The academic mission of The Henry Samueli School of Engineering has been developed to be consistent with the missions and goals set for it by the State of California, the University of California, and the University of California, Irvine (UCI) campus. Specifically, the academic mission of the School is to educate students, at all levels, to be the best engineers and leaders in the nation and world by engaging them in a stimulating community dedicated to the discovery of knowledge, creation of new technologies, and service to society.

The individual engineering and related programs have published program objectives that are consistent with the missions and goals of the University of California, UCI, and The Henry Samueli School of Engineering.

The School offers undergraduate majors in Aerospace Engineering (AE), Biomedical Engineering (BME), Biomedical Engineering: Premedical (BMEP), Chemical Engineering (ChE), Civil Engineering (CE), Computer Engineering (CpE), Computer Science and Engineering (CSE), Electrical Engineering (EE), Engineering (a general program, GE), Environmental Engineering (EnE), Materials Science Engineering (MSE), and Mechanical Engineering (ME). The undergraduate majors in Aerospace, Biomedical, Chemical, Civil, Computer, Computer Science and Engineering, Electrical, Environmental, Materials Science, and Mechanical Engineering are accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org; Computer Science and Engineering (CSE) is also accredited by the Computing Accreditation Commission of ABET, http://www.abet.org. The undergraduate major in Biomedical Engineering; Premedical (BMEP) is not designed to be accredited, therefore is not accredited by ABET.

Aerospace Engineering considers the flight characteristics, performance, and design of aircraft and spacecraft. An upper-division series of courses in aerodynamics, propulsion, structures, and control follows a common core with Mechanical Engineering. The skills acquired in those courses are integrated in the capstone aerospace design course. The intent of the program is to produce highly proficient engineers who can tackle the aerospace engineering challenges of the future.

Biomedical Engineering applies engineering principles to solve complex medical problems and focuses at improving the quality of health care by advancing technology and reducing costs. Examples include advanced biomedical imaging systems, the design of microscale diagnostic systems, drug delivery systems, and tissue engineering. Specializations are available that focus student’s technical expertise on biophotonics or biomems.

Biomedical Engineering: Premedical shares introductory engineering courses with Biomedical Engineering, but replaces senior engineering laboratories and design courses with biology and organic chemistry courses required by medical schools for admission. The intent of the program is to produce students with a basic engineering background who are qualified to enter medical school.

Chemical Engineering applies the knowledge of chemistry, mathematics, physics, biology, and humanities to solve societal problems in areas such as energy, health, the environment, food, textiles, shelter, semiconductors, and homeland security. Employment opportunities exist in various industries such as chemical, petroleum, polymer, pharmaceutical, food, textile, fuel, consumer products, and semiconductor, as well as in local, state, and federal governments.

Civil Engineering addresses the challenges of large-scale engineering projects of importance to society as a whole, such as water distribution, transportation, and building design. Specializations are provided in General Civil Engineering, Environmental Hydrology and Water Resources, Structural Engineering, and Transportation Systems Engineering. Alternatively, students can select a concentration in Computer Applications, Engineering Management, Infrastructure Planning, or Mathematical Methods.

Computer Engineering addresses the design and analysis of digital computers, including both software and hardware. Computer design includes topics such as computer architecture, VLSI circuits, data base, software engineering, design automation, system software, and data structures and algorithms. Courses include programming in high-level languages such as Python, Java, C, C++; use of software packages for analysis and design; design of system software such as operating systems and hardware/software interfaces; application of computers in solving engineering problems, and laboratories in both hardware and software experiences.

Computer Science and Engineering is designed to provide students with the fundamentals of computer science, both hardware and software, and the application of engineering concepts, techniques, and methods to both computer systems engineering and software system design. The program gives students access to multidisciplinary problems in engineering with a focus on total systems engineering. Students learn the computer science principles that are critical to development of software, hardware, and networking of computer systems. From that background, engineering concepts and methods are added to give students exposure to circuit design, network design, and digital signal processing. Elements of engineering practice include systems view, manufacturing and economic issues, and multidisciplinary engineering applications. The program is administered jointly by the Department of Electrical Engineering and Computer Science in The Henry Samueli School of Engineering and by the Department of Computer Science in the Donald Bren School of Information and Computer Sciences.

Electrical Engineering is one of the major contributors to the modernization of our society. Many of the most basic and pervasive products and services are either based on or related to the scientific and engineering principles taught at the Department of Electrical Engineering and Computer Science. Students specialize in Electronic Circuit Design; Semiconductors and Optoelectronics; RF, Antennas and Microwaves; Digital Signal Processing; or Communications.

The major in Engineering is a special program of study for upper-division students who wish to combine the study of engineering principles with other areas such as the physical and biological sciences, social and behavioral science, humanities, and arts. Students may construct their own specialization. Click on the "Undergraduate Study" tab above for information about this major.
Environmental Engineering concerns the development of strategies to control and minimize pollutant emissions, to treat waste, and to remediate polluted natural systems. Emphasis areas include air quality and combustion, water quality, and water resources engineering.

Materials Science Engineering is concerned with the generation and application of knowledge relating the composition, structure, and synthesis of materials to their properties and applications. During the past two decades, Materials Science Engineering has become an indispensable component of modern engineering education, partly because of the crucial role materials play in national defense, the quality of life, and the economic security and competitiveness of the nation; and partly because the selection of materials has increasingly become an integral part of almost every modern engineering design. Emphasis in the Materials Science Engineering curriculum is placed on the synthesis, characterization, and properties of advanced functional materials; analysis, selection, and design related to the use of materials; the application of computers to materials problems; and the presence of an interdisciplinary theme that allows a qualified student to combine any engineering major with the Materials Science Engineering major.

Mechanical Engineering considers the design, control, and motive power of fluid, thermal, and mechanical systems ranging from microelectronics to spacecraft to the human body. Specializations allow students to focus their technical electives in the areas of Aerospace Engineering, Energy Systems and Environmental Engineering, Flow Physics and Propulsion Systems, and Design of Mechanical Systems.

The School offers M.S. and Ph.D. degrees in Biomedical Engineering; Chemical and Biochemical Engineering; Civil Engineering; Electrical and Computer Engineering, with concentrations in Computer Engineering and Electrical Engineering; Engineering, with concentrations in Environmental Engineering, and Materials and Manufacturing Technology; Materials Science and Engineering; and Mechanical and Aerospace Engineering. Specialized research opportunities are available within each of these programs. Bioreaction and bioreactor engineering, recombinant cell technology, and bioseparation processes are research areas in Biochemical Engineering. In Civil Engineering, research opportunities are provided in structural/earthquake engineering, reliability engineering, transportation systems engineering, environmental engineering, and water resources. Research opportunities in Electrical and Computer Engineering are available in the areas of parallel and distributed computer systems, VLSI design, computer architecture, image and signal processing, communications, control systems, and optical and solid-state devices. Research in combustion and propulsion sciences, laser diagnostics, supersonic flow, direct numerical simulation, computer-aided design, robotics, control theory, parameter identification, material processing, electron microscopy, and ceramic engineering are all available in Mechanical and Aerospace Engineering. The School also offers the M.S. degree in Engineering Management, a joint degree program with the Paul Merage School of Business; and the M.S. degree in Biotechnology Management, a joint degree program with the School of Biological Sciences and The Paul Merage School of Business. See the School of Biological Sciences section of the Catalogue for information.

Undergraduate Study

Planning a Program of Study

Advising

Academic advising is available from academic counselors and peer advisors in the School’s Student Affairs Office, 305 Rockwell Engineering Center, and from faculty advisors. Students must realize, however, that ultimately they alone are responsible for the planning of their own program and for satisfactory completion of the graduation requirements. Students are encouraged to consult with the academic counselors in the Engineering Student Affairs Office whenever they desire to change their program of study. All Engineering majors are required to meet with their faculty advisor at least once each year.

Some engineering students will need more than four years to obtain their B.S. degree, particularly if part-time employment or extracurricular
activities make heavy demands on their time. Normally, such students can stay on track, and are encouraged to do so, by enrolling in summer sessions at UCI or at other institutions when a petition has been approved in advance.

High-achieving students may declare a second major. Early consultation with the School is advisable.

Required courses may be replaced by other courses of equivalent content if the student substantiates the merits of the courses in the program of study and obtains prior approval from faculty in the School.

Students should be aware that most Engineering courses require the completion of prerequisites. The sample programs shown in each departmental description constitute preferred sequences which take into account all prerequisites.

School policy does not permit the deletion of Engineering courses after the second week or addition of Engineering courses after the third week of the quarter without the Associate Dean’s approval.

Undergraduate students who have high academic standing, who have completed the necessary prerequisites, and who have obtained permission from the School may qualify to take certain graduate-level courses.

Students are required to complete UCI’s lower-division writing requirement (see the Requirements for a Bachelor’s Degree section) during the first two years. Thereafter, proficiency in writing and computing (using a higher-level language such as Python, C, C++, Java, or MATLAB) is expected in all Engineering courses.

Students can take the following courses on a Pass/Not Pass basis: (a) courses not used to fulfill the major requirements, and (b) general education courses. Students must take courses to fulfill the UC Entry Level Writing requirement for a grade.

Admissions
The sequential nature of the Engineering program and the fact that many courses are offered only once a year make it beneficial for students to begin their studies in the fall quarter. Applicants wishing to be admitted for the fall quarter, 2014, must have submitted their completed application forms during the priority filing period (November 1–30, 2013).

