Dear Henry Samueli School of Engineering Graduate Student:

Welcome to the 2008-09 academic year! With cutting-edge research centers, superb faculty who are experts in their fields, and a diverse, competitive student body, we pride ourselves on being leaders in Graduate Engineering Education.

This fall proves to be an exciting time for our school, with graduate students from over thirty-five countries enrolled in our programs. Our growth in faculty size, enrollment, and recognition as a top-notch research institution has enabled The Henry Samueli School of Engineering to affect industry in southern California, the United States, and abroad.

I hope your graduate school experience is exciting and challenging, and that you leave us with all of the right tools and knowledge to successfully compete in industry, research, and academia. The Henry Samueli School of Engineering is truly Engineering the Future. We are pleased that you are an integral part of our future. Please let us know how we can enhance your graduate school experience.

I wish you all the best for an outstanding academic year.

Sincerely,

John C. Hart
Associate Dean of Student Affairs
The Henry Samueli School of Engineering
TABLE OF CONTENTS

HSSoE Graduate Student Affairs.................................................................6
Departmental Graduate Coordinators.........................................................7
Faculty Graduate Advisors............................................................................8
Selecting a Research Advisor.......................................................................9
Securing Financial Support........................................................................9
Major Steps toward the M.S. degree............................................................10
Major Steps toward the Ph.D. degree.........................................................11

ENROLLMENT AND REGISTRATION POLICIES: STUDENT STATUS...12

A. Academic Residence Requirements.........................................................12
1. Academic Year..........................................................................................12
2. Summer Session........................................................................................12
3. California Residency for Tuition Purposes.................................................12

B. Enrollment Policies and Procedures.......................................................13
1. Late Enrollment........................................................................................13
2. Full-Time Enrollment/Registration............................................................13
3. Part-Time Enrollment/Registration............................................................14
   a. Guidelines to Establish Part-Time Eligibility...........................................14
   b. Part-Time Limitations and Related Policies............................................15
4. Lapse of Status: Did Not Enroll.................................................................16
5. Lapse of Status: Readmission.................................................................16
6. Enrollment in University Extension..........................................................17
7. Withdrawal...............................................................................................17
   a. Withdrawal between Quarters...............................................................17
   b. Withdrawal after Enrollment and Fee Payment for a Quarter..................17
   c. Withdrawal without Approved Academic Leave of Absence..................17

C. Registration Policy..................................................................................18
1. Continuous Registration Policy...............................................................18
2. Registration Procedures and Prerequisite Waivers....................................18
3. In-Absentia Registration..........................................................................19
4. Academic Leave of Absence (LOA)..........................................................20
   a. Purpose.................................................................................................20
   b. Eligibility Guidelines...........................................................................20
   c. Limitations to LOA............................................................................20
   d. Procedures for Requesting an Academic Leave of Absence..................21
   e. Other Policies Relevant to LOA..........................................................21
5. Filing Fees...............................................................................................22
   a. Procedures for Establishing Eligibility for Filing Fee Status..................23
   b. Limitations on use of University Services while on Filing Fee status......23
6. Terminal Master's Students....................................................................24

D. Tuition Reduction for Non-Resident Doctoral Students
   (International Students)..........................................................................24
1. Eligibility Criteria...................................................................................24
2. Related Policies......................................................................................24
E. Intercampus Exchange Program ................................................................. 25
1. What is Intercampus Exchange? ................................................................. 25
2. Eligibility for Intercampus Exchange ....................................................... 25

ACADEMIC STANDARDS FOR STUDENTS ........................................ 25
A. Progress toward Degree ............................................................................ 25
1. Satisfactory Progress ............................................................................... 25
2. Unsatisfactory Progress .......................................................................... 26
a. Criteria for Determining Unsatisfactory Progress ................................. 26
3. Academic Disqualification ...................................................................... 27
B. Graduate Standards for Grading ............................................................... 27
1. Course Repetition .................................................................................... 28
2. Pass/Not Pass (P/NP) .............................................................................. 28
3. Satisfactory/Unsatisfactory (S/U) .............................................................. 28
4. In Progress (IP) ....................................................................................... 28
5. Incomplete (I) ......................................................................................... 29
6. No Report (NR) ..................................................................................... 29
7. Withdrawal (W) ..................................................................................... 30
C. Removal of Deficient Grades and Repeat of Courses ......................... 30
D. Examinations .......................................................................................... 30
1. Scheduling of Examinations .............................................................. 30
2. Repeat of Critical Examinations ......................................................... 31
3. Credit by Examination ......................................................................... 31

STANDARDS AND REQUIREMENTS FOR GRADUATE DEGREE PROGRAMS ............................................................... 31
A. The Master's Degree ................................................................................. 31
1. Residency Requirement ......................................................................... 32
2. Curricular Requirements ....................................................................... 32
a. Coursework Requirements and Thesis and Examination Options .... 32
b. Advancement to Candidacy ............................................................... 36
c. Final Report for the Master's Degree .................................................. 36
B. Transfer of Credit .................................................................................... 37
1. Policy .................................................................................................. 37
2. Procedures .......................................................................................... 38
3. Accelerated Status M.S. or Ph.D. students ........................................... 38
C. The Doctoral Degree .............................................................................. 38
1. Residency Requirement ....................................................................... 38
2. Teaching Requirement ......................................................................... 39
3. Waiver of Course Work ...................................................................... 40
4. Advancement to Candidacy ............................................................... 40
5. Lapse of Candidacy ............................................................................ 44
6. The Doctoral Committee ................................................................. 44
a. Dissertation ....................................................................................... 44
b. Membership ...................................................................................... 44
c. Appointment Procedures ................................................................. 45
d. Exceptions...............................................................................................................45

e. Duties and Responsibilities..................................................................................46

7. Final Examination ...............................................................................................47

8. Dissertation ..........................................................................................................47

a. How to File ..........................................................................................................47

b. Deadline for Filing...............................................................................................47

c. Public Access.......................................................................................................48

D. Change of Degree Title/Program/Level/or Academic Unit ..................................48

1. Change of Degree Level Within an Academic Unit (Master's to Ph.D.)..............48

2. Change of Degree Level Within an Academic Unit (Ph.D. to Master's).............48

3. Change of Degree Program (Major) Within an Academic Unit.........................49

4. Change of Degree Title and Academic Unit .......................................................49

E. Degree Conferral..................................................................................................49

1. Registration Requirements ....................................................................................49

2. Certification of Degree Award .............................................................................50

F. Graduation and Diploma Information ....................................................................50

1. Advancement to Candidacy Requirement ...........................................................50

2. Diploma and Commencement Form .....................................................................50

3. Commencement ...................................................................................................51

Registration: Enrollment and Fee Payment ...............................................................51

Current Graduate Student Forms ..............................................................................52

Detailed Program Information ..................................................................................52

Biomedical Engineering Catalogue ..........................................................................52

Biomedical Engineering Preliminary Exam ..............................................................57

Biomedical Engineering Plan of Study ....................................................................58

Chemical and Biochemical Engineering Catalogue .................................................59

Chemical and Biochemical Engineering Preliminary Exam .....................................66

Chemical and Biochemical Engineering Plan of Study ............................................67

Civil and Environmental Engineering Catalogue ....................................................68

Civil and Environmental Engineering Preliminary Exam .........................................78

Civil and Environmental Engineering Plans of Study ..............................................79

Electrical Engineering and Computer Science Catalogue .......................................82

Electrical Engineering and Computer Science Preliminary Exam .........................98

Electrical Engineering and Computer Science Plans of Study ................................99

Environmental Engineering Catalogue ....................................................................103

Environmental Engineering Preliminary Exam .........................................................106

Environmental Engineering Plan of Study ..............................................................107

Materials and Manufacturing Technology Catalogue ..........................................108

Materials and Manufacturing Technology Preliminary Exam .............................110

Materials and Manufacturing Technology Plan of Study ....................................112

Materials Science and Engineering Catalogue .......................................................113

Materials Science and Engineering Preliminary Exam .........................................117

Materials Science and Engineering Plan of Study ..................................................118

Mechanical and Aerospace Engineering Preliminary Exam Catalogue ................119

Mechanical and Aerospace Engineering Preliminary Exam Preliminary Exam ......131

Mechanical and Aerospace Engineering Plan of Study .........................................133
What we do
From recruitment and admission to degree conferral and graduation, our office provides many services for new and continuing graduate students. As you navigate toward degree completion, our main function is to provide personal and academic counseling and advice for you. We also collaborate with the various departments on many student-related issues. Our office serves as the final school-wide approval for petitions, advancements to candidacy, degree conferrals, and other processes. (Overall, we are your first point of contact for any and all questions you may have.)

We have an open-door policy, so please feel free to stop by anytime Monday through Friday between 8:30am – 12:00noon and 1:00pm – 4:30pm. If you have an in-depth issue to discuss and would like to schedule an appointment, please feel free to do so by calling the main Student Affairs Office at (949) 824-4334.

While our staff is cross-trained to advise students across all of our departments and programs, each does have her own primary area of advisement. Please see below for details.

Our Staff:
Primary Advisor for students in Electrical Engineering and Computer Science (EECS), Mechanical & Aerospace Engineering (MAE), and Networked Systems (NTWS – admissions):

Sonja Dietrich, Director
101 Engineering and Computing Trailer
sonja.dietrich@uci.edu
(949) 824-3562

Primary Advisor for students in Biomedical Engineering (BME), Civil & Environmental Engineering (CEE), Chemical Engineering and Materials Science (CHEMS), Environmental Engineering (ENE), General Engineering (GEN), and Materials and Manufacturing Technology (MMT):

Claire Goldsby, Graduate Counselor
101 Engineering and Computing Trailer
claire.goldsby@uci.edu
949-824-6475
Again, the Graduate Student Affairs Office offers general counseling during your graduate school career. However, all departments have their own requirements and programs of study. Therefore, it is also important for you to meet with your Faculty Graduate Advisor on a regular basis to ensure your completion of departmental degree requirements.

**Departmental and Program Contacts**

**Departmental Graduate Coordinators**

Each department has its own Graduate Coordinator. These staff members serve as your departmental contact for questions regarding funding and forms processing. They also provide exception memos and serve as a liaison with the Departmental Faculty Graduate Advisors and with our office.

The HSSoE Graduate Coordinators are:

<table>
<thead>
<tr>
<th>Department</th>
<th>Coordinator</th>
<th>Email</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME:</td>
<td>Karen Stephens</td>
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<td>(949) 824-7984</td>
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<td>(949) 824-6475</td>
</tr>
</tbody>
</table>
Faculty Graduate Advisors

The Graduate Advisor is a faculty member in a particular department who serves as the official representative of the Graduate Dean in matters affecting graduate students in his or her department. A close working relationship is established between the Advisor, the Graduate Student Affairs Office and the Graduate Division. The Graduate Dean is dependent upon the experience and judgment of Graduate Advisors, and upon their recommendations, in matters requiring the Graduate Dean's action. The Graduate Division staff and the Graduate Student Affairs staff provide information to the Advisors on a continuing basis and respond to requests for special assistance.

The Faculty Graduate Advisors are responsible for supervising graduate study in their department and for helping graduate students make connections with individual faculty advisors and mentors. In many academic units, the advisor is instrumental in the appointment and supervision of graduate student Teaching Assistants, Associates, Readers, and Tutors.

In our school, there is also an Associate Dean for Student Affairs, John LaRue, who oversees many of the functions which affect graduate students. Dr. LaRue works in conjunction with the Dean of Graduate Division, department chairs, and the Graduate Student Affairs Office.

The current HSSoE Graduate Advisors are:

BME: Frithjof Kruggel fkruggel@uci.edu
CBE: Vasan Venugopalan vvenugop@uci.edu
CEE: Maria Feng mfeng@uci.edu
EECS: Payam Heydari payam@uci.edu
ENE: Bill Cooper wcooper@uci.edu
MAE: Feng Liu (admissions) fliu@uci.edu
         Donald Dabdub (continuing students) ddabdup@uci.edu
MMT: Chin Lee cclee@uci.edu
MSE: Martha Mecartney martham@uci.edu

You may have been granted an "initial technical advisor" upon admission. That particular professor is the coordinator of the specific area of research you may be interested in. You can select a new advisor once you are further along in your program of study. You should discuss this with your department's graduate advisor.
Selecting a Research Advisor

Some of you will arrive at UC Irvine without a research advisor. This is quite common, especially for Ph.D. students who must first complete their M.S. degrees. It is also common for international students. Here are some tips on selecting a research advisor:


2) Navigate through your department's listing of faculty.

3) Look for the faculty profiles and review them.

4) Look for buzzwords and research activities that may be aligned with your research interests.

5) Once you see some that might be of interest to you, contact them via email. You might need to actually find them in their labs and personally ask if they would entertain the possibility of you working with them. You might want to have a curriculum vitae (resume) available, detailing your research and work experience, presentations, publications, and poster sessions. This will help the professor determine if your experience would be beneficial to his or her lab.

6) Ask professors in class if they could be your research advisor or if they know of anyone in the department who would be a good fit for you.

7) Ask your department's Graduate Advisor for advice on selecting a research advisor. Your Graduate Advisor might know of possibilities.

Securing Financial Support

Some of you may arrive at HSSoE without a funding source. Funding at the M.S. level is very limited, and you will need to contact your department's Graduate Advisor for more information. Funding at the Ph.D. level is more prevalent, but is competitive. The process may involve contacting various professors in your department and area of interest on your own. They will not be contacting you! A suggestion is to peruse the school's website for faculty profiles and then email or meet with faculty if the research they are doing matches your own research background and interest. When contacting them ask about available Graduate Student Researcher (GSR) positions. This might take some time. You can also apply to be a Teaching Assistant (TA); however each department has its own process. You will need to contact your department's Graduate Coordinator for this information or the Coordinators in other departments throughout the campus.
Milestones toward Degree Completion

Major Steps toward the M.S. degree

Meet with Graduate Advisor/Graduate Student Affairs Counselor/Graduate Coordinator to discuss program and plan schedule

↓

Begin Coursework

↓

Fill out departmental Program of Study Form

↓

Comprehensive Exam students: complete all coursework and seminars

↓

Thesis students: select a committee chair, select committee members, register for M.S. thesis research

↓

Turn in Advancement to Candidacy Form for the M.S. degree form at least one quarter before you plan to graduate

↓

Turn in Diploma and Commencement Form at the same time you turn in Advancement Form

↓

Comprehensive Exam students: complete coursework and final examination, paper, project, or other assignment as determined by your department or program

↓

Thesis students: complete and defend thesis, submit to University Archives

↓

M.S. degree conferred
Major Steps toward the **Ph.D.** degree

*(If earning M.S. along the way, follow path to M.S. degree above)*

If you already have an M.S. degree when entering, complete departmental coursework necessary to be proficient for preliminary exams (some departments require post-M.S. coursework), if applicable, begin Ph.D. research.

- Select a research advisor, usually by the second quarter of program
- Take preliminary exam, usually at the end of your first year
- Continue Ph.D. research
- Prepare proposal to be reviewed for qualifying examination
  - Select committee members and submit Nomination Form for Qualifying Committee
  - Take qualifying examination, select your doctorate committee, and submit Ph.D. Form I
    - Continue Ph.D. research
  - Present final dissertation defense, fill out Ph.D. Form II and submit
    - Submit manuscript to University Archives
  - Ph.D. Degree conferred
There are many rules, regulations, and policies that surround graduate students time in their degree program. It is important to consult these policies before making decisions about a leave of absence, part-time study, committees, etc. It is also important to be aware of the standards surrounding grading and satisfactory progress to degree. While all rules, regulations, and policies of graduate study are outlined below, we have added boxes around those that come up most frequently. Please contact the Graduate Student Affairs Office with any questions or for guidance.

ENROLLMENT AND REGISTRATION POLICIES:

STUDENT STATUS

A. Academic Residence Requirements

1. Academic Year

According to University of California academic policy, a graduate student is considered to be in residence during an academic quarter only if at least four units of academic credit are earned in regular upper-division undergraduate or graduate-level courses. Except in rare cases, no graduate student will be recommended for any degree that has not completed at least one year of residence.

2. Summer Session

For a candidate for a doctorate degree, and in accordance with UC regulations, residence during a summer session may be counted only under either of the following conditions: (1) enrollment in two consecutive six-week summer sessions, which counts as one term of residence provided you are enrolled in each session for the equivalent of at least two units of upper-division and/or graduate-level coursework as given in a regular term; or (2) enrollment in an eight-week summer session, which counts as one term of residence provided you are enrolled for the equivalent of at least four units of upper-division and/or graduate work as given in a regular quarter. For a candidate for a Master's degree, the same basic criteria apply except that the two six-week summer sessions need not be consecutive.
3. California Residency for Tuition Purposes

All new graduate students, and students returning from an academic leave of absence, are required to complete and submit a *Statement of Legal Residence* to UCI's Registrar's Office to determine their official residency status. Questions about California residence and out-of-state tuition fees should be directed to the UCI Residence Deputy in the Registrar's Office at (949) 824-6129 or res-dep@uci.edu. More information about California Residency for Tuition Purposes is available at http://www.reg.uci.edu/registrar/residence.

B. Enrollment Policies and Procedures

1. Late Enrollment

If you enroll after the second week of classes, you will be assessed a late registration fee. You must complete the Late Registration Authorization form and get it signed by your department's Graduate Advisor, and then by the HSSoE Graduate Student Affairs Office. The signed form must be brought to the Graduate Division for approval by the Graduate Dean. Without the approval of the Graduate Dean, you will not be permitted to enroll in classes. (http://www.rgs.uci.edu/grad/students/forms.htm)

**IMPORTANT NOTE:** The campus' budgetary allocation in support of graduate education is calculated on the basis of Full-Time Equivalent (FTE) enrollment at the end of the third week of the quarter and for three years following advancement to candidacy. Therefore, students are strongly encouraged to register no later than the end of the third week of classes. Failure to do so will result in reduced student funding for UCI.

2. Full-Time Enrollment/Registration

Full-time academic registration is generally expected of all graduate students at the University of California. Full-time registration is defined as 1) payment of applicable University fees; and 2) enrollment in at least 12 units of upper-division or graduate-level academic coursework in a given quarter, including credit for supervised research or teaching occurring during the academic year. During the summer, full-time registration is defined as payment of applicable University fees and enrollment in at least six units of upper-division or graduate-level academic credits. However, continuing UCI graduate students are generally considered to be enrolled students between successive spring and fall quarters. Graduate students may enroll in lower-division courses with the approval of their faculty academic advisor, but such courses are not considered to be part of any graduate program and will not count toward satisfying degree requirements. **Full-time academic registration during regular academic quarters is required of all graduate students holding University-administered fellowships.**

**Course Load Limitations:** Graduate students should not enroll for more than 12 units per quarter in graduate-level coursework, or 16 units in upper-division courses, or a proportionate number in combination. Course loads in excess of 16 units of graduate-
level and/or upper-division credit must be approved in advance by the student's Graduate Advisor, and written notification must be sent by the Faculty Graduate Advisor to the Graduate Dean, via the Graduate Student Affairs Office. If you plan to take more than twelve units during a given term, please contact the Graduate Student Affairs Office. We must clear this registration restriction in your account on the computer.

3. Part-Time Enrollment/Registration

In most instances, completion of an advanced degree at UCI requires full-time study. However, UCI recognizes that a legitimate need may exist for part-time study, and, therefore, is committed to increasing these opportunities whenever academically feasible. Principally, part-time status applies to enrollment in part-time master's degree programs. In some cases the Graduate Dean will approve part-time status for terminal (i.e. not continuing on for Ph.D. studies) master's degree candidates and students in credential programs, where part-time study has been judged academically feasible by the faculty.

