and solids.

166. Advanced Strength of Materials 4 (4 hr.)
Prerequisites: Physics 105A or ME 163; or upper-division course in solid mechanics. Emphasis on current MEMS devices and their applications. Enzymatically-active materials. The discipline of control and its application. Theoretical Analysis in Mechanical Engineering 140B.

167. Mechanical Engineering 140B. Theoretical Analysis in Mechanical Engineering 140B. Theoretical Analysis in Mechanical Engineering 140B.

168. Advanced Strength of Materials 4 (4 hr.)
Prerequisites: Physics 105A or ME 163; or upper-division course in solid mechanics. Emphasis on current MEMS devices and their applications. Enzymatically-active materials. The discipline of control and its application. Theoretical Analysis in Mechanical Engineering 140B.

169. Nonlinear Phenomena 4 (4 hr.)
Prerequisites: Physics 105A or ME 163; or upper-division standing in ECE 183 and Physics 108. Not open for credit to students who have completed ME 125CM or ME 251.

170. Mechanical Engineering 140B. Theoretical Analysis in Mechanical Engineering 140B. Theoretical Analysis in Mechanical Engineering 140B.

171. Introduction to Multiphysics Simulation (3 units)
Prerequisites: Mechanical Engineering 151AE (or equivalent), Mechanical Engineering 125A-B (or equivalent), and Computer Science 164B (or equivalent). Open to students who have completed ME 225CM or ME 251. Not open for credit to students who have completed ME 125CM or ME 251.

172. Fluid Mechanics 4 (4 hr.)
Prerequisites: ME 15A; open to ME majors only. Course materials fee required. Course work required. Design of systems using mechanics, fluid analysis, circuit elements, and programming techniques to realize feasible control design. Introduction to the field of Energetics. Topics include applications to bars, beams, trusses, frames, and solids.

173. Mechanical Engineering 140B. Theoretical Analysis in Mechanical Engineering 140B. Theoretical Analysis in Mechanical Engineering 140B.

174. Advanced Strength of Materials 4 (4 hr.)
Prerequisites: Physics 105A or ME 163; or upper-division course in solid mechanics. Emphasis on current MEMS devices and their applications. Enzymatically-active materials. The discipline of control and its application. Theoretical Analysis in Mechanical Engineering 140B.

175. Introduction to Multiphysics Simulation (3 units)
Prerequisites: Mechanical Engineering 151AE (or equivalent), Mechanical Engineering 125A-B (or equivalent), and Computer Science 164B (or equivalent). Open to students who have completed ME 225CM or ME 251. Not open for credit to students who have completed ME 125CM or ME 251.
197. Introduction to Robotics: Design and Laboratory

Prerequisites: ENGR 1A or ENGR 1A-2A. Not open to credit for students who have completed ENGR 1B or ENGR 1B-2B.

Course materials fee required.

Design, programming, and testing of mobile robots. Design problems formulated in terms of robot performance. Students solve electromechanical problems, developing skills in transmission, control, sensor, spatial reasoning, teamwork and communication. Robots controlled with micro-controllers using C programming interfaced to sensors and inputs.

198. Introduction to Robotics: Planning and Kinematics

Prerequisites: ENGR 3 or either ME 1 or ENGR 1A or ENGR 1A-2A. May be taken concurrently.

Not open for credit to students who have completed ENGR 1B or ENGR 1B-2B.

Course materials fee required.

Design, programming, and testing of mobile robots. Design problems formulated in terms of robot performance. Students solve electromechanical problems, developing skills in transmission, control, sensor, spatial reasoning, teamwork and communication. Robots controlled with micro-controllers using C programming interfaced to sensors and inputs.

186. Introduction to Additive Manufacturing (W)

Introduction to additive manufacturing processes; review manufacturing methods and selection criteria, economics of production, common additive manufacturing technologies and description of the physics of photopolymerization, sintering, selective laser melting and e-beam melting fabrication. May be repeated for a maximum of 12 units variable hours. No more than 4 units may be counted as departmental electives.