High school students wishing to enter the UCI Engineering program must have completed four years of mathematics through pre-calculus or math analysis and are advised to have completed one year each of physics and chemistry. That preparation, along with honors courses and advanced placement courses, is fundamental to success in the Engineering program and is vital to receiving first consideration for admittance to an Engineering major during periods of restricted enrollments. Students applying for admission for fall quarter should complete their examination requirements during May or June of their junior year or during their senior year, but no later than the December test date. (Typically, this means that students will take the SAT Reasoning Test or the ACT Assessment With Writing test in October or November, are strongly encouraged to take the Math Level 2 SAT Subject Exam in November or December.) Applicants must apply for admission to a specific Engineering major or Engineering Undeclared.

If enrollment limitations make it necessary, unaccommodated Engineering applicants may be offered alternative majors at UCI.

Transfer students may be admitted to The Henry Samueli School of Engineering either from another major at UCI or from another college or university. A student seeking admission to The Henry Samueli School of Engineering from colleges and schools other than UCI must satisfy University requirements for admission with advanced standing and should complete appropriate prerequisites for their major of choice. It is to the student’s advantage to complete the Intersegmental General Education Transfer Curriculum (IGETC) or UCI general education and lower-division requirements prior to transfer. Since requirements vary from major to major, those contemplating admission with advanced standing to the School should consult each Department’s Catalogue section and the UCI Office of Admissions and Relations with Schools. (949) 824-6703, for the specific requirements of each program. All transfer students should arrange for early consultation with The Henry Samueli School of Engineering Student Affairs Office at (949) 824-4334.

Change of Major. Students who wish to change their major to one offered by the School should contact the Engineering Student Affairs Office for information about change-of-major requirements, procedures, and policies. Information is also available at http://www.changeofmajor.uci.edu.

Proficiency Examinations
A student may take a course by examination with the approval of the faculty member in charge of the course and the Dean of the School. Normally, ability will be demonstrated by a written or oral examination; if a portion of the capability involves laboratory exercises, the student may be required to perform experiments as well. The proficiency examination is not available for any course a student has completed at UCI.

Concentration: Engineering and Computer Science in the Global Context
The globalization of the marketplace for information technology services and products makes it likely that The Henry Samueli School of Engineering graduates will work in multicultural settings or be employed by companies with extensive international operations, or customer bases. The goal of the concentration is to help students develop and integrate knowledge of the history, language, and culture of a country or geographic region outside the United States, through course work both at UCI and an international host campus, followed by a technology-related internship in the host country.

All of The Henry Samueli School of Engineering majors in good standing may propose an academic plan that demonstrates the ability to complete the concentration (a minimum of eight courses) and other requirements for graduation in a reasonable time frame. It is expected that a student’s proposal will reflect a high degree of planning that includes the guidance of academic counselors and those at the UCI Study Abroad Center regarding course selection, as well as considerations related to internship opportunities, housing, and financial aid. Each student’s proposed program of study must be approved by the Associate Dean for Student Affairs in The Henry Samueli School of Engineering. The Associate Dean will be available to assist qualified students with the development of a satisfactory academic plan, as needed.

The concentration consists of the following components:

1. A minimum of eight courses at UCI or at the international campus with an emphasis on the culture, language (if applicable and necessary), history, literature of the country that corresponds to the international portion of the program, international law, international labor policy, global issues, global institutions, global conflict and negotiation, and global economics;
2. A one- or two-semester sequence of technical courses related to the major and, possibly, culture, history, and literature courses taken at an international university;

3. A two-month or longer technical internship experience in the same country as the international educational experience.

More information about the requirements for the concentration is available in The Henry Samueli School of Engineering Student Affairs Office.

The concentration in Engineering and Computer Science in the Global Context is open to students in Aerospace Engineering, Biomedical Engineering, Biomedical Engineering; Premedical, Chemical Engineering, Civil Engineering, Computer Engineering, Engineering (General), Electrical Engineering, Environmental Engineering, Materials Science Engineering, and Mechanical Engineering.

Requirements for the Bachelor’s Degree

All students in The Henry Samueli School of Engineering must fulfill the following requirements.

All students must meet the University Requirements (catalogue.uci.edu/previouseditions/2013-14/informationforadmittedstudents/requirementsforabachelorsdegree).

All students must meet the School Requirements:

The following are minimum subject-matter requirements for graduation:

Mathematics and Basic Science Courses: Students must complete a minimum of 48 units of college-level mathematics and basic sciences.

Engineering Topics Courses: Students must complete a minimum of 72 units of engineering topics. Engineering topics are defined as courses with applied content relevant to the field of engineering.

Design Units: All undergraduate Engineering courses indicate both a total and a design unit value. Design unit values are listed at the end of the course description. Each student is responsible for the inclusion of courses whose design units total that required by the program of study.

The Academic Plan and Advising Requirements to remain affiliated with The Henry Samueli School of Engineering: All students enrolled in The Henry Samueli School of Engineering are required to meet annually with their designated faculty advisor and to have an academic plan on file with the Student Affairs Office which has been approved by their academic counselor. Students who do not have a plan on file, or deviate from this plan without approval from an academic counselor will be subject to probation. Students on probation for two consecutive quarters who do not have a plan on file, or deviate from this plan without approval from an academic counselor will be subject to disqualification. Students who fail to meet with a faculty advisor each year will be subject to disqualification.

Duplication of Subject Material: Students who take courses which involve considerable duplication of subject material may not receive full graduation credit for all units thus completed.

Residence Requirement: In addition to the University residence requirement, at least 36 upper-division engineering units specified by each major must be completed successfully at the University of California.

Variations: Variations from the general School degree requirements may be made subject to the approval of the faculty of the School. Students wishing to obtain variances should submit petitions to the School’s Student Affairs Office.

Engineering Gateway Freshman-Year Curriculum

Students who know that they want to major in engineering but who are unsure of the specific major should apply for the Engineering Gateway Curriculum and follow the Sample Engineering Gateway Curriculum. Students following the Engineering Gateway Curriculum are required to meet with an academic advisor every quarter and are strongly encouraged to declare a major as soon as possible and then follow the appropriate sample program of study for that major.

Sample Engineering Gateway Curriculum - Freshman

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<thead>
<tr>
<th>Fall</th>
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<tr>
<td>MATH 2A</td>
<td>MATH 2B</td>
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<tr>
<td>CHEM 1A</td>
<td>CHEM 1B</td>
<td>CHEM 1C</td>
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<td>ENGR 1</td>
<td>PHYSICS 7C</td>
<td>CHEM 1LC</td>
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<td>PHYSICS 7LC</td>
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<td>General Education</td>
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<td>EECS 10</td>
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<td>CSE 41</td>
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1 Students who choose to major in Biomedical Engineering or Biomedical Engineering: Premedical should enroll in BME 1 in the fall quarter of the sophomore year. Students who choose to major in Computer Engineering should enroll in EECS 20 by the spring or summer quarter preceding their sophomore year.

2 Students who are considering the Computer Science and Engineering major should enroll in CSE 41.

Students who choose certain majors during the first year may replace Chemistry courses with required major courses.

Students should choose a major by the end of the spring quarter of their freshman year or earlier. Some modification in the program of study might be appropriate if the student chooses a major before the end of the freshman year. In any case, when the major is chosen, the student must meet immediately with an academic counselor to plan the program of study.

Undergraduate Programs

Specific information about courses fulfilling School and major requirements can be found in the department sections. Note that some majors require more units than the School requirements.

Aerospace Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofmechanicaland.aerospaceengineering/#majorstext)

Biomedical Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofbiomedicalengineering/#majorstext)

Biomedical Engineering: Premedical (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofbiomedicalengineering/#majorstext)

Chemical Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofchemicalengineeringandmaterialsscience/#majorstext)
Civil Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofcivilandenvironmentalengineering/#majorstext)

Computer Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofelectricalengineeringandcomputerscience/#majorstext)

Computer Science and Engineering (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/computerscienceandengineering)

Electrical Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofelectricalengineeringandcomputerscience/#majorstext)

Engineering

Environmental Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofcivilandenvironmentalengineering/#majorstext)

Materials Science Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofchemicalengineeringandmaterialsscience/#majorstext)

Mechanical Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofmechanicalandaerospaceengineering/#majorstext)

Minors of Interest to Engineers

Minor in Earth and Atmospheric Sciences

The minor in Earth and Atmospheric Sciences focuses on the application of physical, chemical, and biological principles to understanding the complex interactions of the atmosphere, ocean, and land through climate and biogeochemical cycles. See the Department of Earth System Science (catalogue.uci.edu/previouseditions/2013-14/schoolofphysicalsciences/departmentofearthsystemscience/#undergraduatetext) in the School of Physical Sciences section of this Catalogue for more information.

Minor in Global Sustainability

The interdisciplinary minor in Global Sustainability trains students to understand the changes that need to be made in order for the human population to live in a sustainable relationship with the resources available on this planet. See the Interdisciplinary Studies (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/globalsustainability) section of this Catalogue for more information.

Career Advising

The UCI Career Center provides services to students and alumni including career counseling, information about job opportunities, a career library, and workshops on resume preparation, job search, and interview techniques. See the Career Center section for additional information. In addition, special career planning events are held throughout the year including an annual Career Fair. Individual career counseling is available, and students have access to the Career Library which contains information on graduate and professional schools in engineering, as well as general career information.

Honors

Graduation with Honors. Undergraduate honors at graduation in The Henry Samueli School of Engineering are computed by using 50 percent of the overall UC GPA and 50 percent of the upper-division Engineering GPA. (Engineering E190 is not used in the calculation of the upper-division GPA.) A general criterion is that students must have completed at least 72 units in residence at a University of California campus. Approximately 1 percent of the graduating class shall be awarded summa cum laude, 3 percent magna cum laude, and 8 percent cum laude, with no more than 12 percent being awarded honors. Other important factors are considered (see Honors Recognition (catalogue.uci.edu/previouseditions/2013-14/informationforadmittedstudents/divisionofundergraduateeducation/#honorsopportunitiesetext).