On the recommendation of the academic unit, students admitted to a Ph.D. program may be approved by the Graduate Dean for part-time status on an ad hoc basis for up to three consecutive quarters. Requests for part-time status must be submitted in writing to the Graduate Dean and signed by the Departmental Faculty Graduate Advisor and the Associate Dean for Student Affairs. See Guidelines to Establish Part-Time Eligibility below for details on how to request part-time status.

UCI policy defines part-time enrollment at the graduate-level during the academic year as enrollment in one to eight units, including enrollment in Physical Education classes. Within the guidelines and limitations listed below, you may petition for part-time status. If approved, you must pay UCI the full Registration Fee, all student activities fees, health insurance (i.e., GSHIP) fees, one-half the prevailing Educational Fee, and one-half the Non-resident Tuition Fee (if applicable). Non-residents who have advanced to candidacy, and are already receiving a reduced tuition rate, will not receive any additional reductions in their tuition costs.

a. Guidelines to Establish Part-Time Eligibility

1) The student must meet the standards for part-time study as described in this document.

2) A completed Petition for Reduced Fee Program for Part-Time Study, approved by the Departmental Faculty Graduate Advisor and Associate Dean in the HSSoE Graduate Student Affairs Office, and, if a doctoral student, a memo from the Graduate Advisor in support of the request must be submitted to the Graduate Division. The memo of support should be a self-explanatory document, in that it should include sufficient detail to allow the Graduate Dean to evaluate independently the need for, and feasibility of, part-time status for the graduate student. The minimal elements to include in the support memo are:

   a) a brief explanation of the motivation for the part-time status request
   b) a statement of how part-time status might impact the student's progress toward
degree, and steps to be taken to minimize any negative impact; and

c) an indication of when part-time status would, if approved, begin and end (e.g., Fall 2008 - Spring 2009).

3) To be effective for that academic quarter, the petition must be received by Graduate Division for approval by the Graduate Dean no later than the Wednesday morning of the third week of classes. **There are no exceptions to this deadline.**

*b. Part-Time Limitations and Related Policies*

1) **Purpose:** Approval of part-time enrollment status may be granted only for reasons of occupation, family responsibilities, health, or professional development.

2) **Citizenship:** Ordinarily, graduate students who are not citizens or permanent residents of the United States are not eligible for part-time enrollment because of overriding federal regulations governing student visa status. Please contact the UCI International Center for further information. International students who are eligible to petition for part-time status are required to obtain written approval by the UCI International Center (http://www.ic.uci.edu) prior to submitting a request to the Graduate Division.

3) **Fellowships:** All University fellowships require full-time enrollment in graduate-level courses. For extramural fellowships, you must refer to and adhere to the individual agency guidelines established by the sponsor.

4) **Academic Appointments:** Part-time status may affect academic appointments/employment. Please see your department for more information.

5) **Student Loans:** All students considering applying for part-time status should be cautioned that, in most instances, they will no longer be eligible for deferment of student loan repayment obligations. It is your responsibility to discuss the matter with your loan agency.

6) **Student Housing and Other Services:** Part-time status may affect eligibility for student services, including student housing. If you live on campus and are considering part-time status, please check with the Housing Office.

7) **Maximum Time:** Petitions for part-time status may be requested for the current academic year only and will lapse automatically at the end of the spring quarter unless terminated earlier. You must reapply each year for approved part-time status by submitting a new petition prior to the fall quarter or subsequent quarter's deadline. The deadline is always the Wednesday morning of the third week of classes.

8) **Enrollment Limits:** If the student exceeds the approved part-time enrollment limit of eight units at any point in any quarter for which part-time status is requested and approved, the student will be billed by UCI for the balance of the respective quarter's
full-time student fees (including non-resident tuition, if applicable) and will not be
permitted to register for a subsequent quarter until those required fees are paid in full.

4. Lapse of Status: Did Not Enroll

At UCI, graduate students are expected to remain continuously enrolled in their degree
program while progressing toward their degree. Students who have failed to maintain
their graduate student status will be notified in writing by the Graduate Dean. A Lapse of
Status will occur under any of the following conditions:

a) If you fail to register (i.e., pay fees and enroll in units) by the last week of
   instruction in a given quarter.

b) If an academic leave of absence, or permission to pay the Filing Fee in lieu of
   registration, has not been submitted and approved by the student's department and
   Graduate Division.

c) If you fail to comply with any provisions of admission to UCI.

Notification of lapse of student status will be sent to the student and the academic unit at
the end of the quarter in which one of these conditions applies. Students wishing to re-
enroll retroactively must provide to the Graduate Division a written request signed by
their Department Chair/Program Director and Associate Dean for Student Affairs
requesting reinstatement and justifying the request for change in student status. Approval
of such requests is rare and is given under exceptional circumstances only. In most cases,
students wishing to re-enroll will be required to submit a new Application for Graduate
Study.

5. Lapse of Status: Readmission

Prior to resuming graduate study at the University, a student who previously withdrew, or
who failed to meet the continuous registration requirement, must request readmission
from the Graduate Division by submitting a new Application for Graduate Study with the
full, non-refundable application fee applicable at that time. However, graduate students
who were not enrolled within the previous two years should submit, in addition to the
completed application form, an updated statement of purpose, and transcripts covering all
academic work since their last enrollment at UCI. Further, students applying to a
different program must also submit current letters of recommendation.

Readmission of former UCI graduate students without academic standing may be granted
only by the Graduate Dean and only upon recommendation by the academic unit. If
readmitted, a student’s previous academic work may be applied toward the requirements
for an advanced degree only with the approval of the faculty Graduate Advisor and the
Graduate Dean. A readmitted student must satisfy the academic requirements in effect at
the time of readmission and will be required to satisfy certain requirements a second
time, including formal advancement to candidacy. A readmitted student will also be
expected to complete at least one additional academic quarter in residence before
receiving an advanced degree, which will be conferred no earlier than the second quarter following readmission.

6. Enrollment in University Extension through ACCESS UCI

If you wish to enroll for credit in a University Extension course through ACCESS UCI while registered or while on an approved Leave of Absence, your proposed program of study must be approved in advance by the Graduate Dean with the written recommendation of your faculty advisor. Go to the Extension website for more information on registering for a course through ACCESS UCI: http://unex.uci.edu/courses/access_uci/

7. Withdrawal

a. Withdrawal between Quarters

If you plan to withdraw after completing all academic work for the latest quarter of enrollment, but prior to enrollment and fee payment for the subsequent quarter, you should submit a written notice of intent to your department and the Graduate Division as soon the decision to withdraw has been made. You have two options in such cases: (1) to file a Cancellation/Withdrawal form with the Graduate Division; or (2) to apply for an academic leave of absence http://www.rgs.uci.edu/grad/students/forms.htm. A student in good academic standing who intends to re-enroll after missing no more than three consecutive quarters may wish to choose the latter to avoid a lapse of student status and the necessity to apply for readmission.

b. Withdrawal after Enrollment and Fee Payment for a Quarter

A student who decides to leave the University after paying fees and enrolling for a regular academic session, but before the end of that quarter, and who wishes to cancel enrollment in all classes enrolled, must file the Cancellation/Withdrawal form with the Graduate Division. If you are unable to do so in person because of emergency or serious illness, you should notify Graduate Division by mail or e-mail (ogsfront@uci.edu) as soon as possible so that timely assistance may be provided. Failure to do so will result in the assignment of failing grades in all courses in which the student is enrolled, and will jeopardize further academic standing.

c. Withdrawal without Approved Academic Leave of Absence

A student who withdraws, but has not been granted an academic leave of absence by the Graduate Dean, must apply for readmission in order to resume graduate study at UCI. Requests for readmission require submission of an Application for Graduate Study along with the non-refundable application fee in effect at that time. However, graduate students who were not enrolled within the previous two
years should submit, in addition to the completed application form, an updated statement of purpose, and transcripts covering all academic work since their last enrollment at UCI. Further, students applying to a different program must also submit current letters of recommendation.

A request for readmission may be approved by the Graduate Dean upon recommendation by the academic unit. If readmitted, a student’s previous academic work will be applied toward satisfying the requirements for an advanced degree only with the written approval of the faculty Graduate Advisor and the Graduate Dean. A readmitted student must satisfy the academic requirements in effect at the time of their readmission, and will be required to satisfy certain requirements a second time, including formal advancement to candidacy. A readmitted student will be expected to complete at least one additional academic quarter in residence before receiving an advanced degree, which will be conferred no earlier than the second quarter following readmission.

C. Registration Policy

1. Continuous Registration Policy

A graduate student is expected to register for each regular academic session (Fall, Winter, and Spring quarters) until all requirements for an advanced degree or credential have been completed, including final examinations and the submission of an approved thesis or dissertation. Registration at UCI consists of two separate steps: 1) payment of applicable student fees; and 2) enrollment in at least one unit for graduate support recipients and six units for financial aid recipients. Both steps, payment of fees and enrollment in classes, must be completed for you to be officially registered. Registration may be accomplished either in person or through WebReg (http://www.reg.uci.edu/registrar/soc/webreg.html). The option to enroll in classes through WebReg is available through the second week of classes only. Beginning the third week of classes, Add/Drop/Change cards must be used to enroll.

2. Registration Procedures and Prerequisite Waivers

Detailed registration procedures are outlined on the registration website, published quarterly, via http://www.reg.uci.edu/registrar/soc/rgt.html. You are personally responsible for ensuring that your course enrollment is correct and completed, and have your fees paid, no later than the end of the third week of each quarter. Unless granted an official Academic Leave of Absence or approval to pay the Filing Fee in lieu of registration, a graduate student who does not register (pay fees and enroll in classes) for any quarter by the end of the third week will be considered to have withdrawn from the University, and their respective fee assessment will be cancelled by the Registrar. In such cases, student status and candidacy for any degree will lapse, and any student wishing to continue with their graduate studies at UCI will be required to apply for readmission.
Graduate students are permitted to register for upper-division undergraduate courses and have them count toward their elective units for their degrees. *Please note that each department and program has different standards for how many of these units are acceptable. Specific requirements are listed in the course catalogue.* Most likely, you will need to have the prerequisite for the undergrad course or courses waived. The Graduate Student Affairs Office can help you with this procedure. You will need to provide the course number, five-digit section number, and your student id number, and we can help you with the pre-requisite waiver.

3. In-Absentia Registration (http://www.rgs.uci.edu/grad/students/forms.htm)

In accordance with UCI policy, a student engaged in graduate study or research outside the State of California for an entire quarter or more is eligible to request that he/she registers *In-absentia*. A student may request approval for *In-absentia* status for up to three consecutive quarters. To continue after a third consecutive quarter on *In-absentia* status, however, the student must reapply (by submitting a new *In-Absentia Registration* request form) before the beginning of the next quarter for which *In-absentia* status is sought. While on *In-absentia* status, policy normally requires students to enroll in 12 units (typically for dissertation research or independent study courses), and pay the required quarterly fees. However, there is a fee reduction of one-half the prevailing registration fee portion of total fees while on *In-absentia* status. Students registering *In-absentia* pay the full educational, health insurance (i.e., GSHIP) and other local fees. The procedures for enrolling are the same as for regular students who are in-residence on campus. If *In-absentia* registration is approved by the academic department, the school, and the Graduate Dean, the Graduate Division will send notice of an In-Absentia Waiver to the UCI Student Billing System. The student will then be billed for the fees due, with the Waiver appearing on the student’s Zotbill as a credit. It is the student’s responsibility to ensure fee payment by the deadline established by the Registrar and published on the registration website.

If the student will be *In-absentia*, and enrolled in 8 or fewer units for the quarter(s) in question, the student may also consider applying for part-time study status. Within the guidelines and limitations outlined on the UCI Petition for Reduced Fee Part-Time Study Program form and Graduate Division Policy, graduate students may petition for part-time status. On the recommendation of the academic unit, students admitted to a Ph.D. program may be approved by the Graduate Dean for part-time status on an *ad hoc* basis for up to three consecutive quarters. If approved, you shall be subject to the same fee circumstances as outlined above, with the exception that you shall be assessed only one-half of the Educational Fee, and, if applicable, only one-half of the Nonresident Tuition Fee or Professional School Student Fee. It is your responsibility to submit all applications and petitions in a timely manner to ensure that your fees are assessed appropriately and prior to all deadlines.
4. Academic Leave of Absence (LOA)
(http://www.rgs.uci.edu/grad/students/forms.htm)

A student is expected to enroll for each regular academic session unless a formal Academic Leave of Absence is granted. A Leave of Absence may be granted for up to one academic year (3 quarters) if, following review of the student's academic record, it is deemed consistent with the student's academic objectives and progress toward degree. Written approvals are required of the Faculty Graduate Advisor, the HSSoE Associate Dean for Student Affairs and the Graduate Dean using the LOA form. If you decide to take a leave of absence, it is important that your application be submitted to the Graduate Dean (120 Administration/Aldrich Hall) prior to the beginning of the quarter for which approval is sought, so in case your application is not approved, you will be able to enroll prior to the deadline. If an Academic Leave of Absence request was approved and the student subsequently becomes ineligible for LOA status (e.g., GPA falls below 3.0 in the quarter prior to leave), approval for LOA status will be rescinded.

The student who will be absent from the campus while continuing to pursue graduate research outside the State of California should register In-absentia, as described above. The student who must leave the academic program for more than three quarters should withdraw and apply for readmission at the time he or she expects to resume graduate study at UCI.

a. Purpose

An Academic Leave of Absence is intended to cover the temporary interruption of the student's academic program. The reason(s) for requesting an LOA must be consistent with University policy and guidelines as outlined below, and with the student's academic program guidelines.

b. Eligibility Guidelines

A leave may be granted when a student plans to be away from the University of California for one of the following reasons:

1) Serious illness or other temporary disability.
2) Enrollment at another educational institution outside the state of California.
3) Concentration on an occupation not directly related to the student's academic program.
4) Responsibilities related to family obligations.
5) Temporary interruption of the student's academic program for other appropriate reasons.

c. Limitations to LOA

Leave of Absence policy does *not* apply under the following circumstances:
1) If a student will be absent from the campus and outside California while continuing to pursue graduate research or scholarly activity. (Students engaged in such activity outside California must register *In-absentia*.)

2) If a student must leave the academic program for more than three quarters. Under such circumstances students should withdraw and apply for readmission at the time he/she expects to resume graduate study at UCI.

3) If a student requests such action retroactively.

4) If a student has not completed at least one quarter of graduate study at UCI.

5) If a student has not demonstrated satisfactory academic progress.

**NOTE:** An Academic Leave of Absence may be terminated at the written request of the student before the end of the approved leave period. However, approval by exception is required if the student will register after the second week of instruction, if the student who has not attained the academic objective for which he/she was admitted, and who either fails to enroll or secure a formal leave, loses all graduate student standing in the University.

d. Procedures for Requesting an Academic Leave of Absence

(http://www.rgs.uci.edu/grad/students/forms.htm)

A request for a Leave of Absence requires submission of a Graduate Division Academic *Leave of Absence* form. The form should be submitted to Graduate Division (120 Administration/Aldrich Hall) prior to the registration deadline for the quarter requested. There is a grace period through the end of the second week of classes. A request for leave submitted after the end of the second week of classes will be granted by exception only. In such cases the department must submit a letter of exception attached to the LOA form, and signed by the department Faculty Advisor or Chair and Associate Dean for Student Affairs, as applicable. In those cases where the fees have been paid, a *Cancellation/Withdrawal* (C/W) form, available from the Registrar's Office or Graduate Division must also accompany the *LOA* form in order to obtain a refund. If the leave is not approved, the forms must be submitted prior to the registration deadline for the quarter requested in order to avoid payment of late registration fees.

e. Other Policies Relevant to LOA

1) **Academic Appointments and Employment:** If you are on an approved leave, you may not be employed by the University of California in any capacity unless you submit a request for an exception, which must be approved by the Graduate Dean or Associate Graduate Dean, following consultation with Human Resources or Academic Personnel, on a case-by-
2) **Degree Requirements:** A student on leave cannot take qualifying examinations for advancement to candidacy or final examinations for the degree, nor pursue their graduate studies on the UCI campus in any other manner. A student may not receive academic credit for work done at another institution during the leave period unless an exception is approved in advance by the Graduate Dean following recommendation of the academic unit.

3) **Fee Refunds:** If fees have been paid for the quarter the leave is requested, the LOA form, as noted above, must be submitted together with a Cancellation/Withdrawal (C/W). Students must indicate on the C/W form, under Reason for Withdrawal, “LOA”. The refund schedule is printed on the back of the C/W form. The effective date for the refund is the date the form is submitted to the Graduate Division.

4) **Filing Fee Restriction:** Immediately following a LOA, students must register for full-time studies. They will not be eligible to be on Filing Fee status.

5) **Financial Support:** While on an academic leave of absence, you are not eligible for University fellowships, University research grants, or financial aid support. In addition, you will, in most cases, lose eligibility for deferment of student loan obligations. It is your responsibility to contact your loan agency to verify your loan status before applying for academic leave of absence.

6) **Health Insurance:** A student on leave will not be covered by the graduate student health insurance (GSHIP) program unless the student self-pays for continued coverage. Students should contact the GSHIP administrator for more information.

7) **Housing:** Leave of absence status may affect eligibility for student housing. If you live on campus and are contemplating an academic leave of absence, you should check directly with the Housing Office for more information.

8) **International Students:** In accordance with visa restrictions, a student who is not a permanent resident or citizen of the U.S. is not permitted to take an academic leave of absence. Any exception to this policy requires written approval by UCI's International Center as indicated on the LOA form. Following receipt of such approval the form must then be submitted to the Graduate Division.

9) **Library Privileges:** A student on leave will lose library privileges. Students should contact the library for more information. In some cases, special arrangements can be made with the library to maintain privileges.

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5. **Filing Fees** (http://www.rgs.uci.edu/grad/students/forms.htm)

UCI's policy on Filing Fees applies to students who have completed all requirements for a terminal Master's or Doctoral degree and are ready for the formal submission of their thesis or
dissertation, or the final, formal examination. The Filing Fee status can be used for one quarter only during the student's graduate training. Students applying for Filing Fee status must be registered in the preceding academic session. A Filing Fee will not be accepted immediately following an academic leave of absence. Only in very rare cases will an exception be considered by the Graduate Dean.

a. Procedures for Establishing Eligibility for Filing Fee Status

To establish eligibility to pay the Filing Fee, you must submit a Graduate Division Filing Fee Petition. The Petition must be approved by the departmental Graduate Advisor and the Chair of your thesis or doctoral committee and must certify that all other requirements for the degree have been met. You also need to obtain the signature of the Associate Dean for Student Affairs from the Graduate Student Affairs Office. International students, in addition, must secure approval from the International Center to go on Filing Fee status. It is important that applications for Filing Fee be submitted to the Graduate Dean at the very beginning of the quarter for which approval is sought so that, if your application is not approved, you will be able to enroll prior to the budgetary deadline.

The completed Filing Fee form should be brought to the Cashier's Office with a check made out for one-half of the Registration Fee (the registration website will list the current fee information). The form should then be submitted to the Graduate Division for final approval/processing.

b. Limitations on Use of University Services While on Filing Fee Status

While on Filing Fee status, you may seek faculty involvement for a final reading of your dissertation or thesis. A student may also take the final oral examination. However, you may not pay the Filing Fee if you are still doing research or if any other use of University facilities or faculty time is anticipated. Additional restrictions while on filing fee status include the following:

1) Loss of eligibility for University administered financial assistance.
2) Loss of student services such as health services, including health insurance (GSHIP). Students may, however, arrange to self-pay.
3) Loss of student housing or library privileges. Students are encouraged to contact the Housing Office and Library for more information.
4) Loss of eligibility status for UCI academic or student appointments.
5) Loss of eligibility in most cases for deferment of student loan repayment obligations. It is the responsibility of the student to contact their loan agency to verify their loan status before applying for filing fee status.