199. Independent Studies in Mechanical Engineering Design Projects (1-9 units)

Prerequisites: ME 105, ME 115C, ME 158B, ME 158A-B-C, or consent of instructor. Open to seniors only.

Course materials fee required. Designed for majors. Concurrently offered with ME 194. Quarters usually offered: Fall, A-3 quarter sequence with grades issued for each quarter. Students must not concurrently enroll in ME 197 and 198A-B-C with the same design project. Course can only be repeated as a full sequence (185A-B-C). Students work in teams under the direction of a faculty advisor (and possibly an industrial sponsor) to lead an engineering design project. Engineering communication, such as reports and oral presentations are covered. Emphasis is practical, hands-on experience, and the integration of analysis and design skills acquired in the companion ME 156 courses.

188. Capstone Mechanical Engineering Design Project (I-9 units)

Prerequisites: ME 198A

Course materials fee required. Designed for majors. Concurrently offered with ME 198B. Quarters usually offered: Winter. A-3 quarter sequence with grades issued for each quarter. Students must not concurrently enroll in ME 197 and 198A-B-C with the same design project. Course can only be repeated as a full sequence (185A-B-C). Students work in teams under the direction of a faculty advisor (and possibly an industrial sponsor) to lead an engineering design project. Engineering communication, such as reports and oral presentations are covered. Emphasis is practical, hands-on experience, and the integration of analysis and design skills acquired in the companion ME 156 courses.

186. Introduction to Additive Manufacturing (W)

Introduction to additive manufacturing processes; review manufacturing methods and selection criteria, economics of production, common additive manufacturing technologies and description of the physics of photopolymerization, sintering, selective laser melting and e-beam melting fabrication. May be repeated for a maximum of 12 units variable hours. No more than 4 units may be counted as departmental electives.

199. Independent Studies in Mechanical Engineering Design Projects (1-9 units)

Prerequisites: consent of instructor; upper-division standing: completion of two upper-division courses in Mechanical Engineering.

Students must have a minimum of 3.0 grade-point average for the preceding three quarters and are limited to 5 units total in 98939/198/199/199A/199B courses combined. No more than 4 units may be counted as departmental electives. May be repeated to 12 units.

Directed individual study.

GRADUATE COURSES

Graduate courses for this major can be found in the UCSB General Catalog.
## CHEMICAL ENGINEERING 2018-19

### Major Requirements

<table>
<thead>
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<th>Units</th>
<th>Units</th>
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<td><strong>CHEMICAL ENGINEERING</strong></td>
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### Technical Electives Taken:
- Three units maximum from CH E 196 and CH E 198 combined; only for students with CHEM 109C
- CH E 198
- CH E 196
- CH E 173
- CH E 171
- CH E 170
- MATH 126
- MATH 125
- MATH 124
- MATH 123
- MATH 122
- MATH 121
- MATH 102
- MATH 101
- MATH 100
- MATRL 135
- MATRL 134
- MATRL 133
- MATRL 132
- MATRL 131
- MATRL 130
- MATRL 129
- MATRL 128
- MATRL 127
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- MATRL 121
- MATRL 111
- MATRL 110
- MATRL 109
- MATRL 108
- MATRL 107
- MATRL 106
- MATRL 105
- MATRL 104
- MATRL 103
- MATRL 102
- MATRL 101
- MATRL 100A
- MATRL 100B
- MATRL 100C
- MATRL 100N
- MATRL 100M
- MATRL 100L
- MATRL 100K
- MATRL 100J
- MATRL 100I
- MATRL 100H
- MATRL 100G
- MATRL 100F
- MATRL 100E
- MATRL 100D
- MATRL 100C
- MATRL 100B
- MATRL 100A
- MATRL 100
- MATRL 10
- MATRL 9
- MATRL 8
- MATRL 7
- MATRL 6
- MATRL 5
- MATRL 4
- MATRL 3
- MATRL 2
- MATRL 1
- CHEM 110
- CHEM 109A
- CHEM 109AH
- CHEM 109B
- CHEM 109BH
- CHEM 1A
- CHEM 1AL
- CHEM 1BL
- CHEM 1CL
- CHEM 1D
- CHEM 1E
- CHEM 2A
- CHEM 2B
- CHEM 2C
- CHEM 2D
- CHEM 2E
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- CHEM 19D
- CHEM 19E
- CHEM 19F
- CHEM 19G
- CHEM 20A
- CHEM 20B
- CHEM 20C
- CHEM 20D
- CHEM 20E
- CHEM 20F
- CHEM 20G