Dean’s Honor List. The quarterly Dean’s Honor List is composed of students who have received a 3.5 GPA while carrying a minimum of 12 graded units.

Gregory Bogaczky Memorial Scholarship. This scholarship was established in memory of Gregory Bogaczky, a former UCI Mechanical Engineering student, and is contributed by the Bogaczky family and friends. An award is given each year to a junior or senior Mechanical Engineering student.

Haggai Memorial Endowed Scholarship. This memorial fund was established in honor of Ted Haggai, an electrical engineer. This scholarship is awarded to an outstanding senior electrical engineering student and member of Tau Beta Pi. Primary consideration will be given to members of Tau Beta Pi who have contributed outstanding service to both UCI and The Henry Samueli School of Engineering.

Christine Jones Memorial Scholarship. This scholarship was established in memory of Christine Jones, an Electrical Engineering graduate, Class of 1989. The primary focus of this scholarship is to provide financial support to a female undergraduate student in The Henry Samueli School of Engineering.

Deborah and Peter Pardoen Memorial Scholarship. This scholarship is awarded each year to a graduating senior in Mechanical Engineering or in Aerospace Engineering. The scholarship is based on outstanding service to The Henry Samueli School of Engineering and the community.

Henry Samueli Endowed Scholarship. This premier scholarship, established by Henry Samueli, is awarded to outstanding freshmen and transfer students in The Henry Samueli School of Engineering. Recipients are chosen by the School based on their academic excellence. The award is renewable up to four years for freshmen and up to two years for transfer students.

Additional awards in other categories are made throughout the academic year.

Center for Opportunities and Diversity in Engineering

305 Rockwell Engineering Center; (949) 824-4334

Robin Jeffers, Director

The Center for Opportunities and Diversity in Engineering (CODE) houses a comprehensive recruitment, retention, and placement program in The Henry Samueli School of Engineering which attempts to provide academic support and professional development to students from backgrounds which have traditionally had limited access to the engineering profession. Services provided include advisement, tutoring, study rooms, notification of research opportunities, fellowships, guest speakers, and employment opportunities. At the core of its activity is the focus on community building, and students are encouraged to bond around their common interests and goals.
Special Programs and Courses

Campuswide Honors Program
The Campuswide Honors Program is available to selected high-achieving students from all academic majors from their freshman through senior years. For more information contact the Campuswide Honors Program, 1200 Student Services II; (949) 824-5461; honors@uci.edu; http://www.honors.uci.edu/.

Engineering 199
Every undergraduate student in The Henry Samueli School of Engineering has the opportunity to pursue independent research under the direct supervision of a professor in the School. Interested students should consult with a faculty member to discuss the proposed research project. If the project is agreed upon, the student must fill out a 199 Proposal Form and submit it to the Engineering Student Affairs Office.

Undergraduate Research Opportunities Program
The Undergraduate Research Opportunities Program (UROP) encourages and facilitates research and creative activities by undergraduates. Research opportunities are available not only from every discipline, interdisciplinary program, and school, but also from many outside agencies, including national laboratories, industrial partners, and other universities. UROP offers assistance to students and faculty through all phases of the research activity: proposal writing, developing research plans, resource support, conducting the research and analyzing data, and presenting results of the research at the annual spring UCI Undergraduate Research Symposium. Calls for proposals are issued in the fall and spring quarters. Projects supported by UROP may be done at any time during the academic year and/or summer, and the research performed must meet established academic standards and emphasize interaction between the student and the faculty supervisor. In addition, all students participating in faculty-guided research activities are welcome to submit their research papers for faculty review and possible publication in the annual UCI Undergraduate Research Journal. For more information, contact the UROP Office, 1100 Student Services II; (949) 824-4189; urop@uci.edu; http://www.urop.uci.edu/.

Accelerated M.S. or Ph.D. Status Program in The Henry Samueli School of Engineering
Exceptionally promising UCI undergraduate Engineering students may, during their junior or senior year, petition for streamlined admissions into a graduate program within The Henry Samueli School of Engineering. Accelerated M.S. Status would allow a student to petition for exemption from UCI’s Graduate Record Examination (GRE) requirement for graduate school admission. (The exemption applies only to current UCI students applying for admission to one of the M.S. programs in The Henry Samueli School of Engineering; other graduate schools may still require the GRE.) A current UCI undergraduate student whose ultimate goal is a Ph.D. may apply for Accelerated Status, however, a GRE score must be submitted.

Accelerated Status applicants would in all other ways be evaluated in the same manner as other applicants to the School’s graduate programs. Occasionally, a candidate for Accelerated Status may be required by the faculty to submit GRE scores in support of the graduate application.

Students who successfully petition for Accelerated Status, upon matriculation to the graduate degree program, may petition to credit toward the M.S. degree up to 18 units (with a grade of B or better) of graduate-level coursework completed in excess of requirements for the UCI bachelor’s degree.

Please see http://www.eng.uci.edu/grad/services/accelerated for more detailed information about this program and its eligibility requirements.

UC Education Abroad Program
Upper-division and graduate Engineering students may participate in a number of programs which offer unique opportunities for education and training abroad. The University’s Education Abroad Program (UCEAP) offers engineering course work for UCI academic credit at a number of universities. Some of the UCEAP-affiliated engineering schools require proficiency in the host country’s language, while others are English speaking. Study abroad may postpone the student’s graduation for one or two quarters, depending primarily on the student’s language preparation (which can begin in the freshman year), but the added experience can add to the student’s maturity and professional competence. UCEAP students pay regular UCI fees and tuition and keep any scholarships they may have. See http://www.studyabroad.uci.edu for additional information.

Student Participation and Organizations
Faculty and committee meetings (except those involving personnel considerations) are open meetings; in addition to designated student representatives, all students are encouraged and expected to participate in the development of School policy. Student evaluation of the quality of instruction for each course is requested each quarter.

Engineering students may join any of a number of student organizations. Most of these organizations are professionally oriented and in many instances are local chapters of national engineering societies. A primary function of these groups is to provide regular technical and social meetings for students with common interests. Most of the groups also participate in the annual Engineering Week activities and in other School functions.

Associated General Contractors (AGC). A student chapter of the national organization, ACG at UCI is an academic engineering club for students interested in the construction field.

American Indian Science & Engineering Society (AISES). The mission of AISES is to increase the representation of American Indians in engineering, science, and technology. Chapters emphasize education as a tool that will facilitate personal and professional growth opportunities through mentor programs, leadership training, scholarships, conferences, and summer job opportunities.

American Institute of Aerospace & Aeronautics (AIAA). The AIAA is a technical society of 40,000 professional and student members devoted to science and engineering in the field of aerospace. The local chapter’s primary activities include seminars, tours of industries, and mentoring for students by professional members.

American Institute of Chemical Engineers (AIChE). AIChE, a student chapter of the national organization, provides Chemical Engineering majors with the opportunity to interact with faculty and professionals in the field.

American Society for Civil Engineers (ASCE). One of the larger engineering clubs. ASCE at UCI is a student chapter of the national organization. The ASCE focuses its efforts on interactions with professional engineers, sponsorship of Engineering Week activities, and participation in the annual ASCE Southwest Conference.
American Society for Materials (ASM). The student chapter of ASM at UCI provides the opportunity for Materials Science Engineering (MSE) students to meet engineers and scientists from local industry, attend seminars organized by the Orange Coast Chapter of ASM International, and organize discussion sessions that focus on progress and advances in the MSE field and that promote interactions between MSE students and materials faculty.

American Society of Mechanical Engineers (ASME). The student chapter of ASME at UCI provides the opportunity for Mechanical Engineering majors to meet with professors, organize social events, and participate in events and competitions supported by the ASME national organization.

Biomedical Engineering Society. The student chapter of BMES at UCI is an academic club for students in the field of Biomedical Engineering.

Chi Epsilon. This organization is a national engineering honor society which is dedicated to the purpose of promoting and maintaining the status of civil engineering as an ideal profession. Chi Epsilon was organized to recognize the characteristics of the individual that are fundamental to the successful pursuit of an engineering career.

Electric Vehicle Association/UCI (EVA/UCI). EVA/UCI gives students an opportunity for hands-on work on electric car conversions coupled with design experience.

Engineering Student Council (ESC). The ESC is the umbrella organization that provides a voice for all Engineering student chapters. A significant activity of the Council is organizing UCI’s annual Engineering Week celebration.

Engineers Without Borders (EWB). This humanitarian organization combines travel with the idea that engineers can play an instrumental role in addressing the world’s assorted challenges. Through the implementation of equitable, economical, and sustainable engineering projects, EWB-UCI works to improve quality of life within developing communities abroad.

Eta Kappa Nu. A student chapter of the National Electrical Engineering Honor Society, Eta Kappa Nu’s purpose is to promote creative interaction between electrical engineers and give them the opportunity to express themselves uniquely and innovatively to project the profession in the best possible manner.

Filipinos Unifying Student-Engineers in an Organized Network (FUSION). Fusion is the merging of diverse, distinct, or separate elements into a unified whole. The mission of FUSION is to promote the academic and professional development of student engineers by providing an organized network of support.

Institute of Electrical and Electronic Engineers (IEEE). A student chapter of a multinational organization, IEEE at UCI encompasses academic, professional, and social activities.

Institute of Transportation Engineers (ITE). ITE is a student chapter of a national group of transportation engineering professionals. Offering opportunities to meet both professionals and other students, ITE focuses its activities on an annual project with practical applications.