If, after paying the Filing Fee, you should find it necessary to use the educational facilities of the University in any way other than those described in this section, you must register for fulltime status. Further, if all requirements are not completed
during the quarter for which the Filing Fee was paid, you must register for full-time status for any subsequent quarter.

6. Terminal Master's Students

Students pursuing a terminal master's degree may not continue to register as a graduate student subsequent to a degree award unless formally admitted to a doctoral program. Engineering M.S. students who were not admitted as a Ph.D. student earning an M.S. along the way must submit the Change of Degree Status form. Two letters from departmental professors, a new statement of purpose and signatures indicating departmental support must accompany the form.

D. Tuition Reduction for Non-Resident Doctoral Students (International Students)

Non-resident doctoral students who have advanced to candidacy are eligible for reduction in the annual nonresident tuition fee of 75% for a maximum of three consecutive calendar years including time on leave of absence. Reduced non-resident tuition begins with the first academic term following advancement to candidacy, and is based on the prevailing tuition rate for the year it is applied. Any non-resident student who continues to be registered, or who re-registers following the three-year maximum allowance, will be charged the full non-resident tuition rate that is in effect at that time of enrollment.

1. Eligibility Criteria

A registered Ph.D. or professional doctoral student who meets all the following criteria is eligible for reduced non-resident tuition:

a. Classification as a non-resident for tuition purposes.
b. Registration in a doctoral program or professional doctoral program that has an advancement to candidacy requirement; AND
c. Approval by the campus to be advanced to doctoral candidacy as of the first day of the academic term, as determined by the campus, for which the reduced tuition is assessed. In order to meet this last requirement, the student must have advanced the quarter prior to receiving any tuition reduction.

2. Related Policies

a. Eligibility for the reduced non-resident tuition following advancement to candidacy is measured in calendar years and ends three calendar years later.

b. Non-resident tuition reduction will normally not be extended if a student fails to enroll for any regular academic quarter during the three-year period, and will not be granted simply because a student does not register during that period. A request for an extension must be approved by the Graduate Dean but would be
E. Intercampus Exchange Program

1. What is Intercampus Exchange?

Through the Intercampus Exchange Program, you may take advantage of unique educational opportunities at another University of California campus. You may also take courses on more than one campus of the University in the same academic session. The program is reserved for those students whose graduate study may be enhanced by work with distinguished faculty or use of facilities and resources accessible only on another UC campus.

2. Eligibility for Intercampus Exchange

You must have completed at least one quarter of graduate study in the University and be in good standing to be eligible to apply for Intercampus Exchange. Approvals by the departmental graduate faculty advisor, the host department(s), and the Deans of the respective graduate offices are required.

ACADEMIC STANDARDS FOR STUDENTS

A. Progress toward Degree

1. Satisfactory Progress
A graduate student is expected to maintain satisfactory progress toward an approved academic objective as defined by the faculty of the program, and in accordance with policies of the Graduate Council and the University. It is important that your academic record be assessed each quarter to confirm satisfactory progress. Satisfactory progress is determined on the basis of both the student's recent academic record and overall performance. Criteria for determining satisfactory progress toward degree is outlined below. Student records should be reviewed with special attention to the following criteria:

• **GPA** - the student must maintain at least a 3.0 cumulative grade point average.
• **Grade Reports** - all I, W, or NR grades should be reviewed and appropriate action taken as needed.
• **P/NP** - no courses graded "Pass" are to be included as part of the advanced degree program, nor are they to be considered as satisfying academic criteria for University-administered fellowships and academic appointments/employment.
• **Enrollment Units** - students must be enrolled for at least 12 graduate or upper-division units of credit each quarter, including credit for supervised teaching and research, unless part-time status or an academic leave of absence has been approved in advance by the Graduate Dean. In cases of approved part-time status, enrollment for up to eight (8) units of credit toward the degree is expected each quarter.
• **Distribution of units** - the number of upper-division and graduate-level units of credit completed toward degree requirements each quarter should be at least eight and no more than 16, unless an exception has been approved in advance.
• **Residency** - time in residence prior to advancement to candidacy for the Ph.D. or professional doctorate degree should be within acceptable limits (ordinarily, no more than four years).

2. Unsatisfactory Progress

A graduate student who has not demonstrated satisfactory progress is not eligible for any academic appointment/employment and may not receive fellowship support or other award that is based upon academic merit.

a. **Criteria for Determining Unsatisfactory Progress**

• An overall grade point average below 3.0; or
• A grade point average below 3.0 in two successive quarters; or
• Fewer than 24 units completed and applicable toward the advanced degree requirements in the last three quarters; or
• Failure to complete required courses or examinations satisfactorily within the period specified by the graduate program; or
• Failure to pass a required examination in two attempts; or
• The appropriate faculty committee's evaluation that there has not been satisfactory progress toward completion of the thesis or dissertation.
• Written notification from the student's research advisor citing lack of evidence toward research goals and that the student has been given due process.
NOTE: Unsatisfactory academic progress may be determined on the basis of explicit requirements such as those outlined above. However, the professional judgment of the faculty, upon review of all graduate work undertaken by the student, is paramount.

3. Academic Disqualification

Students who are making unsatisfactory progress will be placed on Academic Probation for 2 quarters. If the student does not meet the terms of his/her academic probation, after consultation with the student's academic unit, the Graduate Dean may disqualify a student because of unsatisfactory academic progress as described by any of the factors noted in this section. Graduate students are officially disqualified only by the Graduate Dean. However, if a department has determined that a student who has been admitted to a Ph.D. or other professional doctoral program should receive a terminal Master's degree, the department must notify the student in writing that he or she will not be allowed to continue for the doctorate degree. Further, the student must give written permission to have his/her degree objective changed officially from doctorate to master's.

Upon recommendation of academic disqualification by the graduate program, the student's academic record is reviewed carefully by the Graduate Dean in consultation with the student's faculty Graduate Advisor. Unless there are indications of procedural error or other substantive mitigating factors to explain the student's record, the Graduate Dean will notify the student of the impending action in writing, and will provide a reasonable opportunity for the student to correct erroneous or outdated academic records, to submit other information or comments in writing, or to request a second review of academic performance.

B. Graduate Standards for Grading

For a graduate student, only the grades A+, A, A-, B+, B, and S represent satisfactory scholarship, and only course work in which these grades are received may be applied toward degree requirements (see 2, Academic Unit Exceptions, below). If the student has a grade point average of at least 3.0 in all courses applicable to the degree, one UCI course in which a grade of B- is earned may be accepted by the petition process in partial satisfaction of the degree requirements. However, the Electrical Engineering & Computer Science and Biomedical Engineering departments are very strict about the B- exception, and only allow certain courses to be counted under this policy, with no core classes being counted with a B-. If you are an EECS or BME student, please check with your department's Graduate Advisor and in the catalogue under the Electrical Engineering & Computer Science and Biomedical Engineering graduate programs section for more details. Graduate students may not apply courses graded Pass/Not Pass toward any degree or satisfactory progress requirements. A grade point average below the B level (3.0 on a 4.0 scale) is not satisfactory, and a student whose grade point average is below that level is subject to academic disqualification. The minimum grade point average standards, as stated in this manual, are minimum UCI requirements. Individual academic unit faculty members retain the prerogative to apply stricter standards for graduate students within their academic unit.
1. Course Repetition

Courses in which a grade below a B, or a grade of U, was received may be repeated only once. Only the most recently earned grades will be used in computing the student's grade point average for the first eight (8) units of repeated graduate course work. Thereafter, both the earlier and later grades will be used.

2. Pass/Not Pass (P/NP)

The grade Pass (P) is applied to undergraduate coursework only. It is equivalent to C level work or better, and does not represent satisfactory scholarship for a graduate student. The grade P is not considered as meeting the academic criteria for satisfactory progress, for university-administered fellowships, or for academic appointments/employment. If a graduate student chooses the option of P/NP grading, it is assumed that the course is an elective that does not have any significant relationship to the student's progress in the graduate program. A graduate student may elect P/NP grading for one course only (a maximum of 4 units) per quarter. Under no circumstances will courses taken P/NP count toward unit and degree requirements for any graduate degree program.

3. Satisfactory/Unsatisfactory (S/U)

A grade of Satisfactory (S) is equivalent to a grade of B (3.0) or better. No credit is given for a course in which a grade of Unsatisfactory (U) was assigned. You cannot self-elect S/U grading. The S/U grading is assigned by the instructor and may be assigned to all participants in a graduate course. Similarly, with the consent of the academic unit involved, individual study and research or other individual graduate work may be evaluated by means of the grades Satisfactory or Unsatisfactory. NOTE: On Add/Drop cards, the options listed include "grade" or "P/NP" only. Students taking graduate or upper-division undergraduate courses that offer an S/U option, and who wish to elect the S/U option, should select the "grade" option on the card, and then make the necessary arrangements with the instructor. **It is very important that you discuss this option with your instructor. Do not assume the instructor will remember this option at the end of the quarter. Please make arrangements for S/U grading well before grades are to be assigned.**

4. In Progress (IP)

"In Progress" is a transcript notation restricted to sequential courses extending over two or more quarters, and for which use of the IP notation has been approved by the Graduate Council and the academic unit. It indicates satisfactory progress, and should not be assigned if the level or the progress of the work to date is not satisfactory. Upon completion of the last quarter of the course sequence, the grade for the final quarter is assigned for all quarters of the sequence. No course credit is given until the student has completed the entire sequence. If a student who was assigned the provisional notation IP for one or several quarters of a course sequence fails to complete the sequence, the
instructor may assign a final grade and request the Registrar to replace the IP with that final grade on the permanent record. In the event that no action is taken to replace the IP with a final grade, the IP will be changed to an Incomplete (I) at the end of the third quarter following the quarter in which it was originally assigned, or at the end of the quarter immediately preceding award of the degree, whichever comes first. Only quarters in which a student is enrolled will be counted in determining the time at which an IP is changed to an I.

5. Incomplete (I)

The grade Incomplete (I) should be given only when a student's work is satisfactory but is incomplete because of circumstances beyond the student's control, and when the student has been excused in advance from completing the quarter's work. The I grade should not be assigned when the student is working on a long-term project that is scheduled over more than one quarter of enrollment. In such cases, if the project is on schedule, the In Progress grade should be assigned. When no action is taken to replace an IP notation with a final grade, the IP will be changed to an Incomplete. Incompletes arising in this manner may not be replaced by another grade or notation. The grade I should also not be assigned when the student has completed no significant amount of work, or when it was unsatisfactory. The number of Incomplete grades accumulated by a student should be monitored and limited carefully, and should be removed as soon as possible. Although Incomplete grades do not affect the student's grade point average, they are an important factor in evaluating academic progress as well as in determining eligibility for employment. The maximum amount of time that an instructor may allow for making up incomplete work is three quarters of enrollment, but stricter limits may be applied. When work is completed within the time allowed, the student should ask the instructor to submit a change of grade notice to the Registrar. The general procedure is to process such requests with the approval of the Associate Dean for Student Affairs of the school in which the course was offered. If not made up within the time allowed, an "I" grade is recorded permanently. If you become ill or cannot complete a final exam or course project at the end of a quarter, you must contact your professor immediately if the only option is to receive an "I" at the time of grading. Please discuss this with your instructor to ensure timely completion of coursework requirements so the "I" grade can be removed in a timely manner.

6. No Report (NR)

The NR notation is made on a student's permanent record in those cases where the student's name appears on the official class roster but the instructor did not turn in a grade for the student. The NR notation is applied under extenuating circumstances only: specifically, if the student and instructor have not reached agreement on the work, or, if a student misses a final exam, and the instructor does not have a chance to talk with the student before grades are due. Under these circumstances, the instructor may not be able to give a grade based on the material the student has completed. A student who receives an NR transcript notation should immediately contact the instructor to arrange for the removal or replacement of the notation. The NR may be removed from the student's
record by the action of the instructor providing that the assignment of the NR was due to a clerical or procedural error. Depending on the circumstances, the instructor may request that the Registrar change the NR to a grade (including the grade Incomplete), or remove the entry for that course altogether from the permanent record. **If no action is taken to remove the NR from the permanent record after one quarter of subsequent enrollment, or at the end of the quarter immediately preceding award of the degree, whichever comes first, the NR notation will be changed to an F, NP, or U.**

7. Withdrawal (W)

The Registrar will record on a student's permanent academic record a W notation for each course the student drops at any time after the end of the sixth week of instruction in a quarter. Courses in which a W has been entered on a student's transcript will be disregarded in determining the grade point average. In general, W notations are not considered in determining a student's satisfactory progress. However, if a student accumulates a significant number of W notations, they may become a significant factor in this regard.

C. Removal of Deficient Grades and Repeat of Courses

Repetition of courses not authorized to be taken more than once for credit is limited. A graduate student may repeat a course in which a grade below B (3.0) or a grade of Unsatisfactory was received one time. Only the most recently earned grade is used in computing the student's grade point average for the first eight units of repeated work. Thereafter, both the earlier and the later grades are averaged. All credit units attempted and grades received remain part of the permanent record of the student.

D. Examinations

1. Scheduling of Examinations

Ordinarily, examinations that are required for an advanced degree, including language and comprehensive examinations and qualifying or final examinations for the Ph.D. or professional doctorate degree, may be given only during an academic session for which the student has registered. However, with the approval of the graduate committee of the academic unit, such examinations may be given between the end of any academic session for which the student was registered and the beginning of the next regular academic session. In such cases, written notification of intent must be submitted to the Graduate Dean at least two weeks in advance of the exam. **Doctoral preliminary examinations and M.S. comprehensive examinations are mandated by each individual department. Please see the back section of this handbook for more details on departmental examinations, or refer to your department's Graduate Coordinator and Graduate Advisor for more information.**
2. Repeat of Critical Examinations

You shall have the option of taking a second examination in the event of unsatisfactory performance on a critical examination. Included are: the comprehensive examination for Master's degrees, the Ph.D. preliminary examination, the Ph.D. qualifying examination for advancement to candidacy, and the final examination on the Ph.D. dissertation. The second examination may have a format different from the first, but the substance should remain the same. A student whose performance on the second attempt is also unsatisfactory, or who does not undertake a second examination within a reasonable period of time, is subject to academic disqualification. A third examination may be given only with the approval of the departmental graduate committee and the Graduate Dean.

3. Credit by Examination

If you believe that your knowledge of the content of a given course, or knowledge of the appropriate subject matter, is sufficient to be tested by formal examination without enrollment in a course, you may petition for a limited amount of credit by examination. The following conditions must be met before such a petition can be approved:

• The student must be registered for at least four units of upper-division and/or graduate-level work at the time the examination is taken.
• The student's overall scholarship must be satisfactory (3.0 or better cumulative grade point average).
• The course itself must be one that can be tested by examination. Graduate seminars and research courses cannot be taken for credit by examination.

In cases where the petition for credit by examination is approved, instructors retain the prerogative to:

(1) decide whether they will serve as examiners; (2) determine the form such an examination may take; and (3) stipulate whether grades will be reported as Satisfactory/Unsatisfactory or as letter grades in accordance with grading policy for that course. The Credit by Examination Petition may be obtained from the Registrar or from the Academic Dean of the school offering the course. Approval of any petition for credit by examination must be obtained from the Dean of that school prior to the examination. The petition must also be validated at the Cashier’s Office by payment of a small fee.

STANDARDS AND REQUIREMENTS FOR GRADUATE DEGREE PROGRAMS

A. The Master’s Degree

1. Residency Requirement
A minimum of three quarters in academic residence is required prior to the award of most master's degrees. A minimum period of study of one quarter in-residence must intervene between formal advancement to candidacy and the conferring of the master's degree.

2. Curricular Requirements

The requirements listed herein are the minimum required by the University of California. Most master's degree programs require additional work. Detailed information on specific degree requirements can be found in the UCI General Catalogue, via http://www.editor.uci.edu/catalogue, on the Graduate Student Affairs website, and/or on individual department websites. You are responsible for fulfilling requirements in effect the year in which you are admitted. Under certain circumstances, the student, with the written approval of the faculty advisor and school's associate dean for graduate student affairs, may opt to accept the new requirements. In such cases, the academic unit must notify the Graduate Division in writing of the change in order that the student's records correctly identify the new requirements.

a. Coursework Requirements and Thesis and Examination Options

1) Master's Degree Options

The master's degree is attained by: Plan I, the Thesis option, or Plan II, the Comprehensive Examination option. Each of these plans has minimal coursework requirements, but programs may impose additional requirements. Please see the UCI general catalogue for detailed information on options within each department in engineering.

2) Course Requirements

The minimum course requirement for the master's degree is given below. This requirement may be waived or reduced only on the recommendation of the academic unit in which the degree is earned and with the approval of the Graduate Dean. Please see the UCI general catalogue or the website for more information on course requirements within each department in engineering.

Plan I (Thesis)
In addition to the thesis, a minimum of 36 quarter units in approved courses is also required, at least 20 of which must be earned in 200 series graduate-level courses exclusive of credit given for thesis research and preparation. A general examination is also required. Each department has its own requirements and the number of units in core and elective courses, so it is best that you are certain of your department's regulations regarding M.S. programs.
Plan II (Comprehensive Examination)
In addition to the comprehensive examination, a minimum of 36 quarter units (nine courses) in approved courses, at least 24 of which must be from graduate-level courses in the 200 series.

3) Master's Degree Requirements: Thesis Committee: Plan I

Under Plan I, a thesis is required. A committee of three faculty members recommended by the academic unit and appointed by the Graduate Dean shall approve the subject, pass on the content of the thesis, and administer the general examination. Usually one of the committee members directs the work. Two copies of the approved thesis must be filed with the Thesis and Dissertation Manuscript Advisor located in the Main Library, (Room 525).

**Membership**

The thesis committee is comprised of three voting members of the University of California Irvine Academic Senate. A majority of the committee, but not necessarily all, shall be affiliated with the program. The Thesis Committee shall approve the subject of the thesis, pass on the content and administer the general examination. Usually, the Chair of the committee directs the work. Two copies of the approved thesis must be filed with the Thesis and Dissertation Manuscript Advisor.

*Chair:* The Chair of the committee shall always hold a primary or joint academic appointment in the academic unit/program supervising the master's program; no exceptions will be granted for this position.

*General Members:* Non-voting members of the Academic Senate will be considered for general membership on the committee on an exception-only basis. **A formal exception memo on your department's letterhead, written to Frances Leslie, Acting Graduate Dean, from your department's Graduate Advisor, via Associate Dean John LaRue, is needed for this request to be considered.** The Graduate Dean, on behalf of the Graduate Council, retains sole authority to grant exceptions. All such requests must be submitted in writing by the Chair of the academic unit to the Graduate Dean two weeks prior to the examination to allow a reasonable time for review.

*Oversight Member:* If the Chair, Thesis Advisor or other member of the committee has a financial interest in an outside entity that carries the possibility of a conflict of interest that is potentially harmful to the graduate student, an Oversight Member must be appointed in addition to
the two general members. It is understood that the Oversight Member shall not bear a possible conflict of interest potentially harmful to the graduate student in the discharge of his or her role as Oversight Member. See exceptions below for procedures to appoint an Oversight Member.

Role of Oversight Member: The Oversight Member shall participate on all student research advisory and/or thesis committees. An additional role of the Oversight Member is to be fully cognizant of the issues related to the possible conflict of interest and its potential impact on the student, and to be fully cognizant of the UCI resources available should a conflict of interest problem arise. If there do not appear to be any harmful results from the conflict of interest, the Oversight Member shall sign a statement to that effect after each committee meeting and the statement shall be placed in the student's file and a copy forwarded to the Graduate Dean. If the Oversight Member perceives that there is a problem arising from conflict of interest issues, then he/she shall not sign off on the committee deliberation, but shall instead inform the Graduate Dean in writing.