### UNIVERSITY REQUIREMENTS

- American History and Institutions (one 4-unit course, may be counted as G.E. if selected from approved list)
- UC Entry Level Requirement: English Composition
- Must be fulfilled within three quarters of matriculation
- Satisfied by:

### General Education

#### Area A: English Reading & Comprehension (2 courses required)
- A-1
- A-2

#### Area B: Social Science
(2 courses minimum)

#### Area C: Culture and Thought (2 courses minimum)

#### Area D: Science
(1 course minimum)

#### Area E: Culture and Thought
(1 course minimum)

#### Area F: Arts
(2 courses minimum)

#### Area G: Literature
(2 courses minimum)

### Special Subject Areas

- Ethnicity (1 course)
- European Traditions or World Cultures (1 course)
- Writing (4 courses required)

### General Education and Free Electives Taken:

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<th>Units</th>
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<td>WINTER</td>
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* If applying to the BS/MS Materials program student must take: Sophomore year- Phys 4 in Winter or Spring
Junior year- MATRL 100A in Fall, MATRL 100B in Winter, MATRL 100C in Spring

**Students may only count one course toward the major. (MATRL 101 OR MATRL 100B)**
# COMPUTER ENGINEERING 2018-19

## UNIVERSEITY REQUIREMENTS

<table>
<thead>
<tr>
<th>Units</th>
<th>UNIVERSITY REQUIREMENTS</th>
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<tr>
<td></td>
<td>American History and Institutions – (one 4-unit course)</td>
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<td>(may be counted as G.E. if selected from approved list)</td>
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<td>UC Entry Level Requirement: English Composition</td>
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<td>Must be fulfilled within three quarters of matriculation</td>
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## GENERAL EDUCATION

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<th>Area: English Reading &amp; Comprehension – (2 courses required)</th>
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<tr>
<td>Area D: Social Science</td>
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</tr>
<tr>
<td>Area E: Culture and Thought</td>
<td>(2 courses minimum)</td>
</tr>
<tr>
<td>Area F: The Arts</td>
<td>(1 course minimum)</td>
</tr>
<tr>
<td>Area G: Literature</td>
<td>(1 course minimum)</td>
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### Special Subject Areas

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<th>Ethnicity (1 course):</th>
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<tr>
<td>European Traditions</td>
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<tr>
<td>or World Cultures (1 course):</td>
</tr>
<tr>
<td>Writing (4 courses required):</td>
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## NON-MAJOR ELECTIVES

| Courses that can apply toward the major, inside or outside of the Departments of Computer Science or Electrical and Computer Engineering, cannot be taken for the passed/not passed grading option. They must be taken for letter grades. |

## PREPARATION FOR THE MAJOR

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## UPPER DIVISION MAJOR

| Units | CMPSC 130A | ECE 139 or PSTAT 120A | ECE 152A | ECE 154A | ECE 156A-B | ECE 156A-B | ECE 156A-B | ECE 156A-B | ECE 156A-B | ECE 156A-B | ECE 156A-B | ECE 156A-B | ECE 156A-B | ECE 156A-B | ECE 156A-B | ECE 156A-B |
|-------|------------|------------------------|----------|----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 68    | 4          | 4                      | 4        | 4        | 3          | 3          | 3          | 3          | 3          | 3          | 3          | 3          | 3          | 3          | 3          | 3          |