Mexican-American Engineers and Scientists (MAES). Open to all students, MAES is a student and professional organization with the purpose of aiding students in their academic, professional, and social endeavors.

National Society of Black Engineers (NSBE). The NSBE, with almost 6,000 members, is one of the largest student-managed organizations in the country. The Society is dedicated to the realization of a better tomorrow through the development of intensive programs to increase the recruitment, retention, and successful graduation of underrepresented students in engineering and other technical majors.

Omega Chi Epsilon. The student chapter of the National Chemical Engineering Honor Society aims to recognize and promote high scholarship, original investigation, and professional service in chemical engineering.

Phi Sigma Rho. This national sorority is open to women who are in engineering and engineering technology majors. Its purpose is to provide social opportunities, promote academic excellence, and provide encouragement and friendship.

Pi Tau Sigma. The mechanical engineering honor society, Pi Tau Sigma, is committed to recognizing those of high achievement. The goal of the organization is to promote excellence in academic, professional, and social activities.

Sigma Gamma Tau. The aerospace engineering honor society, Sigma Gamma Tau, is committed to recognizing those of high achievement. The goal of the organization is to promote excellence in academic, professional, and social activities.

Society of Hispanic Professional Engineers (SHPE). SHPE is both a student and professional organization. The UCI SHPE chapter works to recruit, retain, and graduate Latino engineers by providing a comprehensive program which includes high school visitations, coordinated study sessions, and industry speakers and tours. At the professional level there are opportunities for career positions and scholarships for members who are enrolled in undergraduate and graduate engineering and computer science programs.

Society of Automotive Engineers (SAE). Members of the SAE chapter at UCI participate in technical expositions, mini-Baja buggy races, student competitions, and social activities.

Society of Women Engineers (SWE). SWE is a national service organization dedicated to the advancement of women in engineering. UCI’s student chapter encourages academic and social support, and membership is open to both men and women in technical majors interested in promoting camaraderie and in helping to make engineering study a positive experience.

Structural Engineers Association of Southern California (SEAOSC). The UCI student chapter of SEAOSC introduces students to the field of structural engineering through tours, speakers, and SEAOSC dinners with professional members of the organization.

Sustainable Energy Technology Club (SETC). With the common theme of energy, club members explore how science and technology can be used as a driving force behind making changes in society with respect to a cleaner environment and less wasteful lifestyles.

Tau Beta Pi. The national Engineering honor society, Tau Beta Pi acknowledges academic excellence in the wide variety of engineering disciplines. Tau Beta Pi at UCI sponsors community service activities, social events, and technical and nontechnical seminars.

Triangle. The national social fraternity is open to engineers, architects, and scientists.
Schoolwide Program

Faculty in the Departments of Biomedical Engineering, Chemical Engineering and Materials Science, Civil and Environmental Engineering, Electrical Engineering and Computer Science, and Mechanical and Aerospace Engineering also teach courses in the major in Engineering program.

Descriptions and requirements for the undergraduate majors in Aerospace Engineering (AE), Biomedical Engineering (BME), Biomedical Engineering: Premedical (BMEP), Chemical Engineering (ChE), Civil Engineering (CE), Computer Engineering (CpE), Computer Science and Engineering (CSE), Electrical Engineering (EE), Engineering (a general program, GE), Environmental Engineering (EnE), Materials Science Engineering (MSE), and Mechanical Engineering (ME) may be found in subsequent sections.

General Undergraduate Major in Engineering

305 Rockwell Engineering Center; (949) 824-4334

The Henry Samueli School of Engineering offers a general undergraduate major in Engineering to upper-division students who wish to pursue broad multidisciplinary programs of study or who wish to focus on a special area not offered in the four departments. Examples of other areas that may be of interest are biochemical engineering, electromechanical engineering, project management, or hydrology. The program of study in any area, aside from the established specializations, is determined in consultation with a faculty advisor.

Admissions

The general major in Engineering is only open to junior-standing students who have completed the required lower-division courses with a high level of achievement. Freshmen are not eligible to apply for this major. The sequential nature of the Engineering program and the fact that many courses are offered only once a year make it beneficial for students to begin their studies in the fall quarter.

Transfer students. The general Engineering major is a specialized program for students who are seeking careers in areas other than traditional engineering disciplines and is open to upper-division students only. Preference will be given to junior-level applicants with the highest grades overall, and who have satisfactorily completed the following required courses: one year of approved calculus, one year of calculus-based physics with laboratories (mechanics, electricity and magnetism), one course in computational methods (e.g., C, C++), and one year of general chemistry (with laboratory).

Students are encouraged to complete as many of the lower-division degree requirements as possible prior to transfer. Students who enroll at UCI in need of completing lower-division course work may find that it will take longer than two years to complete their degrees. For further information, contact The Henry Samueli School of Engineering at (949) 824-4334.

Requirements for the B.S. Degree in Engineering

Credit for at least 180 units, and no more than 196 units. All courses must be approved by a faculty advisor and the Associate Dean of Student Affairs prior to enrollment in the program.

All students must meet the University Requirements (catalogue.uci.edu/previouseditions/2013-14/informationforadmittedstudents/requirementsforabachelorsdegree).

All students must meet the School Requirements.

Major Requirements

Mathematics and Basic Science Courses: MATH 2A-MATH 2B-MATH 2D, MATH 3A, and MATH 3D. PHYSICS 7C, PHYSICS 7LC. With the approval of a faculty advisor and the Associate Dean, students select all additional Mathematics and Basic Science courses.

Engineering Topics Courses: EECS 10. With the approval of a faculty advisor and the Associate Dean, students select all additional Engineering Topics courses.

Design unit values are indicated at the end of each course description. The faculty advisors and the Student Affairs Office can provide necessary guidance for satisfying the design requirements.

Program of Study

Students should keep in mind that the program for the major in Engineering is based upon a rigid set of prerequisites, beginning with adequate preparation in high school mathematics, physics, and chemistry. Therefore, the course sequence should not be changed except for the most compelling reasons. Students must have their programs approved by an academic counselor in Engineering. A sample program of study is available in the Student Affairs Office.

Graduate Study

Graduate Student Affairs Office
305 Rockwell Engineering Center; (949) 824-4334
John LaRue, Associate Dean

Admissions

For information on requirements for admission to graduate study at UCI, contact the appropriate Engineering department, concentration director, or the Graduate Student Affairs Office in The Henry Samueli School of Engineering. Additional information is available in the Catalogue’s Graduate Division (catalogue.uci.edu/previouseditions/2013-14/graduatedivision/#applicationprocedurestext) section. Admission to graduate standing in The Henry Samueli School of Engineering is generally accorded to those possessing a B.S. degree in engineering or an allied field obtained with an acceptable level of scholarship from an institution of recognized standing. Those seeking admission without the prerequisite scholarship record may, in some cases, undertake remedial work; if completed at the stipulated academic level, they will be considered for admission. Those admitted from an allied field may be required to take supplementary upper-division courses in basic engineering subjects. The Graduate Record Examination (GRE) General Test is required of all applicants.

Financial Support

Teaching assistantships and fellowships are available to qualified applicants. (Applicants should contact the Department or concentration director to which they are applying for information.) Research assistantships are available through individual faculty members. Although not required, it is beneficial for applicants to contact the faculty member.
directly to establish the potential for research support. Early applications have a stronger chance for financial support.

Part-Time Study

Those students who are employed may pursue the M.S. degree on a part-time basis, carrying fewer units per quarter. Since University residency requirements necessitate the successful completion of a minimum number of units in graduate or upper-division work in each of at least three regular University quarters, part-time students should seek the advice of a counselor in The Henry Samueli School of Engineering Graduate Student Affairs Office and the approval of the Graduate Advisor in their program. M.S. programs must be completed in four calendar years from the date of admission. Students taking courses in University Extension prior to enrollment in a graduate program should consult the following section on Transfer of Courses.

Transfer and Substitution of Courses

Upon petition, a limited number of upper-division undergraduate or graduate-level courses taken through University Extension, at another UC campus, or in another accredited university may be credited toward the M.S. degree after admission. The applicability of transfer or substitution courses must be approved by the student’s department, the School’s Associate Dean, and the Graduate Dean of the University, in accordance with Academic Senate regulations. Also in accordance with UC Academic Senate policy, transfer credit for the M.S. degree cannot be used to reduce the minimum requirement in strictly graduate (200 series) courses.

Graduate Specialization in Teaching

The graduate specialization in Teaching will allow Engineering Ph.D. students to receive practical training in pedagogy designed to enhance their knowledge and skill set for future teaching careers. Students will gain knowledge and background in college-level teaching and learning from a variety of sources, and experience in instructional practices. Students completing the specialization in Teaching must fulfill all of their Ph.D. requirements in addition to the specialization requirements. Upon fulfillment of the requirements, students will be provided with a certificate of completion. Upon receipt of the certificate of completion, the students can then append “Specialization in Teaching” to their curricula vitae. For details see http://www.eng.uci.edu/grad/services/specialization .

The graduate specialization in Teaching is available only for certain degree programs and concentrations:

• Ph.D. degree in Biomedical Engineering
• Ph.D. degree in Electrical and Computer Engineering
• Ph.D. degree in Engineering with a concentration in Materials and Manufacturing Technology

Graduate Programs

For specific information about program requirements, click on the links below.