Exceptions on Appointment

Oversight Member: The Graduate Dean shall select the Oversight Member from a list of three nominees agreed upon by the student, the faculty research advisor, and the departmental representative. If these individuals cannot agree on three nominees, the departmental representative (either the Graduate Advisor or the Chair if the advisor is conflicted) will select the nominees. The departmental representative shall submit a written request to appoint an Oversight Member to the Graduate Dean no less than two weeks prior to the date of the exam to allow a reasonable time for review. This request should include background information describing the circumstances of the possible conflict. The Graduate Dean will retain sole authority to appoint the Oversight Member. No exceptions to this requirement will be considered.

General Member: Non-voting members of the Academic Senate and faculty members holding professorial titles from other universities will be considered for general membership on the committee on an exception-only basis. Again, the procedure outlined above for exception memos must be followed in order for the request to be approved.

Responsibilities

It is the responsibility of the Chair of the academic unit, the Departmental Faculty Advisor, Mentor or Associate Dean for Student Affairs as appropriate, and the Chair of the Candidacy Committee: (1) to inform the student regarding the policy on Thesis Committees -- including full disclosure of issues pertaining to possible conflict of interest that is
potentially harmful to graduate students; (2) to provide graduate students with a policy statement on such possible conflict of interest prior to the student designating a research topic, forming a graduate committee, or being employed as a research or teaching assistant, whichever comes first; and (3) to ensure that these Academic Senate policies are followed.

Submission of Thesis

The submission of the thesis is the last step in the program leading to the award of an advanced degree. All theses submitted in fulfillment of requirements for advanced degrees at UCI must conform to University regulations with regard to format and method of preparation. The *UCI Thesis and Dissertation Manual* for writing and submitting theses/dissertations is available on the web at www.lib.uci.edu/libraries/collections/special/thesis/tdmanual.html. Students are encouraged to attend the quarterly information sessions that discuss manuscript preparation and filing procedures.

How to File

After the thesis has been approved by the committee, two copies are submitted with the appropriate forms to the manuscript librarian (archives@uci.edu) in the Main Library, Room 525, who accepts it for deposit in the University Archives. The librarian will briefly check to make sure certain aspects of the manuscript are complete and prepared correctly according to the *UCI Thesis and Dissertation Manual* and include verification of the appropriate paper type, margins, and pagination. The librarian will also verify that the committee signatures have been obtained and the degree paperwork has been completed. Library Archives has the responsibility of insuring that the established procedures and standards for manuscript preparation are upheld.

Deadline for Filing

The advanced degree manuscript is expected to be submitted by the deadline in the quarter in which the degree is to be conferred. Friday of the tenth week of classes is the deadline for submitting theses and dissertations during each quarter. Those students who complete requirements and submit theses after the end of the tenth week of classes and prior to the start of the subsequent quarter will earn a degree for the following quarter, but will not be required to pay fees for that quarter. In such cases, to avoid payment of fees, the manuscript, all forms and degree paperwork must be submitted prior to the first day of the quarter in which the degree is to be earned. These deadlines are published on the registration website each quarter, on the Graduate Student Affairs website, or on the Graduate Division website under "deadlines".
Public Access

In accordance with UC and UCI policy, all approved thesis/dissertation manuscripts automatically become available for public access and circulation as part of the UCI Libraries collections.

4) Comprehensive Examination (Plan II)

A final comprehensive examination, the nature of which is to be determined by the academic unit and approved by the Graduate Council, is required of candidates following Plan II. The content of the exam represents a capstone requirement that integrates the intellectual substance of the program. In some departments, a written paper requirement is integrated into their graduate seminar courses. Some departments expect coursework and/or seminar completion in substitution of an exam. Please check the catalogue for the comprehensive requirements for your particular department or program.

b. Advancement to Candidacy

In accordance with University of California policy, you must be advanced to candidacy for your degree prior to the beginning of the final quarter of enrollment. An Application for Advancement to Candidacy (http://www.rgs.uci.edu/grad/students/forms.htm) initiated by the student and approved by the academic unit should be submitted to the Graduate Dean at least 30 days before the opening of the quarter in which the degree is expected. The Application must be accompanied by petitions for any course credits that have not already been approved by the Graduate Dean. If the master's degree requires a thesis (Plan I), membership of the thesis committee must be included, and the departmental graduate faculty advisor, the department chair, and the graduate student must sign the Statement of Conflict of Interest form, which is included in the Application.

Deadlines for submission and approval of the Application for Advancement to Candidacy are published each quarter on the registration website and the Graduate Division website. If you have not advanced to candidacy before the beginning of the quarter in which all requirements are completed, your degree will not be conferred until the end of the following quarter. When you are formally advanced to candidacy, you and the academic unit are notified in writing.

c. Final Report for the Master’s Degree

It is the graduate program's responsibility, in cooperation with the student, to ensure that the course requirements of the graduate program have been met prior
to submitting the *Final Report for the Master's Degree* to the Graduate Division. Substitutions within the graduate student program of study do not need to be approved through the Graduate Dean unless they affect minimum University and program requirements for the Master's degree.

The *Application for Advancement to Candidacy* is also the form used to certify completion of all degree requirements prior to formal award of the Master's degree. Upon formal advancement to candidacy, the form is returned to the graduate program.

If you have satisfied all requirements except for satisfactory completion of the final quarter's course work, the department should complete the certification and return it to the Graduate Division prior to receipt of final grade reports. If you are deficient of coursework or have received a grade lower than a "B", the conferral of degree will not occur. The Graduate Division will verify final grades with the Registrar. The department is consulted if there is any doubt about conferral of the degree, and the you will need to make arrangements to take care of the deficiency (submit a petition to allow a B- grade to count toward the degree, or retake a course or substitute another course in the place of a course with lower than a "B" received.) Please see your department concerning petitions - some departments, such as Electrical Engineering & Computer Science and Biomedical Engineering are strict with the granting of the B- petition and only allow it to be applied to certain courses.

**B. Transfer of Credit**

The [General Petition](http://www.rgs.uci.edu/grad/students/forms.htm) may be used for purposes of requesting transfer of credit by currently enrolled students only.

### 1. Policy

Transfers of credit toward master's degree requirements are governed by University regulation and policy summarized in the [UCI General Catalogue](http://www.editor.uci.edu/catalogue).

a. Petitions for transfer credit will be considered only when the work is necessary to fulfill degree requirements.
b. If official transcripts of academic work are not already in the student's file, they must be submitted as part of any petition for transfer credit or course substitution of degree requirements.
c. No petition for transfer credit is needed for work completed as a regular graduate student in UCI regular academic sessions, at other campuses through Intercampus Exchange, or in UCI Summer Sessions, including Summer Sessions prior to first registration quarter at UCI following formal admission to a graduate program.

### 2. Procedures
a. Petitions for transfer of credit should be submitted as soon as possible after first enrollment as a UCI graduate student or completion of the academic work for which transfer credit is requested. All petitions for transfer credit must be supported by official transcripts of the work completed by the issuing institution.
b. Up to one-half the total units required earned during regular academic quarters at another graduate division of the University of California may be transferred.
c. Up to one-fifth the total units required may be transferred from any one or a combination of the following: University of California Extension, another institution, or Summer Sessions at another UC campus.
d. Semester units will be transferred at 1.5 times the quarter unit value.
e. In all cases, transfer credit may be allowed only for graduate-level work taken after awarding of the Bachelor's degree or when taken as an undergraduate in excess of both the unit and major requirements for the Bachelor's degree. No transfer of credit will be accepted for work applied toward the requirements of another graduate degree.
f. No transfer credit will be allowed for any course in which a grade below B or the equivalent is assigned.
g. No transfer credit may be given for work completed while currently enrolled, or on an academic leave of absence, without prior written approval of the departmental faculty Graduate Advisor and the Graduate Dean.
h. Under no circumstances will grade credits be transferred.
i. Courses that are transferred do not count toward the required number of units in 200-series courses.

3. Accelerated Status M.S. or Ph.D. students

If you entered the M.S. or Ph.D. program as an Accelerated Status student, you may petition to have eighteen units of graduate or upper-division undergraduate coursework taken while an undergrad to be transferred into your M.S. program. The graduate or upper-division undergraduate coursework cannot have counted toward your B.S. and must be above and beyond those courses required for your undergraduate degree. In order to have these courses transferred, you will need to fill out the General Petition Form, found on the Graduate Division Website at http://www.rgs.uci.edu/grad/students/forms.htm

C. The Doctoral Degree

1. Residency Requirement

In accordance with University of California policy, a minimum of six quarters in academic residence is required prior to awarding the Ph.D. Typically, a longer period of study, four to seven years, is required for completion of all degree requirements. It is the responsibility of the academic unit to inform the student upon admission to the program of the expected degree time. If a student does not meet the departmental expected degree time, not including the first three Academic Leave of Absence quarters, a letter is sent to
the student and to the department strongly encouraging the student to contact her/his Faculty Advisor and set a completion date. A deadline will be set for the student by the Graduate Dean if a timely response is not received from the student or department. Should the student miss the established deadline, a memo will be sent to the student’s Faculty Advisor requesting a reevaluation of the student. The reevaluation should include either a recommendation for disqualification or the establishment of a second deadline date.

2. Teaching Requirement

Some graduate programs require graduate students pursuing the Ph.D. to acquire teaching experience at the post-secondary level under faculty supervision. This requirement is usually satisfied by appointment as a Teaching Assistant or Teaching Associate in undergraduate courses. Please see your department for guidelines and policies regarding eligibility and consideration for being a Teaching Assistant.

a) In order to establish eligibility for appointment as a UCI Teaching Assistant (TA) or Teaching Associate, international students who are not citizens of countries where English is either the primary or dominant language are required to pass an oral English proficiency exam approved by the UCI campus. To determine which countries are exempt from this requirement under the criteria offered by the Graduate Council, please contact your department’s Graduate Coordinator, or Jonathan Lew in the Graduate Division.

Students can fulfill this requirement by passing one of the following exams:

a) Test of Spoken English (TSE) which is administered by the Educational Testing Service (ETS) at centers outside of the US and Canada.

b) Test of English as a Foreign Language Internet-based Testing1 (TOEFL iBT) is administered by ETS in U.S. centers and abroad;

c) International English Language Testing System1 (IELTS) is available in over 120 countries. With a number of IELTS test centers offering off-site testing, the test is accessible in 30 more countries;

d) Spoken Proficiency English Assessment Kit (SPEAK) which is available at UCI only after a student is admitted;

e) Test of Oral English Proficiency (TOEP) which is administered at UCI and is only an option if a student fails to pass the TSE or SPEAK.

For more detailed information (including the respective passing scores) on these exams of spoken English proficiency, please go to http://www.rgs.uci.edu/grad/students/esl_tests.htm

To help UCI graduate students strengthen their oral English proficiency, UCI offers several on-campus resources including our ESL Program and our oral communication workshops. Additional resources are available from off-campus sites including sites offering special oral language practice exercises.
Although these tests must be taken in their entirety, passing only the speaking module/section on either test with the score specified will meet UCI’s oral proficiency requirements.

3. Waiver of Course Work

Courses taken toward a graduate degree at another institution cannot be transferred for credit toward a Ph.D. at UCI. However, a course requirement may be waived if a similar course was taken at another institution. The General Petition (http://www.rgs.uci.edu/grad/students/forms.htm) should be used for all requests for waivers of course work. To obtain a waiver, the academic unit should submit a full description of the course including a syllabus and a copy of the student's transcripts along with the Petition to Graduate Division for review and approval.

4. Advancement to Candidacy/Qualifying Examination

As a doctoral student, you will advance to candidacy for the Ph.D. upon successfully demonstrating a high level of scholarship in full-time study at the Ph.D. level, and upon completing all preparatory work, departmental preliminary examinations, and demonstrating readiness to proceed to the dissertation phase. A complete description of the policy on advancement to candidacy and advancement committees is provided below.

a. Advancement to Candidacy

Ph.D. students are nominated for advancement to candidacy in a particular field by the academic unit responsible for advanced degrees in that field. Students are advanced to candidacy if they pass by unanimous vote an oral examination administered by a Candidacy Committee. The Graduate Dean may delegate to the academic units the role of appointing Candidacy Committees. However, the Graduate Dean retains sole authority to grant any exceptions to the committee appointment, and to appoint a nominee as Oversight Member in those cases where the possibility of a conflict of interest that is potentially harmful to the graduate student exists. It is understood that the Oversight Member shall not bear a possible conflict of interest potentially harmful to the graduate student in the discharge of his or her role. Requests for approval of exceptions must be submitted in writing by the Chair of the academic unit to the Graduate Dean at least two weeks prior to the scheduled exam to allow a reasonable time for review. The academic unit must also inform students regarding the policy on candidacy committees including policy related to possible conflict of interest that is potentially harmful to graduate students. It is the responsibility of the Chair of the academic unit, the Departmental Faculty Advisor/Mentor or Associate Dean of the School as appropriate, and the Chair of the Candidacy Committee to ensure that these policies are followed. Should these policies not be followed, the student, at the discretion of the Graduate Dean, will be required to retake the Advancement Exam. You must receive approval for your
qualifying/candidacy committee. A nomination form must be completed at least two weeks before your exam. Nomination forms can be obtained in the Student Affairs Office, room 101 Engineering and Computing Trailer.

b. Candidacy Committee

The Candidacy Committee is comprised of five faculty who are voting members of the University of California Academic Senate. Non-voting Senate members or faculty holding professorial titles at other Universities will be considered on an exception-only basis. For the exception, a memo from your department's Graduate Advisor address to the Acting Dean of Graduate Division, Frances Leslie, via John LaRue, Associate Dean of Student Affairs, must be submitted, asking for a non-UCI faculty member or adjunct professor to serve on your committee. Candidacy committee members need not necessarily be from the Irvine Division, but a majority must hold primary or joint appointments in the student’s department. If the student is not affiliated with an individual department, a majority of the committee must hold either primary or joint appointments with the academic unit granting the doctoral degree. The additional criteria that apply to the membership of the committee are listed below.

Membership

The Chair: The Chair of the Candidacy Committee must hold either a primary or joint appointment in the student’s department (or academic unit) and must be a voting member of the UC Irvine Academic Senate. No exceptions to these requirements will be considered.

General Membership: At least two members in addition to the Chair must hold either a primary or joint appointment in the student’s department or academic unit. No exceptions to the requirement that a majority of voting members hold appointments in the student’s department or academic unit will be considered. Non-voting Senate members or faculty holding professorial titles at other universities will be considered on an exception-only basis. Please see bold text above for exception procedures.

The Outside Member: One member of the Candidacy Committee, designated the "outside member", must be from the Irvine Division and may not hold either a primary or joint appointment in the student's department or academic unit. It can be a professor from another department in Engineering, as long as he or she does not have an appointment in your department. An accurate verification of this can be determined in the UCI general catalogue under the School of Engineering. All Engineering professors and their titles and appointments are listed in the catalogue. The outside member represents the faculty at large. The role of the “outside member” is to serve as an unbiased and independent judge of both the quality and fairness of the exam. It is therefore desirable that this individual be familiar with the student’s research field. (No exceptions to these requirements
will be considered.)

The Oversight Member: If the Chair, Research/Thesis advisor or other member of the committee has a financial interest in an outside entity that carries a possibility of a conflict of interest potentially harmful to the graduate student, an oversight member must be appointed in addition to the three general members. It is understood that the Oversight Member shall not bear a possible conflict of interest potentially harmful to the graduate student in the discharge of his or her role.

Role of the Oversight Member: The Oversight Member shall participate on all student research advisory and/or thesis committees. An additional role of the Oversight Member is to be fully cognizant of the issues related to the possible conflict of interest and its potential impact on the student, and to be fully cognizant of the UCI resources available should a conflict of interest problem arise. If there do not appear to be any harmful results from the conflict of interest, the Oversight Member shall sign a statement to that effect after each committee meeting and the statement shall be placed in the student's file as well as forwarded to the Graduate Dean. If the Oversight Member perceives that there is a problem arising from conflict of interest issues, then he/she shall not sign off on the committee deliberation, but shall instead inform the Graduate Dean in writing.

Appointment Procedures

The qualifications of all committee members must be evaluated and approved by the HSSoE Graduate Student Affairs Office, acting on behalf of the Associate Dean. When the proposed membership deviates from the standard committee composition, as in the case of non-voting Senate members or faculty members from other universities, or when appointment of an Oversight Member is perceived to be necessary, a request for an exception or nomination must be submitted in writing to the Graduate Dean. Non-voting Senate members or faculty holding professorial titles at other Universities will be considered on an exception-only basis. The Graduate Dean retains sole authority to grant these exceptions, which must be submitted in writing by the Chair of the academic unit at least two weeks prior to the scheduled exam, and must be accompanied by a curriculum vitae of the individual for whom the exception is being requested. A list of the faculty holding primary or joint appointments with the student’s department or academic unit may be required by the Graduate Dean.

Oversight Member: The Graduate Dean shall select the Oversight Member from a list of three nominees agreed upon by the student, the faculty research advisor, and the departmental representative. If these individuals cannot agree on three nominees, the departmental representative (either the Graduate Advisor or the department Chair if the advisor is conflicted) will select the nominees. The departmental representative shall submit a written request to appoint an Oversight Member to the Graduate Dean no less than two weeks prior to the date of the exam to allow a reasonable time for review. This request should include
background information describing the circumstances of the possible conflict. The Graduate Dean will retain sole authority to appoint the Oversight Member. No exceptions to this requirement will be considered. It is the responsibility of the Chair of the academic unit, the Departmental Faculty Advisor/Mentor or Associate Dean for Student Affairs as appropriate, and the Chair of the Candidacy Committee: (1) to inform the student regarding the policy on Candidacy Committees, including full disclosure of issues pertaining to the possibility of a conflict of interest that is potentially harmful to graduate students; (2) to provide graduate students with a policy statement on such possible conflict of interest prior to the student designating a research topic, forming a graduate committee, or being employed as a researcher or teaching assistant, whichever comes first; and (3) to ensure that these Academic Senate policies are followed. Should these Senate policies not be followed the student will be required to retake the Qualifying Exam.

Duties and Responsibilities

The Candidacy Committee is charged with determining the fitness of the student to proceed with the doctoral dissertation through a formal Qualifying Examination. The examination should evaluate both general preparedness in the discipline, and specific competence to pursue the proposed dissertation topic. In its deliberation, the Committee ordinarily will review the student's academic record, preliminary examinations and evaluations by other faculty. The Committee may conduct any other examination it deems appropriate. The Committee ordinarily will review an outline of the proposed dissertation project, and will determine by oral examination the student's competence in that area. When, by unanimous vote, the Committee decides the student is qualified for the dissertation phase, it shall recommend advancement to candidacy.

Voting Procedures

Before voting upon its recommendation for or against candidacy, the Committee, as a whole, shall meet with the student, and any member of the Committee will have the right to pose appropriate questions to the student. If it decides to do so, the Committee may conduct part of the examination on an individual basis; e.g., the student may meet with each member in turn. However, the Committee must conclude its examination when convened with the student present.

Conduct of the Exam

Although the formal Qualifying Examination for candidacy ordinarily is conducted in a single day, the Committee may meet intermittently over a longer period, and may decide to reexamine the student on one or more topics after a specified interval. When the Committee meets to conduct the oral Qualifying Examination, it must report to the Graduate Council via the Graduate Dean within 30 days. If the Committee decides to reexamine the student at a later date or does
not pass the student for any reason, this must be reported to the Graduate Dean. The final vote and recommendation of the Committee must be unanimous and unequivocal. A recommendation that a student not be advanced is subject to conditions described herein.