## FRESHMAN YEAR

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<th>CHEM 1AL or 2AC</th>
<th>Math, Science,</th>
<th>MATH 3A</th>
<th>Engr. Elective</th>
<th>MATH 3B</th>
<th>Phys 2</th>
<th>WRIT 1E or 2E</th>
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## SOPHOMORE YEAR

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<th>ECE 10AL</th>
<th>ECE 15A</th>
<th>ECE 152A</th>
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## JUNIOR YEAR

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## SENIOR YEAR

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<td>CMPS Electives</td>
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## TOTAL UNITS REQUIRED FOR GRADUATION

1. CMS 8 may be used to satisfy the Math, Science, Engineering Elective requirement.
2. PSTAT 120A is offered each quarter. ECE 139 is offered only in spring quarter, and is better suited for future upper division electives for the Computer Engineering major.
3. ENGR 101 may be taken any quarter of senior year.
## COMPUTER SCIENCE 2018-19

### MAJOR REQUIREMENTS

#### PREPARATION FOR THE MAJOR

<table>
<thead>
<tr>
<th>Units</th>
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<td>PSTAT 120A</td>
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#### UNIVERSITY REQUIREMENTS

- American History and Institutions: (one 4-unit course, may be counted as G.E. if selected from approved list)
- UC Entry Level Requirement: English Composition
  - Must be fulfilled within three quarters of matriculation
  - Satisfied by:

#### UPPER DIVISION MAJOR

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<td>CMPSC 130A-B</td>
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<td>PSTAT 120B</td>
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(Selected from the following list (at least 8 units must be CMPSC courses))

- Prior approval of the student’s major field electives must be obtained from the faculty advisor.
- Courses that can apply toward the major, inside or outside of the Department of Computer Science, cannot be taken for the passed/not passed grading option. They must be taken for letter grades.

#### FRESHMAN YEAR

<table>
<thead>
<tr>
<th>FALL units</th>
<th>WINTER units</th>
<th>SPRING units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMPSC 16</td>
<td>CMPSC 16</td>
<td>CMPSC 24</td>
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<tr>
<td>CMPSC 32</td>
<td>4</td>
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<tr>
<td>CMPSC 40</td>
<td>MATH 3B</td>
<td>MATH 4A</td>
</tr>
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<td>CMPSC 48</td>
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<tr>
<td>MATH 3A-B, 4A-B, 6A</td>
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<tr>
<td>PSTAT 120A</td>
<td>4</td>
<td>4</td>
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<tr>
<td>G.E. Elective</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>WRIT 1, 2, or G.E. Elective</td>
<td>4/5</td>
<td>4/5</td>
</tr>
<tr>
<td>Total units required for graduation</td>
<td>184</td>
<td></td>
</tr>
</tbody>
</table>

* Or you may take CMPSC 140 in Winter Quarter to satisfy this requirement.

** Or you may take CMPSC 162 to satisfy this requirement.

*** ENGR 101 may be taken any quarter of senior year.

## SCIENCE COURSES

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYS 1, 2, 3, 3L</td>
</tr>
<tr>
<td>Science Electives (see Dept. for list)</td>
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</table>

## SCIENCE COURSES

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSTAT 120A</td>
</tr>
<tr>
<td>MATH 3A-B, 4A-B, 6A</td>
</tr>
<tr>
<td>PSTAT 120B</td>
</tr>
<tr>
<td>G.E. Elective</td>
</tr>
<tr>
<td>WRIT 1, 2, or G.E. Elective</td>
</tr>
<tr>
<td>Field or Free Elective</td>
</tr>
<tr>
<td>Science or Free Elective</td>
</tr>
<tr>
<td>Total units required for graduation</td>
</tr>
</tbody>
</table>
### UNIVERSITY REQUIREMENTS

- **American History and Institutions** – (one 4-unit course, may be counted as G.E. if selected from approved list)
- **UC Entry Level Requirement: English Composition**
  - Must be fulfilled within three quarters of matriculation
  - Satisfied by:

### GENERAL EDUCATION

#### General Subject Areas
- **Area A:** English Reading & Comprehension – (2 courses required)
  - A-1
  - A-2
- **Area D:** Social Science
  - (2 courses minimum)
- **Area E:** Culture and Thought
  - (2 courses minimum)
- **Area F:** The Arts
- **Area G:** Literature
  - (1 course minimum)
- **Special Subject Areas**
  - **Ethnicity:** (1 course)
  - **Writing:** (4 courses required)

### NON-MAJOR ELECTIVES

- General Education and Free Electives taken:

### TOTAL UNITS REQUIRED FOR GRADUATION

... 189

### ELECTRICAL ENGINEERING 2018-19

#### PREPARATION FOR THE MAJOR

<table>
<thead>
<tr>
<th>Units</th>
<th>CHEM 1A, 1AL or 2A, 2AC</th>
<th>CMPSC 16</th>
<th>ECE 5</th>
<th>ECE 10A, 10AL, 10B, 10BL, 10C, 10CL</th>
<th>ECE 15A</th>
<th>ENGR 3</th>
<th>MATH 3A-B, 4A-B, 6A-B, 7A-B</th>
<th>PHYS 1, 2, 3, 4L, 4L, 5L</th>
<th>UNIVERSITY REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>American History and Institutions – (one 4-unit course, may be counted as G.E. if selected from approved list)</td>
</tr>
</tbody>
</table>

#### UPPER DIVISION MAJOR

<table>
<thead>
<tr>
<th>Units</th>
<th>ECE 130A-B</th>
<th>ECE 132</th>
<th>ECE 134</th>
<th>ECE 137A-B</th>
<th>ECE 139</th>
<th>ECE 152A</th>
<th>ENGR 101</th>
<th>GENERAL EDUCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### GENERAL EDUCATION

- **Area A:** English Reading & Comprehension – (2 courses required)
  - A-1
  - A-2
- **Area D:** Social Science
  - (2 courses minimum)
- **Area E:** Culture and Thought
  - (2 courses minimum)
- **Area F:** The Arts
- **Area G:** Literature
  - (1 course minimum)
- **Special Subject Areas**
  - **Ethnicity:** (1 course)
  - **Writing:** (4 courses required)

#### Prior approval of the student's departmental electives must be obtained from the student's faculty adviser.

- Must include at least 2 sequences, one of which must be an approved EE Senior Capstone Design/Project course sequence.

#### Approved Departmental Electives:

<table>
<thead>
<tr>
<th>Units</th>
<th>ECE 120A-B</th>
<th>ECE 147A-B</th>
<th>ECE 179D, P</th>
</tr>
</thead>
<tbody>
<tr>
<td>79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Courses that can apply toward the major, inside or outside of the Department of Electrical and Computer Engineering, cannot be taken for the passed/not passed grading option. They must be taken for letter grades.

#### TOTAL UNITS REQUIRED FOR GRADUATION

... 189

### ELECTRICAL ENGINEERING 2018-19

#### FRESHMAN YEAR

<table>
<thead>
<tr>
<th>Units</th>
<th>FALL</th>
<th>WINTER</th>
<th>SPRING</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>CHEM 1A or 2A</td>
<td>ECE 5</td>
<td>CMPS 16</td>
</tr>
<tr>
<td>16</td>
<td>CHEM 1AL or 2AC</td>
<td>MATH 3B</td>
<td>MATH 4A</td>
</tr>
<tr>
<td>16</td>
<td>ENGR 3</td>
<td>PHYS 1</td>
<td>PHYS 2</td>
</tr>
<tr>
<td>16</td>
<td>MATH 3A</td>
<td>WRIT 2E or 50E</td>
<td>WRIT 50E or G.E.</td>
</tr>
</tbody>
</table>

#### SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>Units</th>
<th>FALL</th>
<th>WINTER</th>
<th>SPRING</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>ECE 10A</td>
<td>ECE 10B</td>
<td>ECE 10C</td>
</tr>
<tr>
<td>17</td>
<td>ECE 10AL</td>
<td>ECE 10BL</td>
<td>ECE 10CL</td>
</tr>
<tr>
<td>13</td>
<td>MATH 4B</td>
<td>ECE 15A</td>
<td>MATH 6B</td>
</tr>
<tr>
<td>13</td>
<td>PHYS 3</td>
<td>MATH 6A</td>
<td>PHYS 5</td>
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<td>13</td>
<td>PHYS 3L</td>
<td>PHYS 4</td>
<td>PHYS 5L</td>
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</table>

#### JUNIOR YEAR

<table>
<thead>
<tr>
<th>Units</th>
<th>FALL</th>
<th>WINTER</th>
<th>SPRING</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>ECE 130A</td>
<td>ECE 130B</td>
<td>ECE 137B</td>
</tr>
<tr>
<td>16</td>
<td>ECE 132</td>
<td>ECE 13TA</td>
<td>ECE 139</td>
</tr>
<tr>
<td>16</td>
<td>ECE 134</td>
<td>ECE Elective</td>
<td>ECE 152A</td>
</tr>
<tr>
<td>16</td>
<td>G.E. or Free Elective</td>
<td>G.E. or Free Elective</td>
<td>G.E. or Free Elective</td>
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</table>

#### SENIOR YEAR

<table>
<thead>
<tr>
<th>Units</th>
<th>FALL</th>
<th>WINTER</th>
<th>SPRING</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>ECE Electives</td>
<td>ECE Electives</td>
<td>ECE Electives</td>
</tr>
<tr>
<td>16</td>
<td>G.E. or Free Electives</td>
<td>G.E. or Free Electives</td>
<td>G.E. or Free Electives</td>
</tr>
</tbody>
</table>

1. ECE 139 may also be taken in the spring quarter of the sophomore year.
2. ECE 152A may also be taken in the spring quarter of the sophomore year.
3. ENGR 101 may be taken any quarter of senior year.
4. ECE Electives must include at least two sequences, one of which must be an approved EE senior capstone design project sequence.
### MECHANICAL ENGINEERING 2018-19

#### PREPARATION FOR THE MAJOR

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1A, 1AL, 1B, 1BL or 2A, 2AC, 2B, 2BC</td>
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<tr>
<td>ENGR 3</td>
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</tr>
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<td>MATH 3A-B, 4A-B, 4A-B</td>
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<tr>
<td>ME 3</td>
<td>3</td>
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<td>ME 10</td>
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<td>ME 12S</td>
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<td>ME 14</td>
<td>4</td>
</tr>
<tr>
<td>ME 15</td>
<td>4</td>
</tr>
<tr>
<td>ME 16</td>
<td>4</td>
</tr>
<tr>
<td>ME 17</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 1, 2, 3L, 4L, 4L</td>
<td>16</td>
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</table>

#### UNIVERSITY REQUIREMENTS

<table>
<thead>
<tr>
<th>Area</th>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
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<td>(2 courses required)</td>
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<tr>
<td>A-2</td>
<td></td>
<td></td>
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</tbody>
</table>

**TOTAL UNITS REQUIRED FOR GRADUATION:** 191

---

### MECHANICAL ENGINEERING 2018-19

#### FRESHMAN YEAR

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>FALL</td>
<td>14/17</td>
</tr>
<tr>
<td>WINTER</td>
<td>17</td>
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<tr>
<td>SPRING</td>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>CHEM 1A or 2A</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1B or 2B</td>
<td>3</td>
</tr>
<tr>
<td>MATH 4A</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 1AL or 2AC</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 1BL or 2BC</td>
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<td>ME 106</td>
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<td>MATH 3A</td>
<td>4</td>
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<td>MATH 3B</td>
<td>4</td>
</tr>
<tr>
<td>ENGR 3</td>
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<td>ME 125A or G.E. Elective</td>
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<td>PHYS 1</td>
<td>4</td>
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<tr>
<td>PHYS 2</td>
<td>4</td>
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<tr>
<td>WRIT 1E or 2E</td>
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<tr>
<td>WRIT 50E or G.E. Elective</td>
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**TOTAL:** 14/17  17  19

#### SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Units</th>
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<tbody>
<tr>
<td>FALL</td>
<td>16</td>
</tr>
<tr>
<td>WINTER</td>
<td>16</td>
</tr>
<tr>
<td>SPRING</td>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>MATH 4B</td>
<td>4</td>
</tr>
<tr>
<td>MATH 6A</td>
<td>4</td>
</tr>
<tr>
<td>MATH 6B</td>
<td>4</td>
</tr>
<tr>
<td>ME 14</td>
<td>4</td>
</tr>
<tr>
<td>ME 16</td>
<td>4</td>
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<tr>
<td>ME 16</td>
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<td>ME 17</td>
<td>3</td>
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<tr>
<td>ME 151C</td>
<td>3</td>
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<tr>
<td>G.E. Elective</td>
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**TOTAL:** 16  16  15

#### JUNIOR YEAR

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<thead>
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<th>Quarter</th>
<th>Units</th>
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</tr>
<tr>
<td>WINTER</td>
<td>17</td>
</tr>
<tr>
<td>SPRING</td>
<td>17</td>
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<table>
<thead>
<tr>
<th>Course</th>
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<td>MATRL 101</td>
<td>3</td>
</tr>
<tr>
<td>ME 151A</td>
<td>4</td>
</tr>
<tr>
<td>MATRL 100F</td>
<td>3</td>
</tr>
<tr>
<td>ME 152A</td>
<td>4</td>
</tr>
<tr>
<td>ME 151B</td>
<td>4</td>
</tr>
<tr>
<td>G.E. or Free Elective</td>
<td>4</td>
</tr>
<tr>
<td>ME 152B</td>
<td>3</td>
</tr>
<tr>
<td>ME 151C</td>
<td>3</td>
</tr>
<tr>
<td>ME 163</td>
<td>3</td>
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<tr>
<td>G.E. or Free Elective</td>
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**TOTAL:** 15  17  17

#### SENIOR YEAR

<table>
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<th>Quarter</th>
<th>Units</th>
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</tr>
<tr>
<td>WINTER</td>
<td>16</td>
</tr>
<tr>
<td>SPRING</td>
<td>16</td>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>ME 154, ME 157, or 159B</td>
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</tr>
<tr>
<td>ME 167</td>
<td>3</td>
</tr>
<tr>
<td>ME 156A</td>
<td>3</td>
</tr>
<tr>
<td>G.E. or Free Electives</td>
<td>4</td>
</tr>
<tr>
<td>ME 189A</td>
<td>3</td>
</tr>
<tr>
<td>Departmental Electives</td>
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<tr>
<td>ME 199C</td>
<td>3</td>
</tr>
<tr>
<td>G.E. or Free Electives</td>
<td>4</td>
</tr>
</tbody>
</table>

**TOTAL:** 16  16  16

---

1. ME 12S is offered every Fall, Winter, and Spring quarter. The ME 12S requirement must be finished before the start of the Third Year.

2. If applying to the BS/MS Materials program, juniors must take MATRL 100A in Fall, MATRL 100B in Winter, and MATRL 100C in Spring.

3. Course availability may vary. If using ME 154, ME 157, or ME 167 to satisfy requirement, students may not count the course as an Engineering Elective.