Biomedical Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofbiomedicalengineering/#graduatetext)
Biotechnology Management
Chemical and Biochemical Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departamentofochemicalengineeringandmaterialsscience/#graduatetext)

Civil Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofcivilandenvironmentalengineering/#graduatetext)
Electrical and Computer Engineering (Concentration in Computer Engineering) (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofelectricalengineeringandcomputerscience/#graduatetext)
Electrical and Computer Engineering (Concentration in Electrical Engineering) (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofelectricalengineeringandcomputerscience/#graduatetext)
Engineering (Concentration in Environmental Engineering) (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofcivilandenvironmentalengineering/#graduatetext)

Engineering (Concentration in Materials and Manufacturing Technology) Engineering Management
Materials Science and Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofchemicalengineeringandmaterialsscience/#graduatetext)
Mechanical and Aerospace Engineering (catalogue.uci.edu/previouseditions/2013-14/thehenrysamuelischoolofengineering/departmentofmechanicalandaerospaceengineering/#graduatetext)

The M.S. and Ph.D. degree program in Networked Systems (catalogue.uci.edu/previouseditions/2013-14/interdisciplinarystudies/networkedsystems) is supervised by an interdepartmental faculty group. Information is available in the Interdisciplinary Studies section of the Catalogue.

M.S. and Ph.D. in Engineering with a Concentration in Materials and Manufacturing Technology

305 Rockwell Engineering Center; (949) 824-4334
http://www.eng.uci.edu/grad/concentration/mmt
Chin C. Lee, Director and Graduate Advisor

Faculty

Mark Bachman: Integrated microsystems, microfabrication technology, biomedical microdevices, sensor systems, human sensing, human-machine interface
Ozdal Boyraz: Silicon photonics, nonlinear optics in silicon, cascaded cavity silicon Raman lasers
Peter J. Burke: Nano-electronics, bio-nanotechnology
Zhongping Chen: Optical sensor and imaging, MEMS and biophotonic system, and biomedical devices
James C. Earthman: Fatigue behavior and cyclic damage, automated materials testing and diagnostics, high-temperature fracture, biomaterials, green materials
Franco De Flaviis: Microwave materials and devices, MEMS devices and fabrication processes
John C. LaRue: Fluid mechanics, micro-electrical-mechanical systems (MEMS), turbulence, heat transfer, instrumentation
Abraham Lee: Micro and nanofluidic chips, droplet-based reactors for bioassays and materials synthesis, cell and biomolecular based sensors, nanoparticles and vesicles for drug delivery and targeted therapeutics

Chin C. Lee: Bonding technology, electronic packaging, acoustics, microwaves, semiconductor devices, thermal management

Henry P. Lee: Optoelectronic materials, growth, and devices

Guann-Pyng Li: High-speed semiconductor technology, optoelectronic devices, integrated circuit fabrication and testing

Marc J. Madou: Fundamental aspects of micro/nano-electro-mechanical systems (MEMS/NEMS), biosensors, nanofluidics, biomimetics

J. Michael McCarthy: Machine design and kinematic synthesis of spatial mechanisms and robots

Lizhi Sun: Micro- and nano-mechanics, composites and nanocomposites, materials; optical glass pastes; silicone and epoxy encapsulants; luminescent and phosphor nanocomposites; die attach adhesives and electrical/thermal conductive optoelectronic devices (LEDs, solar cells, sensors, etc.); polymer

Frank G. Shi: Materials, packaging/manufacturing technologies for tele-communication and information technologies; MEMS-based health monitoring systems, disposable diagnostic devices, prosthetic implants

Andrew A. Shapiro-Scharlotta (Adjunct): Electronic properties of materials; electronic packaging materials, processes, and characterization

Andrei M. Shkel: Design and advanced control of micro-electro-mechanical systems (MEMS); precision micro-sensors and actuators for telecommunication and information technologies; MEMS-based health monitoring systems, disposable diagnostic devices, prosthetic implants

Albert Yee: Nanofabrication of soft materials, physics of polymer thin films, nanomechanical properties of polymers, ultra-low-k dielectrics, fracture and toughening of polymer nanocomposites

Materials and Manufacturing Technology (MMT) is concerned with the generation and application of knowledge relating the composition, structure, and processing of materials to their properties and applications, as well as the manufacturing technologies needed for production. During the past two decades, MMT has become an important component of modern engineering education, partly because of the increased level of sophistication required of engineering materials in a rapidly changing technological society, and partly because the selection of materials has increasingly become an integral part of almost every modern engineering design. In fact, further improvements in design are now viewed more and more as primarily materials and manufacturing issues. Both the development of new materials and the understanding of present-day materials demand a thorough knowledge of basic engineering and scientific principles including, for example, crystal structure, mechanics, mechanical behavior, electronic, optical and magnetic properties, thermodynamics, phase equilibria, heat transfer, diffusion, and the physics and chemistry of solids and chemical reactions.

The field of MMT ranks high on the list of top careers for scientists and engineers. The services of these engineers and scientists are required in a variety of engineering operations dealing, for example, with design of semiconductors and optoelectronic devices, development of new technologies based on composites and high-temperature materials, biomedical products, performance (quality, reliability, safety, energy efficiency) in automobile and aircraft components, improvement in nondestructive testing techniques, corrosion behavior in refineries, radiation damage in nuclear power plants, fabrication of steels, and construction of highways and bridges.

Subjects of interest in Materials and Manufacturing Technology cover a wide spectrum, ranging from metals, optical and electronic materials to superconductive materials, ceramics, advanced composites, and biomaterials. In addition, the emerging new research and technological areas in materials are in many cases interdisciplinary. Accordingly, the principal objective of the graduate curriculum is to integrate a student’s area of emphasis—whether it be chemical processing and production, electronic and photonic materials and devices, electronic manufacturing and packaging, or materials engineering—into the whole of materials and manufacturing technology. Such integration will increase familiarity with other disciplines and provide students with the breadth they need to face the challenges of current and future technology.

Students with a bachelor’s degree may pursue either the M.S. or Ph.D. degree in Engineering with a concentration in Materials and Manufacturing Technology (MMT). If students choose to enter the Ph.D. program directly, it is a requirement that they earn an M.S. degree along the way toward the completion of their Ph.D. degree.

**Recommended Background**

Given the nature of Materials and Manufacturing Technology as an interdisciplinary program, students having a background and suitable training in either Materials, Engineering (Biomedical, Civil, Chemical, Electrical, and Mechanical), or the Physical Sciences (Physics, Chemistry, Geology) are encouraged to participate. Recommended background courses include an introduction to materials, thermodynamics, mechanical
properties, and electrical/optical/magnetic properties. A student with an insufficient background may be required to take remedial undergraduate courses following matriculation as a graduate student.

Core Requirement

Because of the interdepartmental nature of the concentration, it is important to establish a common foundation in Materials and Manufacturing Technology (MMT) for students from various backgrounds. This foundation is sufficiently covered in MMT courses that are listed below and that deal with the following topics: ENGRMSE 200 Crystalline Solids: Structure, Imperfections and Properties; ENGRMAE 252 Fundamentals of Microfabrication or ENGR 265 Advanced Manufacturing; ENGRMSE 259 Mechanical Behavior of Solids - Atomistic Theories; EECS 274 Biomedical Microdevices (MEMOS). Core courses must be completed with a grade of B (3.0) or better.

Electives

Electives are grouped into four areas of emphasis.

Chemical Processing and Production:
- CHEM 213 Chemical Kinetics
- CBEMS 210 Reaction Engineering
- CBEMS 220 Transport Phenomena
- CBEMS 230 Applied Engineering Mathematics I
- CBEMS 240 Advanced Engineering Thermodynamics

Electronic and Photonic Materials and Devices:
- BME 210 Cell and Tissue Engineering
- EECS 174 Semiconductor Devices
- EECS 188 Optical Electronics
- EECS 277A Advanced Semiconductor Devices I
- EECS 277B Advanced Semiconductor Devices II
- EECS 277C Nanotechnology
- EECS 285A Optical Communications
- EECS 285B Lasers and Photonics
- EECS 280A Advanced Engineering Electromagnetics I
- EECS 280B Advanced Engineering Electromagnetics II

Electronic Manufacturing and Packaging:
- EECS 273 Electronics Packaging
- EECS 279/ENGRMAE 249 Micro-Sensors and Actuators
- EECS 285A Optical Communications
- EECS 285B Lasers and Photonics
- ENGRMAE 253 Advanced BIOMEMS Manufacturing Techniques

Materials Engineering:
- CHEM 225 Polymer Chemistry: Synthesis and Characterization of Polymers
- PHYSICS 238A-238B-238C Condensed Matter Physics and Condensed Matter Physics
- ENGRMSE 205 Materials Physics
- ENGRMSE 251 Dislocation Theory
- ENGRMSE 252 Theory of Diffusion
- ENGRMSE 254 Polymer Science and Engineering

Electives are grouped into four areas of emphasis.

Chemical Processing and Production:
- CHEM 213 Chemical Kinetics
- CBEMS 210 Reaction Engineering
- CBEMS 220 Transport Phenomena
- CBEMS 230 Applied Engineering Mathematics I
- CBEMS 240 Advanced Engineering Thermodynamics

Electronic and Photonic Materials and Devices:
- BME 210 Cell and Tissue Engineering
- EECS 174 Semiconductor Devices
- EECS 188 Optical Electronics
- EECS 277A Advanced Semiconductor Devices I
- EECS 277B Advanced Semiconductor Devices II
- EECS 277C Nanotechnology
- EECS 285A Optical Communications
- EECS 285B Lasers and Photonics
- EECS 280A Advanced Engineering Electromagnetics I
- EECS 280B Advanced Engineering Electromagnetics II

Electronic Manufacturing and Packaging:
- EECS 273 Electronics Packaging
- EECS 279/ENGRMAE 249 Micro-Sensors and Actuators
- EECS 285A Optical Communications
- EECS 285B Lasers and Photonics
- ENGRMAE 253 Advanced BIOMEMS Manufacturing Techniques

Materials Engineering:
- CHEM 225 Polymer Chemistry: Synthesis and Characterization of Polymers
- PHYSICS 238A-238B-238C Condensed Matter Physics and Condensed Matter Physics
- ENGRMSE 205 Materials Physics
- ENGRMSE 251 Dislocation Theory
- ENGRMSE 252 Theory of Diffusion
- ENGRMSE 254 Polymer Science and Engineering

It should be noted that specific course requirements within the area of emphasis are decided based on consultation with the Director of the MMT concentration.