Procedure for Validating and Recording Results

Upon completion of the Qualifying Examination, the results should be submitted to the Graduate Division on the Ph.D. Form I: Report of the Ph.D. Candidacy Committee (http://www.rgs.uci.edu/grad/students/forms.htm). The Ph.D. Form I must be signed by all committee members at the time the candidacy examination is concluded and submitted even if the student failed the examination. Prior to convening a student committee for the advancement to candidacy exam, the Departmental Graduate Faculty Advisor, the department chair, and the graduate student must sign the Statement on Conflict of Interest form which is included in the Ph.D. Form I. If the unanimous recommendation of the Committee is favorable, the student must pay the $65 Advancement to Candidacy Fee to the campus Cashier's Office that will validate the Ph.D. Form I. You must then submit the Ph.D. Form I to the Graduate Division. The date you submit the signed and validated Ph.D. Form I will be the official date of advancement. On the Ph.D. Form I, you must place an asterisk next to the three names of the members who will comprise your final doctoral committee. This must be done before you can successfully advance to candidacy. You and your graduate program will be notified in writing of formal advancement and the appointment of a Doctoral Committee.

5. Lapse of Candidacy

Candidacy for the Ph.D. will lapse automatically if the student loses graduate standing by academic disqualification or failure to comply with the University policy on continuous registration. A readmitted student who was a candidate for the Ph.D. must again advance to candidacy and thereafter enroll as a candidate for at least one academic quarter before the Ph.D. will be conferred.

6. The Doctoral Committee

a. Dissertation

The Doctoral Committee shall supervise the preparation and completion of the dissertation and the final examination.

b. Membership

The Doctoral Committee is nominated by the Candidacy Committee with the concurrence of the candidate, the doctoral committee Chair, and the Academic Unit Chair or designee, on the Ph.D. Form I. The Doctoral Committee is comprised of three voting members of the University of
California Academic Senate -- not necessarily the Irvine Division -- or the equivalent. A majority of the committee shall be affiliated with the student's program.

1) Chair: The Chair of the Committee shall always hold a primary or joint academic appointment in the academic unit/program supervising the doctoral program; no exceptions will be granted for this position. The Chair of the Doctoral Committee is the member of the graduate program faculty responsible for providing primary guidance of the student's dissertation.

2) Oversight Member: If the Chair, Research/Thesis advisor, or other member of the committee, has a financial interest in an outside entity that carries a possibility of a conflict of interest potentially harmful to the graduate student, an oversight member must be appointed in addition to the two general members. It is understood that the Oversight Member will not bear a possible conflict of interest potentially harmful to the graduate student in the discharge of his or her role. (http://www.rgs.uci.edu/grad/staff/coi.htm)

Role of the Oversight Member: The Oversight Member shall participate on all student research advisory and/or doctoral committees. An additional role of the Oversight Member is to be fully cognizant of the issues related to possible conflict of interest and its potential impact on the student, and to be fully cognizant of the UCI resources available should a conflict of interest problem arise. If there do not appear to be any harmful results from the conflict of interest, the Oversight Member shall sign a statement to that effect after each committee meeting and the statement shall be placed in the student's file as well as forwarded to the Graduate Dean. If the Oversight Member perceives that there is a problem arising from conflict of interest issues, then he/she should not sign off on the committee deliberation, but should instead inform the Graduate Dean in writing.

c. Appointment Procedures

The qualifications of all committee members must be evaluated and approved by the academic unit Chair or designee. When the membership of the proposed committee conforms to Senate policy as defined in this regulation, the Graduate Dean, on behalf of the Graduate Council, may delegate to the academic unit the authority to appoint, evaluate and approve the remaining members of the Doctoral Committee.

d. Exceptions

1) Oversight Member

In those cases where a possible conflict of interest exists as described above, the Graduate Dean shall select the Oversight Member from a list of three nominees agreed upon by the student, the faculty research advisor and the departmental representative. If these individuals cannot agree on three nominees, the departmental representative (either the Graduate Advisor or the Chair if the advisor is conflicted) shall select the nominees. The departmental representative shall submit the request to appoint an
Oversight Member in writing to the Graduate Dean no less than two weeks prior to the date of the exam to allow a reasonable time for review. This request should include background information describing the circumstances of the possible conflict. The Graduate Dean will retain sole authority to appoint the Oversight Member. No exceptions to this requirement will be considered.

2) General Members

Non-voting members of the Academic Senate, and faculty holding professional titles at other institutions, will be considered for general membership on the committee on an exception-only basis. **If you wish to have a non-UCI faculty member or an adjunct professor serve on your committee, a memo from your department's Graduate Advisor, via John LaRue, Associate Dean, to Frances Leslie, Acting Dean of Graduate Division, asking permission for this request is required.** The Graduate Dean, on behalf of the Graduate Council, retains sole authority to grant exceptions. All such requests must be submitted in writing by the Chair of the academic unit to the Graduate Dean at least two weeks prior to the date of the exam to allow a reasonable time for review.

*e. Duties and Responsibilities*

It is the responsibility of the Chair of the academic unit, the departmental Faculty Advisor/Mentor or Associate Dean for Student Affairs as applicable, and the Chair of the Doctoral Committee to:

1) Inform the student regarding the policy on Doctoral Committees, including full disclosure of issues pertaining to the possibility of conflict of interest potentially harmful to the student;
2) Provide graduate students with a policy statement on conflict of interest prior to the student designating a research topic, forming a graduate committee, or being employed as a research or teaching assistant, whichever comes first; and
3) Ensure that the Academic Senate policies are adhered to.

Oftentimes, a student's committee changes after the time of advancement to candidacy and before the dissertation and final examination are completed. If your committee composition changes, you must inform the Acting Graduate Dean, Frances Leslie, of the intent to change membership. The proper procedure is through a memo from your department's Graduate Advisor, to Frances Leslie, Acting Graduate Dean, via John LaRue, Associate Dean of Student Affairs, with the old membership listed first, and the proposed new membership listed second. Remember that the ****majority**** of members MUST be from your department.
7. Final Examination

If a final examination is required by the graduate program, the Doctoral Committee supervises that examination, the focus of which is the content of the doctoral dissertation. Ordinarily, the final examination will be given just prior to the completion of the dissertation and while the student is in residence during a regular academic session, and will be open to all members of the academic community.

*Ph.D. Form II: Report on Final Examination*
(http://www.rgs.uci.edu/grad/students/forms.htm)

Upon completion of the final examination (if required) and approval of the dissertation, the Doctoral Committee recommends, by submission of *Ph.D. Form II*, the conferral of the Ph.D. subject to final submission of the approved dissertation for deposit in the University Archives.

8. Dissertation

The submission of the dissertation is the last step in the program leading to the award of an advanced degree. All dissertations submitted in fulfillment of requirements for advanced degrees at UCI must conform to certain University regulations and specifications with regard to format and method of preparation. The *UCI Thesis and Dissertation Manual* for writing and submitting theses/dissertations is available at http://www.lib.uci.edu/libraries/collections/special/thesis/tdmanual.html. You are encouraged to attend the quarterly information sessions that discuss manuscript preparation and filing procedures. The Doctoral Committee certifies that the completed dissertation is satisfactory through the signatures of all Committee members on the signature page of the completed dissertation. The doctoral committee chair is responsible for the content and final presentation of the manuscript.

a. How to File

After your dissertation has been approved by the committee, two copies are submitted with the appropriate forms to the manuscript librarian (archives@uci.edu) in the Main Library, Room 525, who accepts it for deposit in University Archives. The librarian will briefly check to make sure certain aspects of the manuscript are complete and prepared correctly according to the *UCI Thesis and Dissertation Manual* and include verification of the appropriate paper type, margins, and pagination. The librarian will also verify that the committee signatures have been obtained and the degree paperwork has been completed. Library Archives has the responsibility of insuring that the established procedures and standards for manuscript preparation are upheld.

b. Deadline for Filing
The advanced degree manuscript is expected to be submitted by the deadline in the quarter in which the degree is to be conferred. Friday of the tenth week of classes is the deadline for submitting theses and dissertations during each quarter. If you complete requirements and submit dissertations after the end of the tenth week of classes and prior to the start of the subsequent quarter, you will earn a degree for the following quarter, but will not be required to pay fees for that quarter. In such cases, to avoid payment of fees, the manuscript, all forms and degree paperwork must be submitted prior to the first day of the quarter in which the degree is to be earned. These deadlines are published in the Graduate Division website and on the registration website each quarter.

c. Public Access

In accordance with UC and UCI policy, all approved thesis/dissertation manuscripts automatically become available for public access and circulation as part of the UCI Libraries collections.

D. Change of Degree Title/Program/ Level/or Academic Unit

1. Change of Degree Level within an Academic Unit (Master's to Ph.D.)

A student who was admitted to the master's degree program may be considered by the unit's admissions committee for subsequent admission to Ph.D. status. The committee will require two new letters of recommendation, a new Statement of Purpose, and up-to-date official transcripts in order to review the Ph.D. request. The committee could also request other items as needed. The process is internal to that academic unit until a decision is made. If the committee decides not to accept the student for study leading to the Ph.D., the academic unit offering the degree must notify the student in writing. If the committee accepts the student for doctoral studies, the recommendation must be transmitted in writing to the Graduate Dean, using the Change of Degree Level form, who has the authority to approve and formally recognize the change to doctoral status. Only at that time will you be eligible to register as a doctoral student.

International Students: Because of visa sponsorship requirements, an international student ordinarily must provide verification of financial resources prior to formal recognition of doctoral student status.

2. Change of Degree Level within an Academic Unit (Ph.D. to Master's)

A student admitted for the Ph.D. degree, who, in the judgment of the unit's graduate affairs committee should not continue past the master's degree, must be notified in writing by the academic unit offering the degree. A copy of the letter must be sent to the Graduate Dean. In some cases a doctoral student may choose to leave the program with a master's degree only. It is the responsibility of the academic unit to notify the Graduate Division in writing of this change in status. This notice must include the student's written permission to have his/her degree
objective changed officially from doctorate to master's and is done by completing the Change of Degree Level Form.

3. Change of Degree Program (Major) Within an Academic Unit

Within the same academic unit (i.e. within the EECS department), the unit's committee that oversees admissions for a change of degree program may consider a student's request be admitted to a different program. If the committee approves such a change, the Change of Major petition (http://www.rgs.uci.edu/grad/students/forms.htm) should be transmitted to the Graduate Division. Upon recommendation of the committee, the Graduate Dean will ordinarily approve and formally recognize the change.

4. Change of Degree Title and Academic Unit

A current student who wishes to transfer to a graduate program offered by a different academic unit should first consult with the Faculty Graduate Advisor of the desired program or unit. A formal request for such a change must be submitted to the Graduate Dean. On the online application, the student must indicate therein the most recent quarter of enrollment at UCI and indicate "change of program" on the application in the statement of purpose section. The statement of purpose must include the student's revised academic objective. The full application fee will not be charged unless there is a lapse of student status. The Graduate Division may request the current custodian of the student's departmental academic records to forward copies of certain documents to the academic unit the student wishes to enter. The receiving unit may require the student to submit additional information, such as current letters of recommendation, as necessary and appropriate. If the change is not approved by the academic unit that the student seeks to enter, formal notice should be sent to the student with a copy to the Graduate Dean and the student's current academic unit.

If the unit's graduate affairs committee recommends acceptance of the student, a copy of the formal admission letter must be sent to the Graduate Dean and the student's current academic unit. However, if the student seeks an advanced degree from the initial program, all requirements for that degree must be completed before the change of program or unit becomes effective. Students transferring from one program to another must also complete a Cancellation/Withdrawal (C/W) form available through both the Graduate Division and the Registrar's Office. For "reason for withdrawal," the student should write "transfer from _____ to _____." The student must sign and date the form and submit it to the Graduate Division to complete the transfer process.

E. Degree Conferral

1. Registration Requirements

Master's and doctoral degrees are conferred at the end of the academic quarter in which all requirements have been satisfied. Ordinarily, a graduate student will be registered for the quarter in which all degree requirements are completed and the degree is to be
conferred. If all degree requirements (including acceptance of the dissertation or thesis by the librarian and completion of all required examinations) are completed before the first day of the regular academic quarter in which the degree is to be conferred, and the student was registered for the previous regular quarter, registration fees are not required. If you do not meet this second submission deadline, you may be eligible to pay a Filing Fee in lieu of registration under certain circumstances. Unless payment of a Filing Fee or an academic leave of absence is approved, you must register each quarter until all degree requirements are completed. If you do not complete the necessary courses by the end of the quarter in which degree conferral is expected, or do not attain the required level of scholarship, registration for the next regular academic session is mandatory; otherwise, student status and candidacy for the degree will lapse. Once your status lapses, the degree can be conferred only after your readmission, followed by at least one quarter of registration and reinstatement to candidacy.

2. Certification of Degree Award

The Graduate Division notifies students by mail of formal degree conferral at the end of the quarter in which the degree is conferred. As soon as all degree requirements are completed, you may submit a Degree Certification Request form (http://www.rgs.uci.edu/grad/students/forms.htm). The Letter of Degree Certification bears the Graduate Dean's signature stamp and University Seal and is the equivalent of the diploma or the official academic transcript posting for employment and career advancement purposes. The student may request one copy for personal use, or for direct transmission to another educational institution or employer. While there is no charge for this service, only one official Letter of Degree Certification is provided for each degree.

F. Graduation and Diploma Information

1. Advancement to Candidacy Requirement

A student who expects to complete all requirements for an advanced degree in a given quarter must be advanced to candidacy for that degree prior to the first day of the quarter in which the degree will be conferred.

2. Diploma and Commencement Form

If you expect to graduate during the fall or winter quarter, you must submit the Graduate Student Diploma and Commencement form, (http://www.rgs.uci.edu/grad/students/forms.htm) along with the completed and approved thesis/dissertation manuscript and other final degree paperwork to University Archives (Main Library, Room 525). Please consult the Graduate Division website for deadlines regarding filing of Masters and doctoral degree paperwork (http://www.rgs.uci.edu/grad/students/forms/filing_deadlines.pdf).

Students who expect to graduate during the spring quarter or Summer Session must submit this form by the last working day before the spring quarter begins to the Graduate
Division. Those Masters degree students who are not required to submit a thesis manuscript must still submit the form to the Graduate Division. Late filing of this form may delay the ordering of the diploma, and may result in a student’s name being excluded from the commencement ceremony list. Once the appropriate forms have been received by the Graduate Division, they will be approved and forwarded to the UCI Registrar. Each spring quarter, based on verified information provided by the Graduate Division, the Registrar's Office provides the academic units a roster of those students who plan to graduate by the end of the academic year. The academic units then verify the accuracy of the rosters and return them to the Registrar's Office, which then orders the diplomas. This information is also forwarded to the Commencement Office for inclusion in the Spring Commencement program.

3. Commencement

Questions regarding eligibility to participate in spring commencement should be directed to the student's academic unit. If the Graduate Student Diploma and Commencement Form is submitted later than the deadline, the student should still turn it in to the Graduate Division as soon as possible. The student should also contact the Registrar's Office to ensure his/her name will be included on the Commencement publication.

REGISTRATION: ENROLLMENT

AND FEE PAYMENT

Please go to http://www.reg.uci.edu for information on registering for classes, and paying your fees and tuition. This extensive site has everything related to courses and registration at UC Irvine, including the 2008-09 catalogue. On this site, you will find the searchable schedule of classes for fall 2008: http://webster.reg.uci.edu/perl/WebSoc. You must ensure that you both enroll and pay fees by the corresponding deadlines. You will receive a computerized billing statement from campus billing services. This bill is commonly referred to as a Zotbill, and is used to pay your fees and tuition. If you will be receiving financial support in the form of a fellowship or academic employment, your fees may be payable by Electronic Fee Payment, as part of the registration process. Please contact the Graduate Division on campus if you have questions about how this process works. You will be subject to a service charge if you register late. If you were previously an undergraduate at UC Irvine, be sure to enroll using the graduate student identification number contained in your admission letter and Zotbill. Further, more detailed information on enrollment procedures and fee payment, including deadlines for registration and fee payment, is included on the Registrar’s website with at http://www.reg.uci.edu.
Current Graduate Student Forms

A variety of forms necessary for navigation through your graduate school experience and degree completion can be found at: http://www.rgs.uci.edu/grad/students/forms.htm. These forms can also be obtained in the main Student Affairs Office, 101 Engineering and Computing Trailer.

Detailed Program Information

Biomedical Engineering:

Catalogue

MASTER OF SCIENCE DEGREE

Two options are available for the M.S. degree: a thesis option and a comprehensive examination option. Both options require the student to specify an area of specialty, and to successfully complete a minimum of 36 units of course work beyond the bachelor's degree, at least 28 of which must be at the 200 level including the 22 units of core course requirements. The degree will be granted upon the recommendation of the Chair of the Department of Biomedical Engineering and The Henry Samueli School of Engineering Associate Dean of Graduate Studies, subject to final approval of the Graduate Council.

Plan I: Thesis Option

A thesis option is available to students who prefer to conduct a focused research project. Students selecting this option must select a thesis advisor and complete an original research investigation including a written thesis, and obtain approval of the thesis by a thesis committee. A maximum of eight M.S. research units (i.e., BME296) may be applied toward the 36-unit requirement.

Plan II: Comprehensive Examination Option

Alternatively, students may select a comprehensive examination option in which they must successfully complete 36 units of study and pass a comprehensive examination. The preliminary examination in the Ph.D. program, described below, will serve as the comprehensive examination. However, the passing grade to qualify at the Master's competency level will be lower than the grade required for a student to advance in the Ph.D. program.

DOCTOR OF PHILOSOPHY DEGREE

The Ph.D. degree requires the achievement of an original and significant body of research that advances the discipline. Students with a B.S. degree may enter the Ph.D. program directly, provided they meet the background requirements described above. The Graduate Committee will handle applicants on a case-by-case basis, and any specific additional courses required by the student will be made explicit at the time of admission.
Each student is matched with a faculty advisor, and an individual program of study is designed by the student and a faculty advisory committee. Two depth courses are required beyond that of the M.S. degree in preparation for the qualifying examination. Four milestones are required: (1) successful completion of 36 units of course work beyond the bachelor's degree, at least 28 of which must be at the 200 level including the 22 units of core course requirements; (2) successful completion of a preliminary examination at the Ph.D. competency level; (3) formal advancement to candidacy by successfully passing a qualifying examination; and (4) completion of a significant body of original research and the submission of an acceptable written dissertation and its successful oral defense.

The preliminary examination will normally be taken at the end of the first year (May). A student must take it within two years of matriculating in the program, and must either have passed all of the core courses or have an M.S. degree prior to taking the examination. The Preliminary Examination Committee prepares the examination and sets two minimum competency levels, one for awarding the Master's degree and the second for continuing on in the Ph.D. program. Students who fail to pass at the Ph.D. level may retake the examination the following year. Students who fail the second attempt will not be allowed to continue in the program. Students who pass either attempt at the Master's competency level will be awarded an M.S. degree. After passing the preliminary examination at the Ph.D. competency level, students are matched with a BME faculty advisor and design an individual program of study with their advisor.

Advancement to candidacy must be completed by the end of the summer of the second year following the passing of the preliminary examination. (Special exceptions can be made, but a formal request with justification must be supplied in writing to the Associate Chair of Biomedical Engineering and Director of Graduate Studies.) Students who do not pass the qualifying examination within two quarters after the summer of their second year will be ineligible to continue in the program. The qualifying examination follows campus and The Henry Samueli School of Engineering guidelines and consists of an oral and written presentation of original work completed thus far, and a coherent plan for completing a body of original research. The qualifying examination is presented to the student's graduate advisory committee, which is selected by the student and faculty advisor and must have a minimum of five faculty (including the faculty advisor). Of these five faculty, three must be BME faculty. In addition, one faculty member must have his/her primary appointment outside the Department of Biomedical Engineering. The fifth member must have his/her primary appointment outside of The Henry Samueli School of Engineering.

The Ph.D. is awarded upon submission of an acceptable written dissertation and its successful oral defense. The degree is granted upon the recommendation of the graduate advisory committee and the Dean of Graduate Studies. 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.