4. Students may only count one course toward the major. (MATRL 101 OR MATRL 100B)
Additional Resources and Information

Gaucho On-Line Data (GOLD) – student record, class registration, degree audits—https://my.sa.ucsb.edu/gold
UMAIL – campus email for official notifications—http://www.umail.ucsb.edu
Schedule of Classes information – quarterly calendar and information—http://www.registrar.ucsb.edu
General Catalog for UCSB – academic requirements for all campus majors—http://my.sa.ucsb.edu/Catalog/
Summer Sessions – Summer programs and course offerings—http://www.summer.ucsb.edu
Tutoring – course-specific tutoring and academic skills development—http://www.clas.ucsb.edu
Education Abroad Program – EAP options for engineering students—email: eap@engineering.ucsb.edu
College Honors Program – program information and opportunities—email: honors@engineering.ucsb.edu

Policy on Academic Conduct

It is expected that all students in the College of Engineering, as well as those who take courses within the College, understand and subscribe to the ideal of academic integrity. To provide guidance on this, the College of Engineering has adopted a policy on expected academic conduct, a full copy of which appears below. As an example, it is not acceptable by default to work collaboratively on a homework assignment. In computer programming courses, a mere preliminary discussion of an assignment can lead to similarities in the final program that are detectable by sophisticated plagiarism detection software (see http://theory.stanford.edu/~aiken/moss/).

Instructors who have established that academic misconduct has occurred in their class have a variety of options at their disposal, which range from allowing the student to redo the work and/or assigning a failing grade to referring the case to the UCSB Judicial Affairs Office for either a letter of warning or a formal hearing before the Student-Faculty Committee on Student Conduct. Instructors are encouraged to discuss these remedies in further detail with the Associate Dean for Undergraduate Studies in the College of Engineering. Moreover, students who have been suspended because of academic misconduct charges are encouraged to work with the College of Engineering Undergraduate Office to develop an amended schedule that will permit the timeliest possible completion of a degree program.

College of Engineering Policy

The College of Engineering’s Academic Conduct Policy is compatible with that of the University of California, in that it is expected that students understand and subscribe to the ideal of academic integrity, and are willing to bear individual responsibility for their work. Any work (written or otherwise) submitted to fulfill an academic requirement must represent a student’s original work. Any act of academic dishonesty, such as cheating or plagiarism, will subject a person to University disciplinary action.

Cheating is defined by UCSB as the use, or attempted use, of materials, information, study aids, or services not authorized by the instructor of the course. The College of Engineering interprets this to include the unauthorized use of notes, study aids, electronic or other equipment during an examination or quiz; copying or looking at another individual’s examination or quiz; taking or passing information to another individual during an examination or quiz; taking an examination or quiz for another individual; allowing another individual to take one’s examination; stealing examinations or quizzes. Students working on take-home exams or quizzes should not consult students or sources other than those permitted by the instructor.

Plagiarism is defined by UCSB as the representation of words, ideas, or concepts of another person without appropriate attribution. The College of Engineering expands this definition to include the use of or presentation of computer code, formulae, ideas, or research results without appropriate attribution.

Collaboration on homework assignments (i.e., problem sets), especially in light of the recognized pedagogical benefit of group study, is dictated by standards that can and do vary widely from course to course and instructor to instructor. The use of old solution sets and published solution guides presents a similar situation. Because homework assignments serve two functions—helping students learn the material and helping instructors evaluate academic performance—it is usually not obvious how much collaboration or assistance from commonly-available solutions, if any, the instructor expects. It is therefore imperative that students and instructors play an active role in communicating expectations about the nature and extent of collaboration or assistance from materials that is permissible or encouraged.

Expectations of Members of the College Academic Community

In their classes, faculty are expected to (i) announce and discuss specific problems of academic dishonesty that pertain particularly to their classes (e.g., acceptable and unacceptable cooperation on projects or homework); (ii) act reasonably to prevent academic dishonesty in preparing and administering academic exercises, including examinations, laboratory activities, homework and other assignments, etc.; (iii) act to prevent cheating from continuing when it has been observed or reported to them by students, chairs, or deans; and, (iv) clearly define for students the maximum level of collaboration permitted for their work to still be considered individual work.

In their academic work, students are expected to (i) maintain personal academic integrity; (ii) treat all exams and quizzes as work to be conducted privately, unless otherwise instructed; (iii) take responsibility for knowing the limits of permissible or expected cooperation on any assignment.
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