Master of Science Degree

Two options are available for M.S. degree students: a thesis option and a comprehensive examination option. Both options require the completion of at least 12 courses of study.

Plan I. Thesis Option

For the thesis option, students are required to complete an original research project and write an M.S. thesis. A committee of three full-time faculty members is appointed to guide the development of the thesis. Students must also obtain approval for a complete program of study from the program director. At least seven courses (3-unit or 4-unit) must be taken from courses numbered 200–289, among which at least four courses (3-unit or 4-unit) are from MMT core courses and at least three courses (3-unit or 4-unit) are in the area of emphasis approved by the faculty advisor and the graduate advisor. Four units of CBEMS 296, EECS 296, ENGR 296, ENGRMAE 296, BME 296, or ENGRCEE 296 count as the equivalence of one course. Up to three courses equivalent of CBEMS 296, EECS 296, ENGR 296, ENGRMAE 296, BME 296, or ENGRCEE 296 and up to two courses (3-unit or 4-unit) of upper-division undergraduate elective courses taken as a graduate student at UCI can be applied toward the 12-course requirement.

Plan II. Comprehensive Examination Option

For the comprehensive examination option, students are required to complete minimally 12 courses (3-unit or 4-unit) of study. At least eight courses (3-unit or 4-unit) must be taken from courses numbered 200–289, among which at least four courses (3-unit or 4-unit) are from MMT core courses and at least four courses (3-unit or 4-unit) are in the area of emphasis approved by the faculty advisor and the graduate advisor. Four units of CBEMS 299, EECS 299, ENGRMAE 299, EECS 299, or ENGRCEE 299 count as the equivalence of one course. One course equivalent of CBEMS 299, EECS 299, ENGRMAE 299, BME 299, ENGRCEE 299, and up to two courses (3-unit or 4-unit) of upper-division undergraduate elective courses taken as a graduate student at UCI can be applied toward the 12-course requirement.

In the last quarter, an oral comprehensive examination on the contents of study will be given by a committee of three faculty members including the advisor and two members appointed by the program director. Part-time study for the M.S. degree is available and encouraged for engineers working in local industries. Registration for part-time study must be approved in advance by the MMT program director, the School’s Associate Dean, and the Graduate Dean.

NOTE: Students who entered prior to fall of 2012 should follow the course requirements outlined within the Catalogue of the year they entered. The change in number of units per course is not intended to change the course requirements for the degree nor to have any impact in the number of courses students are taking. As such, students will need to continue to meet the same high standards and plan of study requirements as
previously required. Students will work with their advisor to create a plan of study encompassing the equivalent topical requirements, as well as the equivalent number of courses to the previous 36-unit requirement.

In addition to fulfilling the course requirements outlined above, it is a University requirement for the Master of Science degree that students fulfill a minimum of 36 units of study.

**Concurrent Study in the Program in Law and Graduate Studies (PLGS)**

Students have the option to pursue a coordinated curriculum leading to a J.D. degree from the School of Law in conjunction with a Master’s or Ph.D. degree in Engineering with a concentration in Materials and Manufacturing Technology. For students pursuing the M.S. thesis option, 8 units of research can be substituted for law electives, and comprehensive exam students can petition two course (non-course or area of emphasis courses) to be substituted by law electives.

**Doctor of Philosophy Degree**

The Ph.D. degree in Engineering with a concentration in Materials and Manufacturing Technology requires a commitment on the part of the student to dedicated study and collaboration with the faculty. Ph.D. students are selected on the basis of outstanding demonstrated potential and scholarship. Applicants must hold the appropriate prerequisite degrees from recognized institutions of high standing. Students entering with a master’s degree may be required to take additional course work, to be decided in consultation with the graduate advisor and the program director. Students without a master’s degree may be admitted into the Ph.D. program. However, these students will be required to complete the degree requirements above for the master’s degree prior to working on doctoral studies. After substantial academic preparation, Ph.D. candidates work under the supervision of faculty advisors. The process involves immersion in a research atmosphere and culminates in the production of original research results presented in a dissertation.

Milestones to be passed in the Ph.D. program include the following: acceptance into a research group by the faculty advisor during the student’s first year of study, successful completion of the Ph.D. preliminary examination during years one or two, development of a research proposal, passing the qualifying examination during year three (second year for those who entered with a master’s degree), and the successful completion and defense of the dissertation during the fourth or fifth year. There is no foreign language requirement.

The degree is granted upon the recommendation of the doctoral committee and the Dean of Graduate Division. The normative time for completion of the Ph.D. is five years (four years for students who entered with a master’s degree). The maximum time permitted is seven years.

**M.S. in Engineering Management**

305 Rockwell Engineering Center; (949) 824-4334
http://www.eng.uci.edu/grad/programs/em

John LaRue, Associate Dean for Student Affairs, The Henry Samueli School of Engineering
Alladi Venkatesh, Associate Dean of Master’s Programs, The Paul Merage School of Business

**Engineering Management Steering Committee**

Imran S. Currim: Marketing research, customer choice, design and marketing of products and services, customer behavior online, and assessing the impact of competitive product and service features and marketing efforts on consumer choice and market share

Payam Heydari: Design and analysis of analog, RF, and mixed-signal integrated circuits; analysis of signal integrity and high-frequency effects of on-chip interconnects in high-speed VLSI circuits

John C. LaRue: Fluid mechanics, micro-electrical-mechanical systems (MEMS), turbulence, heat transfer, instrumentation

Marc J. Madou: Fundamental aspects of micro/nano-electromechanical systems (MEMS/NEMS), biosensors, nanofluidics, biomimetics

Jean-Daniel M. Saphores: Transportation economics, planning and policy, environmental and natural resource economics and policy, quantitative methods

Alladi Venkatesh: Community-based technologies: home informatics and networking; youth and new media; consumers and electronic environments, and cross-cultural research

The Master of Science in Engineering Management is a graduate degree jointly offered by The Paul Merage School of Business and The Henry Samueli School of Engineering that will prepare engineers for leadership roles in technology, science, government, and engineering-based companies and organizations. The curriculum includes courses in engineering from The Henry Samueli School of Engineering and courses in business administration from The Paul Merage School of Business. Students will emerge as innovators by taking on the role of business and engineering project managers tasked with solving complex engineering product development challenges through consulting projects, business plans, and exposure to current issues within the engineering sector. Through this process, quantitative and qualitative skills along with business communication skills will be developed.

This competitive major teaches business from the engineering perspective and engineering from the business perspective, and students will learn to think about their work through the lens of innovation and to develop a crucial view to enhance their careers.

**Admissions**

Applicants apply directly to The Samueli School for the M.S. in Engineering Management. Applicants must meet any applicable prerequisite requirements for the specific engineering specialization they wish to pursue. Admission to graduate standing in The Samueli School of Engineering is generally accorded to those possessing at least a B.S. degree in engineering or an allied field obtained with an acceptable level of scholarship from an institution of recognized standing. Those seeking admission without the prerequisite scholarship record may, in some cases, undertake remedial work; if completed at the stipulated academic level, they will be considered for admission. Those admitted from an allied field may be required to take supplementary upper-division courses in basic engineering subjects.

The Samueli and Merage Schools will evaluate applicants on their prior academic record and their potential for management and leadership as demonstrated in submitted application materials including work experience and in an interview. These materials will include university transcripts, GRE test scores, resume, letters of recommendation, and a Statement of Purpose. Competitive applicants will be interviewed by the Merage School.
Master of Science Degree: Plan II: Comprehensive Exam Option

The M.S. degree requires the completion of designated course work which corresponds to a minimum of 17 courses beyond the bachelor’s degree. As part of the program, students must complete a two-week orientation and an intensive course in early to mid-September preceding the fall quarter which presents fundamental concepts of management to initiate students into the concrete challenges that managers in high-performing organizations typically confront.

Core Requirements

Due to the interdisciplinary nature of this degree, it is important to establish a common foundation in Engineering Management for students from various backgrounds. This foundation is sufficiently covered in Engineering Management courses that are listed below and that deal with the following topics:

- MGMTMBA 200 Management of Innovative Organizations
- MGMTMBA 211 MBA Proseminar
- MGMTMBA 298 Experiential Learning (or equivalent)
- ENGR 280 Entrepreneurship for Scientists and Engineers

Plus, a departmental seminar based on specialization area, for example:

- BME 298 Seminars in Biomedical Engineering
- CBEMS 298 Seminars in Engineering
- ENGRCEE 295 Seminars in Engineering
- EECS 294 Electrical Engineering and Computer Science Colloquium
- ENGRMAE 298 Seminars in Mechanical and Aerospace Engineering

Electives

Business. In addition to the core courses listed above, at least five additional courses from The Merage School of Business are required. (Students will be recommended certain classes based on career tracks they plan to pursue.)

- Three Merage School M.B.A. core courses;
- Two additional courses from a selected group of either core or elective courses.