**GRADUATE PROGRAM IN MATHEMATICAL AND COMPUTATION BIOLOGY**

The graduate program in Mathematical and Computational Biology (MCB) is a one-year "gateway" program designed to function in concert with selected department programs, including the Ph.D. in Biomedical Engineering. Detailed information is available online at http://mcsb.bio.uci.edu/ and in the School of Biological Sciences section of the *Catalogue*, page 153.

**Courses in Biomedical Engineering**

**UPPER-DIVISION UNDERGRADUATE**
BME110A-B-C Biomechanics I, II, III (4-4-4) F, W, S. Introduction to continuum mechanics of both living and non-living systems. Laws of motion and free-body diagrams. Stresses, deformation, compatibility conditions, and constitutive equations. Properties of common fluids and solids. Field equations and boundary conditions. Applications to bioengineering designs. Prerequisites: Physics 7D, 7LD, 7E. BME110A-B and BMEH110A-B may not both be taken for credit. BME110A-B-C must be taken in the same academic year. (Design units: 1-1-1)

BMEH110A-B Honors Biomechanics I, II (4-4) F, W. Covers the same material as BME110A-B but in greater depth. Prerequisites: Physics 7D, 7LD, 7E and admission to the Campuswide Honors Program. BMEH110A-B and BME110A-B may not both be taken for credit. (Design units: 1-1)


BME120 Quantitative Physiology: Sensory Motor Systems (4) F. A quantitative and systems approach to understanding physiological systems. Systems covered include the nervous and musculoskeletal systems. Prerequisite: Mathematics 3D or equivalent, or consent of instructor. Concurrent with BME220. (Design units: 2)

BME121 Quantitative Physiology: Organ Transport Systems (4) W. A quantitative and systems approach to understanding physiological systems. Systems covered include the cardiopulmonary, circulatory, and renal systems. Prerequisite: Mathematics 3D or equivalent, or consent of instructor. Same as CBEMS104. Concurrent with BME221, CBEMS204. (Design units: 1).

BME130 Biomedical Signals and Systems (4) F. Analysis of analog and digital biomedical signals; Fourier series expansions; difference and differential equations; convolution. System models: discrete-time and continuous-time linear time-invariant systems; Laplace and Fourier transforms. Analysis of signals and systems using computer programs. Prerequisites: Mathematics 2J and 3D; Mathematics 7 recommended. (Design units: 1)

BME135 Photomedicine (4). Studies the use of optical and engineering-based systems (laser-based) for diagnosis, treating diseases, manipulation of cells and cell function. Physical, optical, and electro-optical principles are explored regarding molecular, cellular, organ, and organism applications. Prerequisites: Physics 3A-B-C or 7A-B-D, or EECS12 or consent of instructor. Same as Biological Sciences D130. (Design units: 0)

BME136 Engineering Optics for Medical Applications (4). Fundamentals of optical systems design, integration, and analysis used in biomedical optics. Design components: light sources, lenses, mirrors, dispersion elements, optical fibers, detectors. Systems integration: microscopy, radiometry, interferometry. Optical system analysis: resolution, modulation transfer function, deconvolution, interference, tissue optics, noise. Prerequisite: BME130, BME135, EECS180, or consent of instructor. (Design units: 3)

BME137 Introduction to Biomedical Imaging (4). Introduction to imaging modalities widely used in medicine and biology, including x-ray, computed tomography (CT), nuclear medicine (PET and SPET), ultrasonic imaging, magnetic resonance imaging (MRI), optical tomography, imaging contrast, imaging processing, and complementary nature of the imaging modalities. Prerequisite: BME130. (Design units: 1).

BME140 Design of Biomedical Electronics (4) W. Analog and digital circuits in bioinstrumentation. AC and DC circuit analysis, design and construction of filter and amplifiers using operational amplifier, digitization of signal and data acquisition, bioelectrical signal, design and construction of ECG instrument, bioelectrical signal measurement and analysis. Prerequisite: BME130. (Design units: 3)

BME145 MEMS and Nanotechnology for Biomedicine and Biotechnology (4). Basic concepts of MEMS and nanotechnology, its application to biotechnology/biomedicine. Introduction to scaling laws as applied toward living systems and artificial devices; micro- and nanofabrication; sensor and actuator principles; drug delivery, implantable systems, minimally invasive surgery, total analysis systems. (Design units: 1)
BME146 Miniaturization in Biotechnology and Biological Science (4). Introduction to BIOMEMS. Study of the fundamentals of sensing techniques. Introduction to various types of biosensors and biological principles; nanomachining and biomimetics. (Design units: 1)

BME150 Biotransport Phenomena (4). Fundamentals of heat and mass transfer, similarities in rate equations. Applications to biological mass transport at cellular and systems level. Methods and instruments used to measure quantitatively mass transfer processes, including microcirculation. Emphasis on practical application of fundamental principles. Prerequisites: BME110A-B. BME150 and CBEMS125C may not both be taken for credit. (Design units: 1)

BME160 Tissue Engineering (4) S. Quantitative analysis of cell and tissue functions. Emerging developments in stem cell technology, biodegradable scaffolds, growth factors, and others important in developing clinical products. Applications to bioengineering design. Prerequisites: BME50A-B, BME121. (Design units: 2)

BME170 Biomedical Engineering Laboratory (4) S. Introduction to the measurement and analysis of biological systems using engineering tools and techniques. Laboratory experiments involve living systems with the emphasis on biophotonics, BIOMEMS, and physiological systems. Labs include Optical Spectroscopy, BIOMEMS Fabrication and Characterization, Cardiovascular Physiology, and Neuroengineering. Prerequisites: BME111, BME120, BME121, BME130, BME140. (Design units: 1)

BME180A-B-C Biomedical Engineering Design (3-3-3) F, W, S. Design strategies, techniques, tools, and protocols commonly encountered in biomedical engineering; clinical experience at the UCI Medical Center and Beckman Laser Institute; industrial design experience in group projects with local biomedical companies; ethics, economic analysis, marketing, and FDA product approval. Prerequisites: BME111, BME120, BME121, BME140. Open only to senior BME majors. In-progress grading. BME180A-B-C must be taken in the same academic year. (Design units: 3-3-3)

BME195 Special Topics in Biomedical Engineering (1 to 4). Prerequisites vary. May be repeated for credit. (Design units: varies)

BME197 Seminars in Biomedical Engineering (1) F. Presentation of advanced topics and reports of current research efforts in Biomedical Engineering. Prerequisite: senior standing. Concurrent with BME298. (Design units: varies)

BME199 Individual Study (1 to 4). Independent research conducted in the laboratory of a Biomedical Engineering core faculty member. A formal written report of the research conducted is required at the conclusion of the quarter. Prerequisites: Biological Sciences 194S and consent of instructor. May be repeated for credit. (Design units: varies)

BME199 Individual Study for Honors Students (1 to 4). Independent research conducted in the laboratory of a Biomedical Engineering faculty member for participants in the Campuswide Honors Program. A formal written report of the research conducted is required at the conclusion of quarter. Prerequisites: Biological Sciences 194S and consent of instructor. Open only to members of the Campuswide Honors Program who are Biomedical Engineering or Biomedical Engineering: Premedical majors. May be repeated for credit. (Design units: varies)

GRADUATE

BME200 Introduction to Biomedical Engineering (3). Offers a perspective on bioengineering as a discipline in a seminar format. Principles of problem definition, team design, engineering inventiveness, information access, communication, ethics, and social responsibility are emphasized.

BME210 Cell and Tissue Engineering (4) F. A biochemical, biophysical, and molecular view of cell biology. Topics include the biochemistry and biophysical properties of cells, the extracellular matrix, biological signal transduction, and principles of engineering new tissues.
BME213 Systems Cell and Developmental Biology (4). Introduces concepts needed to understand cell and developmental biology at the systems level, i.e., how the parts (molecules) work together to create a complex output. Emphasis on using mathematical/computational modeling to expand/modify insights provided by intuition. Prerequisite: graduate standing. Same as Developmental and Cell Biology 232.

BME220 Quantitative Physiology: Sensory Motor Systems (4) F. A quantitative and systems approach to understanding physiological systems. Systems covered include the nervous and musculoskeletal systems. Concurrent with BME120.

BME221 Quantitative Physiology: Organ Transport Systems (4) W. A quantitative and systems approach to understanding physiological systems. Systems covered include the cardiopulmonary, circulatory, and renal systems. Same as CBEMS204. Concurrent with BME121 and CBEMS104.

BME223 Advanced Cardiovascular Biomechanics (3). Considers the modern developments in cardiovascular biomechanics at an advanced mathematical level. Selected topics in the dynamics of the heart and blood vessels, pulsatile blood flow, microcirculation, and muscle mechanics. Also considers modeling of boundary value problems in cardiovascular engineering.


BME230B Applied Engineering Mathematics II (4) W. Advanced engineering mathematics for biomedical engineering. Focuses on biomedical system identification. Includes fundamental techniques of model building and testing such as formulation, solution of governing equations (emphasis on basic numerical techniques), sensitivity theory, identifiability theory, and uncertainty analysis.

BME233 Dynamic Systems in Biology and Medicine (4). Introduces elements of system theory and application of these principles to analyze biomedical, chemical, social, and engineering systems. Students use analytical and computational tools to model and analyze various dynamic systems such as population dynamics, Lotka-Volterra equation, and others. Prerequisite: graduate standing.

BME240 Introduction to Clinical Medicine for Biomedical Engineering (3). An introduction to clinical medicine for graduate students in biomedical engineering. Divided between lectures focused on applications of advanced technology to clinical problems and a series of four rotations through the operating room, ICU, interventional radiology/imaging, and endoscopy. Formerly Engineering 240.

BME261 Biomedical Microdevices I (3) S. In-depth review of microfabricated devices designed for biological and medical applications. Studies of the design, implementation, manufacturing, and marketing of commercial and research bio-MEMS devices. Formerly BME261A.

BME262 Microfluidics (3). An advanced course on microfluidics research and its application in Biomedical Engineering. Offers in-depth perspective on different fabrication methods and different microfluidic devices that are used in Biomedical Engineering. The principles of microfabrication, surface treatment, device design, and application are covered. Prerequisites: advanced courses in mathematics, physics, and chemistry.

BME263 Microsystem Technologies for Biomolecular Assays (3). Introduction to state-of-the-art micro Total Analysis Systems (mTAS) for biomolecular assays, device design principles for microscale sample preparation, flow transport, biomolecular manipulation/separation/detection, technologies for integrating these devices into microsystems. Applications include clinical medicine, health monitoring, biotechnology, biodetection.

BME295 Special Topics in Biomedical Engineering (1 to 4) F, W, S. Prerequisites vary. May be repeated for credit as topics vary.
BME296 Master of Science Thesis Research (1 to 12). Individual research or investigation conducted in the pursuit of preparing and completing the thesis required for the M.S. in Engineering. Prerequisite: consent of instructor. May be repeated for credit.

BME297 Doctor of Philosophy Dissertation Research (1 to 12). Individual research or investigation conducted in the pursuit of preparing and completing the dissertation required for the Ph.D. in Engineering. Prerequisite: consent of instructor. May be repeated for credit.

BME298 Seminars in Biomedical Engineering (1) F, W, S. Presentation of advanced topics and reports of current research efforts in biomedical engineering. Designed for graduate students in the biomedical engineering program. Satisfactory/Unsatisfactory only. May be repeated for credit. Concurrent with BME298.

BME299 Individual Research (1 to 12). Individual research or investigation under the direction of an individual faculty member. Prerequisite: consent of instructor. May be repeated for credit.

Ph.D. Preliminary Examination Information

The BME preliminary exam is offered once a year, in mid-to-late May, is taken by all first year Ph.D. students and any student who needs to retake it. It is designed to test your overall knowledge of the core subjects as taught in the BME core classes. The exam is given both in written form and orally. There are three major subject areas that you will be tested on: Systems Physiology (BME220/221), Cell and Tissue Engineering (BME210), and Engineering Mathematics (BME 230A/B). The exam works on a point system. During the written exam, a student can receive 0 (fail), 1 (conditional pass), or 2 (pass) points. If the student has a point total of 4-5 points, they are offered the opportunity to take the oral exam to demonstrate their proficiency in the deficient area(s) with point(s) less than 2. If the student fails to receive a total of 4 points, they automatically fail and cannot take the oral exam. If the student fails to pass the preliminary exam on the first attempt, he/she will be offered a second and final chance the following year to retake the exam.
PLAN OKED
M.S. Plan of Study
Plan of Study goes here
**Chemical and Biochemical Engineering:**

*Catalogue*

**Graduate Study in Chemical and Biochemical Engineering**

Chemical engineering uses the knowledge of chemistry, mathematics, physics, biology, and social sciences to solve societal problems such as energy, health, environment, food, clothing, shelter, and semiconductors. It serves a variety of processing industries whose vast array of products include chemicals, petroleum products, plastics, pharmaceuticals, foods, textiles, fuels, consumer products, and electronic and cryogenic materials. It also serves society to improve the environment by reducing and eliminating pollution. Chemical engineering is an engineering discipline that has its strongest ties with the molecular sciences. This is an important asset since sciences such as chemistry, molecular biology, biomedicine, and solid-state physics are providing the seeds for future technologies. Chemical engineering has a bright future as the discipline which will bridge science with engineering in multidisciplinary environments.

Biochemical Engineering is concerned with the processing of biological materials and processes that use biological agents such as living cells, enzymes, or antibodies. Biochemical Engineering, with integrated knowledge of the principles of biology and chemical engineering, plays a major engineering role in the rapidly developing area of biotechnology. Career opportunities in Biochemical Engineering are available in a variety of industries such as biotechnology, chemical, environmental, food, petrochemical, and pharmaceutical industries.

The principle objectives of the graduate curriculum in Chemical and Biochemical Engineering are to develop and expand students' abilities to solve new and more challenging engineering problems and to promote their skills in independent thinking and learning in preparation for careers in manufacturing, research, or teaching. These objectives are reached through a program of course work and research designed by each student with the assistance, advice, and approval of a primary faculty advisor and a faculty advisory committee. Programs of study leading to the M.S. and Ph.D. degrees in Chemical and Biochemical Engineering are offered.

**MASTER OF SCIENCE DEGREE**

Two plans are available for the M.S. degree: a thesis option and a comprehensive examination option. Opportunities are available for part-time study toward the M.S. degree.

Students who enter the program with a B.S. degree in chemical engineering must take at least six graduate-level courses (22 units), while students who enter without undergraduate preparation in chemical engineering are required to take three to five additional prerequisite courses (Mathematics 105A-B-C and Engineering CBEMS40B or CBEMS45B-C, CBEMS110, CBEMS112, and CBEMS120A or CBEMS125A). A detailed program of study for each entering student is formulated in consultation with a faculty advisor and must be approved by the graduate advisor.

**Plan I: Thesis Option**

The thesis option requires completion of 38 units of study (eight of which can be taken for study in conjunction with the thesis research topic); the completion of an original research project; the writing of the thesis describing it; and successful defense of the thesis.
Plan II: Comprehensive Examination Option

The comprehensive examination option requires a minimum of 36 quarter units in approved courses, at least 28 of which must be from graduate courses in the 200 series in Chemical Engineering and Materials Science.

DOCTOR OF PHILOSOPHY DEGREE

The doctoral program is tailored to the individual needs and background of the student. The detailed program of study for each Ph.D. student is formulated in consultation with an advisory committee which takes into consideration the objectives and preparation of the candidate. The program of study must be approved by the faculty of the School.

There are no specific course requirements, but there are several milestones to be passed: acceptance into a research group by the faculty advisor, successful completion of the Ph.D. preliminary examination, formal advancement to candidacy in the third year (second year for students who entered with a master's degree) by passing the qualifying examination which assesses the candidate's preparation for research and evaluates the proposed original research, successful completion of the research, and presentation and successful defense of the dissertation. There is no foreign language requirement. Ph.D. students have to meet departmental research requirements as a research assistant or equivalent, with or without salary. The degree is granted upon the recommendation of the Doctoral Committee and the Dean of the Graduate Division. For at least the final two years of the doctoral program it is expected that the student will be a full-time resident in the School. 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.

Courses in Chemical Engineering

UNDERGRADUATE UPPER-LEVEL

CHEMICAL ENGINEERING

CBEMS104 Quantitative Physiology: Organ Transport Systems (4). A quantitative and systems approach to understanding physiological systems. Systems covered include the cardiopulmonary, circulatory, and renal systems. Prerequisite: Mathematics 3D or equivalent, or consent of instructor. Same as BME121. Concurrent with CBEMS204 and BME221. (Design units: 1)

CBEMS110 Reaction Kinetics and Reactor Design (4) F. Introduction to quantitative analysis of chemical reactions and chemical reactor design. Reactor operations including batch, continuous stirred tank, and tubular reactor. Homogeneous and heterogeneous reactions. Prerequisites: Mathematics 3D; Chemistry 1C; CBEMS40B or CBEMS45B-C. (Design units: 2)

CBEMS112 Introduction to Biochemical Engineering (3). Application of engineering principles to biochemical processes. Topics include: microbial pathways, energetics and control systems, enzyme and microbial kinetics, and the design and analysis of biological reactors. Prerequisites: Chemistry 1C, Mathematics 3D; and CBEMS110 or consent of instructor. (Design units: 1)

CBEMS116 Field Practicum in Environmental Engineering (4). Application of concepts from engineering and microbiology to the characterization and analysis of microbial pollution in coastal waters. Topics include public health microbiology, microbial diversity and ecology, molecular diagnostics of waterborne pathogens. Laboratory exercises and a field-scale experiment. Corequisite: CBEMS110 or CEE162. Concurrent with CBEMS216. (Design units: 2)
CBEMS120A Momentum Transfer (4) F. Macroscopic and differential mass balances; macroscopic and differential linear and angular momentum balances, mechanical energy balances; Ideal fluids, Newtonian and non-Newtonian fluids and turbulence. Applications to chemical processes. Prerequisites: CBEMS40A, Mathematics 3D. CBEMS120A and CBEMS125A may not both be taken for credit. (Design units: 1)

CBEMS120B Heat and Mass Transfer (4) W. Macroscopic and differential energy balances. Heat transfer coefficients, convective and radiative heat transfer, applications to equipment design, macroscopic and differential species balances, mass transfer with and without chemical reactions, mass transfer equipment design. Prerequisite: CBEMS120A. CBEMS120B and CBEMS125B may not both be taken for credit. (Design units: 1)

CBEMS124 Transport Phenomena in Living Systems (3). An introduction to transport phenomena in cellular and whole organ systems. Application of transport theory including advection and diffusion to the movement of molecules in biological systems, including the cardiovascular system (heart and microcirculation), and the lung. Prerequisite: CBEMS120A or CBEMS125A or consent of instructor. (Design units: 0)

CBEMS125A Momentum Transfer (4). Fluid statics, surface tension, Newton's Law of viscosity, non-Newtonian and complex flows, momentum equations, momentum transport, laminar and turbulent flow, velocity profiles, flow in pipes, flow around objects, design of piping systems, pumps and mixing and other applications to chemical and related industries. Prerequisites: CBEMS45A-B-C; Mathematics 3D. Only one course from CBEMS125A, CBEMS120A, MAE130A, MAEH130A, CEE170, and CEEH170 may be taken for credit. (Design units: 1)

CBEMS125B Heat Transfer (3). Principles of conduction, radiation, and convection of heat; phenomenological rate laws, differential and macroscopic energy balances; heat transfer rates, steady state and unsteady state conduction, convection; applications to chemical and related industries. Prerequisite: CBEMS125A. Only one course from CBEMS125B, CBEMS120B, and MAE120 may be taken for credit. (Design units: 1)