M.B.A. Courses

Core:

- MGMTMBA 201A Statistics for Management
- MGMTMBA 201B Management Science
- MGMTMBA 202 Organizational Analysis for Management
- MGMTMBA 203A Financial Accounting for Management
- MGMTMBA 203B Managerial Accounting for Management
- MGMTMBA 204A Microeconomics for Management
- MGMTMBA 204B Macroeconomics for Management
- MGMTMBA 205 Marketing Management
- MGMTMBA 206 Business and Government

MGMTMBA 207 Information Technology for Management
MGMTMBA 208 Operations Management
MGMTMBA 209A Managerial Finance
MGMTMBA 210 Business Strategy

Electives:

Refer to the Business School section of the Catalogue for a list of current M.B.A. electives.

Engineering. In addition to the core courses listed above, at least five courses from The Samueli School of Engineering are required. (Students will be recommended certain classes based on career tracks they plan to pursue.)

- Three courses from a chosen primary specialization in Engineering: Biomedical Engineering, Chemical and Biochemical Engineering, Civil Engineering, Electrical and Computer Engineering, Materials Science and Engineering, or Mechanical and Aerospace Engineering;
- Two additional elective courses chosen from the primary specialization, from another specialization, or from other courses offered in the M.S. in Engineering Management program that are identified as elective courses.

Approved Specialization Courses

Biomedical Engineering:

- BME 210 Cell and Tissue Engineering
- BME 213 Systems Cell and Developmental Biology
- BME 220 Quantitative Physiology: Sensory Motor Systems
- BME 221 Quantitative Physiology: Organ Transport Systems
- BME 230A Applied Engineering Mathematics I
- BME 230B Applied Engineering Mathematics II
- BME 233 Dynamic Systems in Biology and Medicine
- BME 236 Engineering Optics for Medical Applications
- BME 247 Microfluids and Lab-On-A-Chip
- BME 248 Microimplants
- BME 249 Biomedical Microdevices I

Chemical and Biochemical Engineering:

- CBEMS 195 Special Topics in Chemical Engineering and Materials Science
- CBEMS 218 Bioengineering with Recombinant Microorganisms
- CBEMS 221 Drug Delivery
- CBEMS 232 Bioseparation Processes
- CBEMS 249 Special Topics in Chemical Engineering and Materials Science

Civil Engineering:

- ENGRCEE 220A Travel Demand Analysis I
- ENGRCEE 221A Transportation Systems Analysis I
- ENGRCEE 225B Transportation Planning Models II
- ENGRCEE 249 Earthquake Engineering
ENGRCEE 250 | Finite Element Method in Structural Engineering  
ENGRCEE 262 | Environmental Chemistry II  
ENGRCEE 263 | Advanced Biological Treatment Processes  
ENGRCEE 265 | Physical-Chemical Treatment Processes  
ENGRCEE 272 | Groundwater Hydrology  
ENGRCEE 273 | Watershed Modeling  
ENGRCEE 276 | Hydrology  
ENGRCEE 281 | Structural Reliability  

**Electrical and Computer Engineering:**  
EECS 202A | Principles of Imaging  
EECS 210 | Modeling and Rendering for Image Synthesis  
EECS 211 | Advanced System Software  
EECS 213 | Computer Architecture  
EECS 215 | Design and Analysis of Algorithms  
EECS 217 | VLSI System Design  
EECS 222 | Embedded System Modeling  
EECS 225 | Embedded Systems Design  
EECS 241A | Digital Communications I  
EECS 248A | Computer and Communication Networks  
EECS 261A | Linear Optimization Methods  
EECS 267A | Industrial and Power Electronics  
EECS 273 | Electronics Packaging  
EECS 274 | Biomedical Microdevices (MEMOS)  
EECS 277C | Nanotechnology  
EECS 278 | Micro-System Design  
EECS 279 | Micro-Sensors and Actuators  

**Materials Science and Engineering:**  
CBEMS 221 | Drug Delivery  
CBEMS 249 | Special Topics in Chemical Engineering and Materials Science  
EECS 273 | Electronics Packaging  
EECS 277C | Nanotechnology  
ENGRMAE 252 | Fundamentals of Microfabrication  
ENGRMSE 254 | Polymer Science and Engineering  
ENGRMSE 255A | Design with Ceramic Materials  
ENGRMSE 261 | High Temperature Deformation of Engineering Materials  
ENGRMSE 268 | Principles of Coatings, Thin Films and Multi-layers  

**Mechanical and Aerospace Engineering:**  
ENGRMAE 207 | Methods of Computer Modeling in Engineering and the Sciences  
ENGRMAE 218 | Sustainable Energy Systems  
ENGRMAE 247 | Micro-System Design  
ENGRMAE 249 | Micro-Sensors and Actuators  
ENGRMAE 250 | Biorobotics  
ENGRMAE 252 | Fundamentals of Microfabrication  

ENGRMAE 253 | Advanced BIOMEMS Manufacturing Techniques  
ENGRMAE 274 | Optimal Control  

## M.S. in Biotechnology Management  
The M.S. in Biotechnology Management is a joint graduate degree that will prepare scientists for leadership roles in biotechnology, science, and engineering-based companies through a curriculum comprised of courses from the Department of Molecular Biology and Biochemistry (MB&B) in the School of Biological Sciences, the Department of Biomedical Engineering in The Henry Samueli School of Engineering, and The Paul Merage School of Business. Students will receive advanced training in biotechnology through course work, a teaching laboratory, and two quarters of independent research in a faculty laboratory of their choosing. They will also learn to think as a business manager by solving product development challenges through consulting projects, creating business plans, and by exposure to current issues within the biotechnology sector. Students will develop quantitative and qualitative skills along with business communication skills. Students will learn about business from the biotechnology perspective and biotechnology from the business perspective, and will be taught to think about their work through the lens of innovation, a crucial view for their careers.  

Complete program information is available in the School of Biological Sciences (catalogue.uci.edu/previouseditions/2013-14/#graduatetext) section of the Catalogue.  

## Faculty  
Amir AghaKouchak, Ph.D. University of Stuttgart, Assistant Professor of Civil and Environmental Engineering  
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Paul D. Arthur, Ph.D. California Institute of Technology, Professor Emeritus of Mechanical and Aerospace Engineering, Registered Professional Engineer  
Satya N. Atluri, Sc.D. Massachusetts Institute of Technology, UCI Distinguished Professor of Mechanical and Aerospace Engineering  
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Anna Grosberg, Ph.D. California Institute of Technology, Assistant Professor of Biomedical Engineering and of Chemical Engineering and Materials Science
<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation and Title</th>
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<tbody>
<tr>
<td>Gary L. Guymon, Ph.D.</td>
<td>University of California, Davis, <em>Professor Emeritus of Civil and Environmental Engineering</em>, Registered Professional Engineer</td>
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<tr>
<td>Jered Haun, Ph.D.</td>
<td>University of Pennsylvania, <em>Assistant Professor of Biomedical Engineering</em></td>
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<td>Faryar Jabbari, Ph.D.</td>
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<td>R. (Jay) Jayakrishnan, Ph.D.</td>
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<td>Michelle Khine, Ph.D.</td>
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<td>J. Michael McCarthy, Ph.D.</td>
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A. Lee Swindlehurst, Ph.D. Stanford University, Professor of Electrical Engineering and Computer Science

Harry H. Tan, Ph.D. University of California, Los Angeles, Professor Emeritus of Electrical Engineering and Computer Science
Courses

**ENGR 1. Freshman Seminar In Engineering. 1 Unit.**
An introduction to the engineering profession. Weekly seminars by both faculty and representatives from industry present an overview of each engineering discipline. Students learn about current trends and issues in engineering, and career and academic options.

(Design units: 0)

Grading Option: Pass/no pass only.

Restriction: Freshmen only.

**ENGR 7A. Introduction to Engineering I. 2 Units.**
Introduction to engineering disciplines and the design process. Course may be offered online.

(Design units: 1)

Grading Option: In progress only.

**ENGR 7B. Introduction to Engineering II. 2 Units.**
Introduction to engineering disciplines and the design process. Course may be offered online.

(Design units: 2)

Prerequisite: ENGR 7A.

Adjunct Professors

Hooman Darabi, Ph.D. University of California, Los Angeles, Assistant Adjunct Professor of Electrical Engineering and Computer Science

Xiaogang Gao, Ph.D. University of Arizona, Adjunct Professor of Civil and Environmental Engineering
ENGR 10. Computational Methods in Engineering. 4 Units.
Procedures and procedure followers, algorithms and flow charts, computer languages, subprograms. Computer macro- and microelements, number systems. Methods of differentiation, integration, curve fitting, list processing. Error analysis. Must qualify in BASIC and FORTRAN at end of course through computer use.

(Design units: 0)
Prerequisite: Prerequisite or corequisite: MATH 2A.
Overlaps with ENGRMAE 10, EECS 10, EECS 12.

ENGR 15. Problem Solving in Engineering. 4 Units.
Introduction to scientific computing to solve engineering problems. Problem identification, algorithmic design, and solution using appropriate computational tools. Design and application documentation.

(Design units: 1)
Corequisite: MATH 3D.
Prerequisite: (EECS 10 or EECS 12 or ENGRMAE 10 or CSE 41 or I&C SCI 31) and MATH 3A.
Overlaps with ENGRCEE 20.
Restriction: Biomedical Engineering majors have first consideration for enrollment.

ENGR 30. Statics. 4 Units.
Addition and resolution of forces distributed forces, equivalent system of forces centroids, first moments, moments and products on inertia, equilibrium of rigid bodies, trusses, beams, cables.