CBEMS125C Mass Transfer (3). Molecular and continuum approaches to diffusion and convection in fluids and multi-component mixtures; mass transfer rates; steady state, quasi-steady state and transient mass transfer; effect of reactions on mass transfer; convective mass transfer coefficients; simultaneous mass, heat and momentum transfer; applications to chemical and related industries. Prerequisite: CBEMS125B. CBEMS125C and BME150 may not both be taken for credit. (Design units: 1)

CBEMS126 Biomedical Photonics (3). Biophysical principles governing the interaction of laser radiation with biological materials, cells, and tissues. Utilization of these principles in several biomedical therapeutic and diagnostic applications is also covered and discussed in detail. Prerequisites: CBEMS120A-B or CBEMS125A-B-C; or consent of instructor. Concurrent with CBEMS226. (Design units: 0)

CBEMS130 Separation Processes (4) S. Application of equilibria and mass and energy balances for design of separation processes. Use of equilibrium laws for design of distillation, absorption, stripping, and extraction equipment. Design of multicomponent separators. Prerequisite: CBEMS40B or CBEMS45B-C. (Design units: 3)

CBEMS132 Bioseparation Processes (3). Recovery and purification of biologically produced proteins and chemicals. Basic principles and engineering design of various separation processes including chromatography, electrophoresis, extraction, crystallization, and membrane separation. Prerequisites: CBEMS40A-B or CBEMS45A-B-C; CBEMS120A or CBEMS125A. (Design units: 1)

CBEMS134 Introduction to Bioreactor Engineering (3). Unique features of bioreactors. Analyses and design of bioreactors of batch, fed-batch, and continuous flow types. Microbial reactors with and without cell recycles. Bioreactor operations for industrial-important biological products and for biological treatment of wastewater. Prerequisites: CBEMS110. (Design units: 1.5)

CBEMS135 Chemical Process Control (4) F. Dynamic responses and control of chemical process equipment, dynamic modeling of chemical processes, linear systems analysis, analyses and design of feedback loops and advanced control systems. Prerequisites: CBEMS110; CBEMS120B or CBEMS125B-C. (Design units: 1)
CBEMS140A Chemical Engineering Laboratory I (4) W. Experimental study of thermodynamics, fluid mechanics, and heat and mass transfer. Operation and evaluation of process equipment, data analysis. Prerequisites: CBEMS40B or CBEMS45B-C; CBEMS110; and CBEMS120B or CBEMS125B-C. (Design units: 1)

CBEMS140B Chemical Engineering Laboratory II (4) S. Continuation of CBEMS140A covering mass transfer operations such as distillation, absorption, extraction. Rate and equilibria studies in simple chemical systems with and without reaction. Study of chemical process. Prerequisites: CBEMS130, CBEMS135, CBEMS140A. (Design units: 3)

CBEMS145 Chemical Engineering Design (5) S. Application of chemical engineering science techniques to design of chemical processes. Introduction to systematic design of separations and the integration of energy requirement. Integration of process economics and optimization. Consideration of retrofit design, design of nontraditional chemical processes, process safety. Prerequisites: CBEMS110, CBEMS120B or CBEMS125C, CBEMS130. CBEMS145 and CBEMS149A may not both be taken for credit. (Design units: 5)

CBEMS149A Chemical Engineering Design I (3) F, W, S, Summer. Introduction to process design; flow sheets for chemical processes; synthesis of multicomponent separation sequences and reaction paths; synthesis of heat exchange networks; computer-aided design and simulation of processes and components; process economics; process safety; environmental impacts. Prerequisites: CBEMS110, CBEMS125C, CBEMS130. CBEMS149A and CBEMS145 may not both be taken for credit. (Design units: 2)

CBEMS149B Chemical Engineering Senior Design II (3) F, W, S, Summer. Application of chemical engineering basics to practical design problems; design case studies; a major team design project with progress reports, oral presentation, and a technical report with engineering drawings and economics. Prerequisite: CBEMS149A. (Design units: 3)

CBEMS154 Polymer Science and Engineering (4). An introduction to physical aspects of polymers, including configuration and conformation of polymer chains and characterization techniques; crystallinity viscoelasticity, rheology and processing. Prerequisites: Chemistry 1A-B-C and ENGR54, or consent of instructor. (Design units: 1)

CBEMS155 Mechanical Behavior and Design Principles (4) W. Principles governing structure and mechanical behavior of materials, relationship relating microstructure and mechanical response with application to elasticity, plasticity, yielding, necking, creep, and fracture of materials. Introduction to experimental techniques to characterize the properties of materials. Design parameters. Prerequisite: ENGR54. Same as MAE156. (Design units: 2)

CBEMS155L Mechanical Behavior Laboratory (1). Introduction to experimental techniques to characterize mechanical properties of materials. Emphasis on the correlations between property and microstructure. Experiments include: plastic stability in tension, effect of grain size and flow stress at low and high temperatures, strain rate effects, impact test, superplasticity, creep of materials. Corequisite: CBEMS155. Prerequisite: ENGR54.


CBEMS158 Ceramic Materials (3). A technical elective for students interested in the materials area. Topics covered include structure and properties of ceramics and design with ceramics. Prerequisite: ENGR54. (Design units: 1)

CBEMS159 Plasticity and Metal Forming (3). Stress and strain analysis, plasticity equations, yielding, integration of plasticity equations, plastic instability, application of plasticity theory to some forming processes. Prerequisites: ENGR54, ENGR150, and MAE30. (Design units: 1)
CBEMS160 Advanced Laboratory in Chemistry and Synthesis of Materials (4) S. Lecture, two hours; laboratory, eight hours. Synthesis and characterization of organic and inorganic materials including polymers and oxides. Techniques include electron and scanning probe microscopy, gel permeation chromatography, x-ray diffraction, porosimetry, and thermal analysis. Prerequisites: ENGR54 or Chemistry 130A-B or 131A-B. Same as Chemistry 156. (Design units: 0).

CBEMS162 Environmental Effects and Corrosion (3). Covers the principles of environmental degradation and corrosion including environmental effects, electrochemical aspects, eight forms of corrosion, corrosion testing, oxidation at elevated temperatures, susceptibilities of various engineering materials, and prevention of environmental degradation. Prerequisites: ENGR54 and CBEMS50L. (Design units: 2)

CBEMS163 Computer Techniques in Experimental Materials Research (3). Principles and practical guidelines of automated materials testing. Computer fundamentals, programming languages, data acquisition and control hardware, interfacint techniques, programming strategies, data analysis, data storage, safeguard procedures. Prerequisite: consent of instructor. Concurrent with MSE263. (Design units: 1)

CBEMS164 X-Ray Diffraction, Electron Microscopy, and Microanalysis (4). Material characterization using x-ray diffraction and scanning electron microscopy (SEM). Topics include x-ray diffraction and analysis; SEM imaging and microanalysis. Prerequisite: ENGR54. (Design units: 1)

CBEMS165 Diffusion and Phase Transformations (3) W. Thermodynamics and kinetics of phase transformations, phase diagrams, diffusional and diffusionless transformations. Prerequisites: ENGR54; CBEMS40B or CBEMS45C or MAE91. (Design units: 0)

CBEMS166 Science of Nanoscale Materials and Devices (3). Covers the properties of nanoscale materials and aspects of current research on next-generation electronic devices. Topics include nanofabrication, characterization of nanostructure materials, and device concepts that take the advantage of quantum mechanical phenomena on the nanoscale. Prerequisites: ENGR54 and Physics 7D. Concurrent with MSE266. (Design units: 0)

CBEMS167 Environmentally Sustainable Manufacturing (3). Multidisciplinary case study approach to environmentally sustainable manufacturing with a focus on electronic products. Engineering, economic, public policy, and industrial ecology aspects. Design, manufacture, policy, and environmental impact reviewed as a function of the entire life-cycle of the materials from extraction through disposal or recycling. Prerequisite: senior standing or consent of instructor. Concurrent with MSE267. (Design units: 0)

CBEMS169 Electronic and Optical Properties in Materials (4). Covers the electronic, optical, and dielectric properties of crystalline and amorphous materials to provide a foundation of the underlying physical principles governing the properties of existing and emerging electronic and photonic materials. Prerequisites: Physics 7D and 7E, Mathematics 2J and 3D. (Design units: 1)

CBEMS172 Microelectronic and Photonic Materials and Technology (3). Covers materials, processes, and principles involved in manufacturing of microelectronics and photonics after the silicon has been fabricated. Considerations of electronic, optical, thermal mechanical, and reliability properties of the materials are viewed in the context of current microelectronics manufacturing processes. Prerequisites: ENGR54, Chemistry 1C, Mathematics 2J, and Physics 7A-B-D-E. Concurrent with MSE272. (Design units: 1)

CBEMS174 Semiconductor Device Packaging (3). Introduction to the semiconductor device packaging and assembly processes. Electrical, thermal, optical, and mechanical aspects of package design and reliability. Special topics on optoelectronics packaging are covered. Prerequisite: CBEMS40A or CBEMS45B or consent of instructor. (Design units: 1)

CBEMS175 Design Failure Investigation (4) S. Survey of the mechanisms by which mechanical devices may fail, including overload, fatigue, corrosion, and wear. Use of fractography and other evidence to interpret failure modes.
and specify design/manufacturing changes. Students redesign failed parts or structures based on actual parts and/or case histories. Prerequisite: ENGR54. (Design units: 2)

CBEMS189A-B-C Senior Design Project (1-2-2) F, W, S. Group supervised senior design projects that deal with materials selection in engineering design and that involve case studies in ethics, safety, design, failure modes, new products, and patents. Activities conclude with a presentation of the projects. In-Progress grading. CBEMS189A-B-C must be taken in the same academic year and requires consent of instructor. (Design units: 1-2-2)


CBEMS191 Materials Outreach (3). Demonstration of major concepts in Materials Science and Engineering. Concepts of materials engineering covered include: deformation mechanisms in crystalline solids, effects of heat treatment on mechanical properties, thermal barrier materials, composites design, mechanical behavior of polymers, superconductivity in ceramics. Prerequisite: ENGR54. (Design units: 1)

CBEMS195 Special Topics in Chemical Engineering and Material Science (1 to 4). Prerequisites vary. May be repeated for credit as topics vary.

CBEMS198 Group Study (1 to 4). Group study of selected topics in engineering. Prerequisite: consent of instructor. May be repeated for credit as topics vary. (Design units: varies)

CBEMS199 Individual Study (1 to 4). For undergraduate Engineering majors in supervised but independent readings, research, or design. 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. Prerequisite: consent of instructor. May be taken up to eight units for letter grade. (Design units: varies)

CBEMSH199 Individual Study for Honors Students (1 to 5). Supervised research in Chemical 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. Prerequisite: consent of instructor. Open only to members of Campuswide Honors Program who are Chemical Engineering majors. May be repeated for credit as topics vary. (Design units: varies)

GRADUATE

CHEMICAL AND BIOCHEMICAL ENGINEERING

CBEMS204 Quantitative Physiology: Organ Transport Systems (4). A quantitative and systems approach to understanding physiological systems. Systems covered include the cardiopulmonary, circulatory, and renal systems. Same as BME221. Concurrent with CBEMS104 and BME121.

CBEMS210 Reaction Engineering (4). Advanced topics in reaction engineering, reactor stability analysis, diffusional effect in heterogeneous catalysis, energy balance, optimization of reactor operation, dispersed in phase reactors. Prerequisite: CBEMS110 or consent of instructor.

CBEMS216 Field Practicum in Environmental Engineering (4). Application of concepts from engineering and microbiology to the characterization and analysis of microbial pollution in coastal waters. Topics include public health microbiology, microbial diversity and ecology, molecular diagnostics of waterborne pathogens. Laboratory exercises and a field-scale experiment. Concurrent with CBEMS116.
CBEMS218 Bioengineering with Recombinant Microorganisms (3). Engineering and biological principles important in recombinant cell technology. Host/vector selection, plasmid propagation, optimization of cloned gene expression, metabolic engineering, protein secretion, experimental techniques, modeling of recombinant cell systems. Prerequisites: CBEMS110, CBEMS112; or consent of instructor.

CBEMS220 Transport Phenomena (4). Heat, mass, and momentum transfer theory from the viewpoint of the basic transport equations. Steady and unsteady state; laminar and turbulent flow; boundary layer theory, mechanics of turbulent transport with specific application to complex chemical engineering situations. Prerequisites: CBEMS120A-B or CBEMS125A-B-C; or consent of instructor.

CBEMS221 Drug Delivery (3). Introduction to design of drug delivery systems. Includes physicochemical and pharmacokinetic considerations in drug formulations, types of therapeutics, routes of administration, biomaterials, and novel drug delivery systems. Prerequisites: undergraduate introductory chemistry and biology.

CBEMS222 Physicochemical Hydrodynamics (3). Principles of the interaction between fluid flow and physical, chemical, and biochemical processes. Focus is on transport and reaction of solutes and colloidal particles in environmental settings. Example applications range from contaminant transport in ocean systems to particle separation. Prerequisite: CBEMS220 or consent of instructor.

CBEMS226 Biomedical Photonics (3). Biophysical principles governing the interaction of laser radiation with biological materials, cells, and tissues. Utilization of these principles in several biomedical therapeutic and diagnostic applications is also covered and discussed in detail. Prerequisites: CBEMS120A-B or CBEMS125A-B-C; or consent of instructor. Concurrent with CBEMS126.

CBEMS230 Applied Engineering Mathematics I (4). Analytical techniques applied to engineering problems in transport phenomena, process dynamics and control, and thermodynamics. Prerequisites: CBEMS110; CBEMS120A-B or CBEMS125A-B-C; or consent of instructor.

CBEMS232 Bioseparation Processes (3). Recovery and purification of biologically produced proteins and chemicals. Basic principles and engineering design of various separation processes including chromatography, electrophoresis, extraction, crystallization, and membrane separation. Prerequisite: CBEMS112 or consent of instructor.

CBEMS234 Bioreactor Engineering (3). Modeling, optimization, and control of biochemical and biological reactors. Statics and dynamics of bioreactors containing recombinant cells and multiple species. Prerequisite: consent of instructor.

CBEMS240 Advanced Engineering Thermodynamics (4). Introduction to modern thermodynamics and applications, with a focus on aspects relevant to chemical and materials engineering. Mathematical tools; equilibrium and stability; microscopic rigorous equations of state; molecular-level thermodynamics of real mixtures; and phase and chemical equilibrium. Prerequisite: CBEMS40B or CBEMS45B-C; or consent of instructor.

CBEMS249 Special Topics in Chemical Engineering and Materials Science (1 to 4). Prerequisites vary. May be repeated for credit as topics vary. Formerly CBE249.

CBEMS280 Optoelectronics Packaging (3). Basic and current issues in the packaging of integrated circuits (IC) and fiber-optic devices are discussed. Prerequisite: consent of instructor.

CBEMS295 Seminars in Engineering (1 to 4). Seminars scheduled each year by individual faculty in major field of interest. Satisfactory/Unsatisfactory grading only. Prerequisite: consent of instructor. May be repeated for credit.

CBEMS296 Master of Science Thesis (4 to 12). Individual research or investigation conducted in preparation for the thesis required for the M.S. degree. May be repeated for credit.
**CBEMS297 Doctor of Philosophy Dissertation Research (4 to 12).** Individual research or investigation conducted in preparation for the dissertation required for the Ph.D. degree. May be repeated for credit.

**CBEMS298 Seminars in Engineering (1).** Presentation of advanced topics and reports of current research efforts in chemical engineering and materials science. Satisfactory/Unsatisfactory grading only. May be repeated for credit.

**CBEMS299 Individual Research (1 to 12).** Individual research or investigation under the direction of an individual faculty member. Prerequisite: consent of instructor. May be repeated for credit.

**Ph.D. Preliminary Examination Information**

Information regarding the Chemical and Biochemical Engineering preliminary exam is forthcoming and will be distributed at a later date.
PLAN OKED
M.S. Plan of Study
Plan of Study goes here
Civil and Environmental Engineering

Catalogue

Graduate Study in Civil Engineering

Civil Engineering addresses the technology of constructed environments and, as such, embraces a wide range of intellectual endeavors. The Department of Civil and Environmental Engineering focuses its graduate study and research program on three areas: structural and geotechnical engineering, including aspects of soil mechanics, structural dynamics, earthquake engineering, and reliability and risk assessment; transportation systems engineering, including traffic operations and management, advanced information technology applications, travel behavior, and transportation systems analysis; and water resources and environmental engineering, including hydrology, water resources, contamination management, and pollution control technologies.

The Department offers the M.S. and Ph.D. degrees in Civil Engineering.

Students may also pursue M.S. and Ph.D. degrees in Engineering through The Henry Samueli School of Engineering graduate concentration in Environmental Engineering.

MASTER OF SCIENCE DEGREE

The M.S. degree reflects achievement of an advanced level of competence for the professional practice of civil engineering. Two plans are available to those working toward the M.S. degree: a thesis option and a course work option. Opportunities are available for part-time study toward the M.S. degree.

Plan I: Thesis Option

The thesis option requires completion of 36 units of study (eight of which can be taken for study in conjunction with the thesis research topic); the completion of an original research project; the writing of the thesis describing it; and presentation of the thesis research findings in a public seminar. Of the 36 units, a minimum of 20 units must be in nonresearch, graduate-level courses.

Plan II: Course Work Option

The course work option requires the completion of 36 units of study, at least 30 of which must be in nonresearch graduate-level courses. The remaining six units may be earned as graduate-level course work, individual research, or upper-division undergraduate units.

Concurrent Master's Degree Program with Planning, Policy, and Design

The Department of Civil and Environmental Engineering (CEE) and the Department of Planning, Policy, and Design (PPD) in the School of Social Ecology offer a concurrent degree program that allows students to earn both a master's in Civil Engineering (M.S.) and a master's in Urban and Regional Planning (M.U.R.P.) in two years (instead of in more than three years). The concurrent degree program requires 72 units of study and is organized around two tracks: (1) transportation systems, and (2) environmental hydrology and water resources. The program core comprises 15 graduate courses for the transportation
systems track, and 13 graduate and two undergraduate courses for the environmental hydrology and water resources track.

Students choose between a thesis option and a comprehensive examination option. The thesis option requires completion of 72 units of study (eight of which may be taken in conjunction with the thesis research); completion of an original research project and the writing of a thesis to describe it; completion of required core courses; and completion of enough units of approved electives to meet the total requirement of 72 units. The comprehensive examination option also requires completion of 72 units of study as well as a professional report, which represents a substantial piece of planning practice, as the capstone event. These units of study include core courses and enough units of approved electives to meet the total requirement of 72 units, with no redundancy of core courses in either CEE or PPD. Electives may include as many as eight units of independent study or approved undergraduate courses.

Undergraduates seeking admission to the concurrent master's degree program should have a strong record of course work in disciplines related to civil engineering and urban planning, and they must meet the requirements for admission in both departments. For more information about these requirements, see http://www.eng.uci.edu/cee/grad/requirements, and http://www.seweb.uci.edu/ppd/admissions.uci.

DOCTOR OF PHILOSOPHY DEGREE

The Ph.D. degree indicates attainment of an original and significant research contribution to the state-of-the-art in the candidate's field, and an ability to communicate advanced engineering concepts. The doctoral program is tailored to the individual needs and background of the student. The detailed program of study for each Ph.D. student is formulated in consultation with a faculty advisor who takes into consideration the objectives and preparation of the candidate. The program of study must be approved by the faculty advisor and the Graduate Advisor of the Department.