(Design units: 0)
Corequisite: MATH 2D.
Prerequisite: (EECS 10 or EECS 12 or ENGRMAE 10 or CSE 41 or I&C SCI 31) and MATH 3A.
Same as ENGRCEE 30, ENGRMAE 30.
Restriction: School of Engineering majors have first consideration for enrollment.

ENGR 54. Principles of Materials Science and Engineering. 4 Units.
Superconductors to biodegradable polymers. Structure and properties of materials, including metal, ceramics, polymers, semiconductors, composites, traditional materials. Atomic structure, bonding, defects, phase equilibria, mechanical properties, electrical, optical and magnetic properties. Introduction to materials processing and synthesis. Materials fee.

(Design units: 0)
Prerequisite: CHEM 1A and PHYSICS 7C.
Restriction: School of Engineering majors have first consideration for enrollment.

ENGR 69. Energy Facilities Inspection. 0 Units.
Inspection of power-generating stations of various types, oil and gas processing facilities, and end-use facilities.

Repeatability: May be repeated for credit unlimited times.

ENGR 80. Dynamics. 4 Units.
Introduction to the kinetics and dynamics of particles and rigid bodies. The Newton-Euler, Work/Energy, and Impulse/Momentum methods are explored for ascertaining the dynamics of particles and rigid bodies. An engineering design problem using these fundamental principles is also undertaken.

(Design units: 0.5)
Prerequisite: MATH 2D and PHYSICS 7C.
Same as ENGRCEE 80, ENGRMAE 80.
Restriction: School of Engineering majors have first consideration for enrollment.

ENGR 92. Engineering and Computer Educational Laboratory. 0 Units.
Comprehensive academic support designed primarily for underrepresented or underprepared students in Engineering, ICS, or selected areas of the physical sciences. Typical program activities: tutoring, study skills, career planning, self-esteem enhancement, library research techniques.

(Design units: 0)
Grading Option: Pass/no pass only.
Repeatability: May be taken for credit for 12 units.

ENGR 93. Public and Professional Service in Engineering. 0 Units.
Student participation in public and professional service activities related to engineering.

Grading Option: Pass/no pass only.
Repeatability: May be repeated for credit unlimited times.

ENGR 98. Group Study . 1-4 Units.
Group study of selected topics in engineering.

(Design units: 1-4)
Repeatability: Unlimited as topics vary.

ENGR 150. Mechanics of Structures. 4 Units.

(Design units: 2)
Prerequisite: (ENGRCEE 30 or ENGR 30 or ENGRMAE 30) and MATH 3A.
Same as ENGRCEE 150, ENGRMAE 150.
Overlaps with ENGRCEE 150.
Restriction: Aerospace Engineering, Chemical Engineering, Materials Science Engineering, and Mechanical Engineering majors have first consideration for enrollment.
ENGR 165. Advanced Manufacturing. 4 Units.
Principles in manufacturing processes. All machining requires energy: mechanical (cutting and shaping), heat energy (laser cutting), photochemical (photolithography), chemical energy (electro chemical machining and chemical vapor deposition). These methods and their fundamentals are examined.

(Design units: 2)

Restriction: School of Engineering majors only. Seniors only.
Concurrent with ENGR 265.

ENGR 180. Entrepreneurship for Scientists and Engineers. 4 Units.
Real-world introduction to the theory and practice of entrepreneurship. Explore organizational, strategic, and financial challenges; start-up strategies; business idea evaluation; and business plan writing. Presentations by prestigious entrepreneurs and industry leaders.

(Design units: 0)

Restriction: Upper-division students only. School of Engineering majors have first consideration for enrollment.
Concurrent with ENGR 280.

ENGR 189. Senior Project - Topics Vary. 1-4 Units.
Multidisciplinary group senior project of theoretical or applied nature involving design.

(Design units: 1-4)

Repeatability: May be taken for credit 12 units as topics vary.
Restriction: Seniors only.

ENGR 190W. Communications in the Professional World. 4 Units.

(Design units: 0)

Prerequisite: Satisfactory completion of the Lower-Division Writing requirement.
Restriction: Aerospace Engineering, Biomedical Engineering, Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Environmental Engineering, Materials Science Engineering and Mechanical Engineering majors have first consideration for enrollment.

( Ib)

ENGR 195. Special Topics in Engineering. 1-4 Units.
Studies in selected areas of Engineering. Topics addressed vary each quarter.

(Design units: 1-4)

Prerequisite: Prerequisites vary.
Repeatability: Unlimited as topics vary.

ENGR 196. Engineering Thesis. 4 Units.
Preparation of final presentation and paper describing individual research in Engineering completed in one or more quarters of individual study (i.e., ENGR 199).

Prerequisite: Completion of at least 4 units of Individual Research in Engineering.

ENGR 196W. Engineering Thesis. 4 Units.
Preparation of final presentation and paper describing individual research in Engineering completed in one or more quarters of individual study (i.e., ENGR 199).

Prerequisite: Completion of at least 4 units of Individual Research in Engineering. Satisfactory completion of the Lower-Division Writing requirement.

(Ib)

ENGR H196. Honors Thesis. 4 Units.
Preparation of final presentation and paper describing individual research in Engineering. For participants in the Campuswide Honors Program.

(Design units: 1-4)

Prerequisite: ENGR H199.
Restriction: Campuswide Honors Program students only.

ENGR H196W. Honors Thesis. 4 Units.
Preparation of final presentation and paper describing individual research in Engineering. For participants in the Campuswide Honors Program.

(Design units: 1-4)

Prerequisite: ENGR H199. Satisfactory completion of the Lower-Division Writing requirement.
Restriction: Campuswide Honors Program students only.

(Ib)

ENGR 197A. Educational Strategies for Tutoring and Teacher Aiding . 4 Units.
Placement in a public elementary or secondary school to gain experience as a tutor or teacher aide. Emphasis on cognitive learning and the development of instructional strategies and resources which can be used in effective cross-age and cross-cultural experiences.

Grading Option: Pass/no pass only.
Repeatability: May be taken for credit 3 times.
Same as EDUC 100.

ENGR 199. Individual Study. 1-4 Units.
Supervised independent reading, research, or design for undergraduate Engineering majors. Students taking individual study for design credit are to submit a written paper to the instructor and to the Undergraduate Student Affairs Office in the School of Engineering.

(Design units: 1-4)

Repeatability: May be taken for credit 8 units.
Restriction: School of Engineering majors only.
ENGR 199P. Individual Study. 1-4 Units.
Supervised independent reading, research, or design for undergraduate Engineering majors. Students taking individual study for design credit are to submit a written paper to the instructor and to the Undergraduate Student Affairs Office in the School of Engineering.

(Design units: 1-4)

Grading Option: Pass/no pass only.

Repeatability: May be repeated for credit unlimited times.

ENGR H199. Individual Study for Honors Students. 1-5 Units.
Supervised research in Engineering for participants in the Campuswide Honors Program. Students taking individual study for design credit are to submit a written paper to the instructor and to the Undergraduate Student Affairs Office in the School of Engineering.

(Design units: 1-5)

Repeatability: May be repeated for credit unlimited times.

Restriction: Campuswide Honors Program students only.

ENGR 260A. Technology for Life. 4 Units.
Engineering techniques including physics, chemistry, biology, and micro/nano technology for enabling life sciences research in the areas of genomics/proteomics, cells, tissues/organs, and biomolecules.

Prerequisite: PHYSICS 106 or CHEM 128L or BIO SCI M118L.

ENGR 260B. Technology of Life. 4 Units.
Engineering perspectives of evolution in life sciences including the physics, chemistry, and mechanics of various life systems such as DNA, RNA, biomolecules, cells, organs.

Prerequisite: PHYSICS 146A or CHEM 128 or BIO SCI D114 or BME 50A or BME 50B.

ENGR 265. Advanced Manufacturing. 4 Units.
Principles in manufacturing processes. All machining requires energy: mechanical (cutting and shaping), heat energy (laser cutting), photochemical (photolithography), chemical energy (electro chemical machining and chemical vapor deposition). These methods and their fundamentals are examined.

Restriction: School of Engineering graduate students only.

Concurrent with ENGR 165.

ENGR 280. Entrepreneurship for Scientists and Engineers. 4 Units.
Real-world introduction to the theory and practice of entrepreneurship. Explore organizational, strategic, and financial challenges; start-up strategies; business idea evaluation; and business plan writing. Presentations by prestigious entrepreneurs and industry leaders.

(Design units: 0)

Restriction: Graduate students only. School of Engineering majors have first consideration for enrollment.

Concurrent with ENGR 180.

ENGR 295. Special Topics in Engineering. 1-4 Units.
Studies in selected areas of Engineering. Topics addressed vary each quarter.

Prerequisite: Prerequisites vary.

Repeatability: Unlimited as topics vary.

Restriction: Graduate students only.

ENGR 296. Master of Science Thesis Research. 1-16 Units.
Individual research or investigation conducted in the pursuit of preparing and completing the thesis required for the M.S. in Engineering.

Repeatability: May be repeated for credit unlimited times.

ENGR 297. Doctor of Philosophy Dissertation Research. 1-16 Units.
Individual research or investigation conducted in the pursuit of preparing and completing the dissertation required for the Ph.D. in Engineering.

Repeatability: May be repeated for credit unlimited times.

ENGR 299. Individual Research. 1-16 Units.
Individual research or investigation under the direction of an individual faculty.

Repeatability: May be repeated for credit unlimited times.

ENGR 299. University Teaching. 4 Units.
University teaching with Engineering faculty.

Grading Option: Satisfactory/unsatisfactory only.

Repeatability: May be repeated for credit unlimited times.

Restriction: Teaching assistants only.