There are no specific course requirements. Within this flexible framework, the School maintains specific guidelines that outline the milestones of a typical doctoral program. All doctoral students should consult the Civil Engineering program's guidelines for details, but there are several milestones to be passed: admission to the Ph.D. program by the faculty; early assessment of the student's research potential (this includes a preliminary examination), research preparation, formal advancement to candidacy by passing the qualifying examination in the third year (second year for students who entered with a master's degree), completion of a significant research investigation, and the submission and oral defense of an acceptable dissertation. There is no foreign language requirement. Ph.D. students have to meet departmental research requirements as a research assistant or equivalent, with or without salary. The degree is granted upon the recommendation of the Doctoral Committee and the Dean of Graduate Studies. For at least the final two years of the doctoral program it is expected that the student will be a full-time resident in the School. 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.

Courses in Civil and Environmental Engineering

UPPER-DIVISION

CEE110 Methods III: Modeling, Economics, and Management (4) S. Analysis, modeling and management of civil engineering systems. Statistics and system performance studies, probabilistic models and simulation, basic economics and capital investments, project elements and organization, managerial concepts and network technique, project scheduling. Emphasis on real-world examples. Laboratory sessions. Prerequisites: CEE11. (Design units: 1)
CEE111 Methods IV: Systems Analysis and Decision-Making (4) W. Analysis and optimization for decision-making in civil and infrastructural systems. Topics include: linear programming formulations and solution algorithms, network models, and logistical models. Emphasis is on project-level and managerial decision-making and selection from alternative designs. Prerequisite: CEE110. (Design units: 1)

CEE121 Transportation Systems I: Analysis and Design (4) F. Introduction to analysis and design of fundamental transportation system components, basic elements of geometric and pavement design, vehicle flow and elementary traffic, basic foundations of transportation planning and forecasting. Laboratory sessions. Prerequisites: CEE11 and CEE81A. (Design units: 2)

CEE122 Transportation Systems II: Operations and Control (4) W. Introduction to fundamentals of urban traffic engineering, including data collection, analysis, and design. Traffic engineering studies, traffic flow theory, traffic control devices, traffic signals, capacity and level of service analysis of freeways and urban streets. Laboratory sessions. Prerequisites: CEE11, CEE121. (Design units: 2)

CEE123 Transportation Systems III: Planning and Forecasting (4) S. Theoretical foundations of transportation planning, design, and analysis methods. Theory and application of aggregate and disaggregate models for land use development, trip generation, and destination, mode, and route choice. Transportation network analysis. Planning, design, and evaluation of system alternatives. Laboratory sessions. Corequisite: CEE110. Prerequisite: CEE121. (Design units: 2)

CEE124 Transportation Systems IV: Freeway Operations and Control (4) S. Fundamentals of traffic on urban freeways, including data collection, analysis, and design. Traffic engineering studies, traffic flow theory, freeway traffic control devices, capacity and level of service analysis of freeways and highways. Laboratory sessions. Prerequisite: CEE121. (Design units: 2)

CEE130 Soil Mechanics (3) W. Mechanics of soils, composition and classification of soils, compaction, compressibility and consolidation, shear strength, seepage, bearing capacity, lateral earth pressure, retaining walls, piles. Prerequisites: CEE150, CEE170. (Design units: 0)

CEE130L Soil Mechanics Laboratory (2) W. Laboratory procedures of soil testing for engineering problems. Corequisite: CEE130. (Design units: 0)

CEE150 Mechanics of Materials (4) F, Summer. Stresses and strains, strain-stress diagrams, axial deformations, torsion, bending and shear stresses in beams, shear force and bending moment diagrams, combined stresses, principal stresses, Mohr's circle, deflection of beams, columns. Prerequisite: CEE30. Only one course from CEE150, CEEH150, ENGR150, ENGRH150, and MAE150 may be taken for credit. (Design units: 1)

CEE150L Mechanics of Materials Laboratory (1) F. Experimental methods and fundamentals for mechanics of materials analysis. Corequisite: CEE150. Prerequisite: CEE30. CEE150L and MAE150L may not both be taken for credit. (Design units: 0)

CEEH150 Honors Mechanics of Materials (4) F. Covers the same material as CEE150 but in greater depth. Prerequisite: CEE30 or ENGR30 or MAE30. Only one course from CEEH150, CEE150, ENGRH150, ENGR150, and MAE150 may be taken for credit. (Design units: 1)


CEE151B Structural Design I (4) S. Structural systems. Loads: dead, live, wind, and seismic. Design of timber structures. Beams, columns, beam-columns, roof, and connections. Prerequisite: CEE151A. (Design units: 3)
CEE151C Structural Design II (4) F. Ultimate strength design. Design of reinforced concrete beam sections. Design for shear and deflection. Design of columns. Design of isolated and combined footings. Laboratory sessions. Prerequisites: CEE130; CEE151B. (Design units: 3)


CEE153 Statically Indeterminate Structures (4). Fundamentals of statically indeterminate structures; strain energy and virtual work; energy theorems; deflections, moment-area methods, conjugate beam, method of virtual work, Castigliano theorem; method of consistent deformations; slope-deflection method; approximate methods; influence lines for indeterminate structures. Prerequisite: CEE151A. (Design units: 0)

CEE155 Structural Steel Design (4). Design in steel of tension members, beams, columns, welded and bolted connections; eccentrically loaded and moment resistant joints; plate girders. Plastic design; load and resistance factor design. Composite construction; introduction to computer-aided design. Laboratory sessions. Prerequisite: CEE151B. (Design units: 4)

CEE156 Foundation Design (4). Applications of soil mechanics principles to the analysis and design of shallow foundations, retaining walls, pile foundations, and braced cuts. Design criteria: bearing capacity, working loads and tolerable settlements, structural integrity of the foundation element. Damage from construction operations. Prerequisites: CEE130, CEE151C. (Design units: 3)

CEE161 Water Quality and Treatment (4) S. Water and the urban environment. Environment regulations. Water quality parameters. Water use, treatment, and reuse. Introduction to modeling and designing of treatment systems. Extensive use of mass balances for system evaluation. Prerequisites: Chemistry 1A; Engineering CEE11; MAE130A or CEE170. (Design units: 2)

CEE162 Introduction to Environmental Chemistry (4) W. Basic concepts from general, physical, and analytical chemistry as they relate to environmental engineering. Particular emphasis on the fundamentals of equilibrium and kinetics as they apply to acid-base chemistry, gas solubility, and redox reactions. Laboratory sessions. Prerequisite: Chemistry 1A-B. (Design units: 0)

CEE163 Biological Treatment Processes (3). Fundamentals and analysis of natural biological processes in the aquatic environment. Design of biological treatment processes with emphasis on suspended growth systems, gas transfer, disinfection. Topics include aerobic and anaerobic treatment systems, biodegradation of contaminants in the environment. Design projects included. Prerequisites: CEE161, CEE162. (Design units: 2)

CEE167 Ecology of Coastal Waters (4) W. Examines the ecological processes of the coastal environment. Investigates the causes of coastal ecosystem degradation and strategies to restore the ecosystem balance or prevent further coastal ecosystem health degradation. Prerequisites: Chemistry 1A-B and Environmental Analysis and Design E8. Same as Environmental Analysis and Design E168.

CEE168 Pollution Prevention and Waste Minimization (3) W. Study of the methods and impacts of selecting alternative technologies, processes, and/or products so as to reduce the sources of pollution and waste. Includes discussion of recycling, environmental regulations, life-cycle assessment, and economic analysis. Prerequisites: Chemistry 1C and Mathematics 3D. (Design units: 2)

CEE170 Introduction to Fluid Mechanics (4) F. Fluid properties; fluid statics; fluids in motion; control volume approach for mass, momentum, and energy conservation; dimensional analysis; surface resistance. Prerequisites: Physics 7A and Mathematics 3D; CEE80/ENGR80/MAE80. Only one course from CEE170, CEEH170, CBEMS120A, CBEMS125A, MAE130A, and MAEH130A may be taken for credit. (Design units: 0)
CEEH170 Honors Introduction to Fluid Mechanics (4) F. Covers the same material as CEE170 but in greater depth. Prerequisites: Physics 7A and Mathematics 3D; CEE80/ENGR80/MAE80. Only one course from CEEH170, CEE170, CBEMS120A, CBEMS125A, MAE130A, and MAEH130A may be taken for credit. (Design units: 0)

CEE171 Infrastructure Hydraulics (4) W. Continuity, energy, and momentum principles applied to flow in closed conduit and open channel infrastructure. Analysis of hydraulic networks. Deterministic and probabilistic factors affecting hydraulic design. Hydrologic design protocols for hydraulic systems. Prerequisites: CEE11; CEE170 or MAE130A. (Design units: 2)

CEE172 Groundwater Hydrology (4). Topics include conservation of fluid mass, storage properties of porous media, matrix compressibility, boundary conditions, flow nets, well hydraulics, groundwater chemistry, and solute transport. Design projects and computer applications included. Prerequisites: CEE170 or MAE130A or consent of instructor. (Design units: 2)

CEE173 Computer Tools for Watershed Modeling (4). Basic principles of hydrologic modeling are practiced in detail. Concepts of watershed, floodplains delineation, hydrologic impact, design studies, and GIS tools are discussed. Focus on the USACE (HEC) software tools (HEC-HMS) and HEC-RAS) along with their associated GIS interfaces. Prerequisites: CEE176 and CEE170. Concurrent with CEE273.


CEE181A-B-C Senior Design Practicum (2-2-2) F, W, S. Team designs a land development project including infrastructural, environmental, circulation aspects. Focus on traffic impact studies, design of road layouts, geometry, signals, geotechnical and hydrological analysis, design of structural elements, economic analysis. Oral/written interim and final design reports. Laboratory sessions. In-Progress grading. Corequisites: CEE121 and CEE151C. Prerequisites: CEE81B, CEE110, CEE161. CEE181A-B-C must be taken in the same academic year. (Design units: 1-2-2)

CEE195 Special Topics in Civil and Environmental Engineering (1 to 4). Corequisite and prerequisite: varies. May be repeated for credit as topics vary. (Design units: varies)

CEE198 Group Study (1 to 4). Group study of selected topics in Civil and Environmental Engineering. Prerequisite: consent of instructor. May be repeated for credit as topics vary. (Design units: varies)

CEE199 Individual Study (1 to 4). For undergraduate Engineering majors in supervised but independent reading, research, or design. 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. May be repeated for credit for a total six units. (Design units: varies)

CEE199P Individual Study (1 to 4). Same description as CEE199. Pass/Not Pass grading only. May be repeated for credit as topics vary. (Design units: varies)

CEEH199 Individual Study for Honors Students (1 to 5). Independent reading, research, or design under the direction of a faculty member or group of faculty members in Civil Engineering. 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. Open only to members of the Campuswide Honors Program who are Civil or Environmental Engineering students. May be repeated for credit as topics vary. (Design units: varies)

**GRADUATE**


CEE220B Travel Demand Analysis II (3) S. Methods of discrete choice analysis and their applications in the modeling of transportation systems. Emphasis on the development of a sound understanding of theoretical aspects of discrete choice modeling that are useful in many applications in travel demand analysis. Prerequisite: CEE220A.

CEE220C Travel Demand Analysis III: Activity-Based Approaches (3) S. The methodological underpinnings of activity-based travel demand modeling. Presents methodologies within the context of a generalization of discrete choice modeling approaches, emphasizing the distinctions that separate these two approaches and presenting appropriate mathematical and statistical tools to address these distinctions.

CEE221A Transportation Systems Analysis I (3) F. Introduction to mathematical methods and models to address logistics and urban transportation problems. Techniques include stochastic models, queuing theory, linear programming, and introductory non-linear optimization. Prerequisite: basic knowledge of probability theory.

CEE221B Transportation Systems Analysis II (3) S. Advanced mathematical methods and models to address logistics and urban transportation problems. Topics include network flows, advanced optimization techniques, dynamic network models, and geometric models. Prerequisites: CEE221A; graduate standing or consent of instructor.

CEE222 Transit Systems Planning (3) F. Planning methods for public transportation in urban areas. Technological and operating characteristics of vehicles, facilities, and systems. Short-range planning techniques: data collection and analysis, demand analysis, mode choice, operational strategies, financial analysis. Design of systems to improve performance.

CEE223 Artificial Intelligence Techniques in Transportation (3) F. Concepts, characteristics, and applications of selected artificial intelligence techniques in transportation engineering, including artificial neural networks, knowledge-based expert systems, and genetic algorithms. Prerequisites: graduate standing or consent of instructor. Formerly CEE223B.

CEE224A Transportation Data Analysis I (3). Statistical analysis of transportation data sources. Analysis of categorical and ordinal data. Regression and advanced multivariate analysis methods such as discriminant analysis, canonical correlation, and factor analysis. Sampling techniques, sample error and bias, survey instrument design. Prerequisites: knowledge of probability and statistics; graduate standing or consent of instructor.

CEE224B Transportation Data Analysis II (3). Advanced methods of statistical analysis of transportation data sources; causal modeling and structural equation models. Analysis of covariance structures involving discrete choice and ordinal scale variables. Prerequisite: CEE224A or equivalent.

CEE225A Transportation Planning Models I (3) F. Analytical techniques for the study of interactions between transportation systems design and the spatial distribution of urban activities. Development of models of demographic and economic activity, land use, and facility location. Forecasting exogenous inputs to existing transportation models. Prerequisite: knowledge of introductory systems analysis.
CEE225B Transportation Planning Models II (3) S. Design and application of comprehensive transportation models. Network development, demand modeling, and equilibrium assignment. Model calibration, validation, prediction, and evaluation. Regional modeling, site impact analysis, and circulation studies. Design of transportation alternatives.


CEE227A Transportation Logistics I: Introduction to Logistics and Supply Chain Management (3) W. Logistics network configuration, inventory management and risk pooling, the value of information, distribution strategies, international supply chain management, coordinated product and supply chain management, customer value and supply chain management, information technology, decision support systems.

CEE228A Urban Transportation Networks I (3) S. Analytical approaches and algorithms to the formulation and solution of the equilibrium assignment problem for transportation networks. Emphasis on user equilibrium (USE), comparison with system optimal, mathematical programming formulation, supply functions, estimation. Estimating origin-destination matrices, network design problems. Prerequisite: CEE220A or equivalent.

CEE228B Urban Transportation Networks II (3). Advanced analysis, optimization, and modeling of transportation networks. Topics include advanced static and dynamic traffic assignment algorithms, linear and nonlinear multi-commodity network flow optimization, network simplex, and network control problems. Prerequisites: CEE221A, CEE228A.

CEE229A Traffic Systems Operations and Control I (3) W. Introduction to operation, control, and analysis of arterial and freeway traffic systems. Control concepts, detectors, local controllers, system masters, incident-detection techniques, advanced traffic measurement technologies, intelligent vehicle-highway systems, advanced transportation management systems, advanced traveler information systems.


CEE231 Foundation Engineering (3) W. Essentials for design and analysis of structural members that transmit superstructure loads to the ground. Topics include subsurface investigations, excavation, dewatering, bracing, footings, mat foundations, piles and pile foundations, caissons and cofferdams, other special foundations. Prerequisite: CEE156 or equivalent.


CEE243 Mechanics of Composite Materials (3) S. Stress-strain relationship for orthotropic materials; invariant properties of an orthotropic lamina; biaxial strength theory for an orthotropic lamina; mechanics of materials approach to stiffness; elasticity approach to stiffness; classical lamination theory; strength of laminates; statistical theory of fatigue damage. Prerequisite: consent of instructor.
CEE245 Experimental Modal Analysis (3) S. A thorough coverage of modal analysis techniques including digital signal processing concepts, structural dynamics theory, modal parameter estimation techniques, and application of modal measurement methods suitable for practical vibration analysis problems. Prerequisite: CEE247 or equivalent.


CEE248 Wind Engineering (3) S. Essentials for the determination of extreme wind loads on structures. Topics include basic characteristics of wind, engineering aspects of wind, wind loads on structures, wind hazard probabilities, and dynamic effects of wind. Prerequisites: CEE11 or equivalent, and CEE247.

CEE249 Earthquake Engineering (3) W. Earthquake magnitude, intensity, and frequency. Seismic damage to structures. Earthquake load prediction including response spectra, normal mode, and direct integration techniques. The basis of building code earthquake load requirements for buildings. Seismic response of special structures. Lifeline engineering. Prerequisite: consent of instructor.

CEE250 Finite Element Method in Structural Engineering (3) S. Finite element concepts in structural engineering including variational formulations, shape functions, elements assembly, convergence, and computer programming. Stiffness of truss, beam, and frame members; two- and three-dimensional solids; plate and shell elements. Static, vibration, stability, and inelastic analyses. Prerequisite: consent of instructor.


CEE255 Advanced Behavior and Design of Steel Structures (3) F. Advanced principles of structural steel design. Analysis and design of beam-column members, braced and unbraced frames for buildings, and plate girders. Review of seismic design provisions. Design of connections. Prerequisite: CEE 153 or consent of instructor.


CEE258 Earthquake-Resistant Structural Design (3) S. Objectives of seismic design. Cyclic load-distortion characteristics of typical structural elements. Desirable structural form. Ductility and methods of achieving it. Use of energy dissipators. Project involving design of multistory, multibay rigid-jointed plane frame. Prerequisite: consent of instructor.

CEE259 Structural Stability (3) S. Introduction to structural stability emphasizing behavior of simple structural components that illustrate various modes of instability: Euler columns, beam columns, beam torsional and lateral instability, circular ring buckling. Elementary matrix methods compatible with the finite element models now used in industry for complex structures. Prerequisite: consent of instructor.
CEE262 Environmental Chemistry II (4) W. Advanced concepts from physical and organic chemistry as they relate to environmental engineering. Emphasis on equilibrium and kinetics as they apply to redox reactions, coordination, adsorption, gas phase reactions, and ion exchange. Laboratory on GC, GC-MS, and ion chromatography. Prerequisite: CEE162.

CEE263 Advanced Biological Treatment Processes (3) W. Analysis of natural biological processes in the aquatic environment. Design of biological treatment processes with emphasis on suspended growth systems. Aerobic and anaerobic treatment systems, biodegradation of contaminants in the environment. Construction and use of computer models for process design and operation. Prerequisites: CEE161 and CEE162.

CEE265 Advanced Physical-Chemical Treatment Processes (4) S. Theory and dynamics of physical and chemical separation processes in water and wastewater treatment. Topics include coagulation, sedimentation, filtration, gas transfer, membrane separations, and adsorption. Prerequisites: CEE161 and CEE162.

CEE268 Pollution Prevention Through Manufacturing, Materials Selection, and Product Design (3) S. Study of manufacturing, materials selection, and product design alternatives that yield less solid, air, and/or water pollutants. Analytical tools, such as life-cycle analysis and economic analysis, that can be used to compare alternatives are discussed. A case study approach is utilized.

CEE271 Flow in Unsaturated Porous Media (3) W. Fluid flow in the unsaturated zone (zone of aeration) of the subsurface. Soil-water physics, flow in regional groundwater systems, miscible displacement, mathematical modeling techniques. Prerequisite: CEE172 or consent of instructor.


CEE273 Computer Tools for Watershed Modeling (4) W. Basic principles of hydrologic modeling are practiced in detail. Concepts of watershed, floodplains delineation, hydrologic impact, design studies, and GIS tools are discussed. Focus on the USACE (HEC) software tools (HEC-HMS) and HEC-RAS) along with their associated GIS interfaces. Concurrent with CEE173.


CEE274B Transport Phenomena in Unsaturated Porous Media and Fractures (3) W. Advanced topics in contaminant transport in porous media. Development of macroscopic transport equations for saturated, partially saturated porous media and fractured formations. Colloid transport. Effects of formation heterogeneity on groundwater flow and transport. Applied mathematical modeling techniques, including self similar and small perturbation solutions. Prerequisites: CEE172 or consent of instructor; CEE283 and consent of instructor.

CEE275 Topics in Coastal Engineering (3) S. Linear wave theory. Wave properties: particle kinematics, energy propagation, shoaling, refraction, reflection, diffraction, and breaking. Wave statistics and spectra. Selected topics from: design of coastal structures; harbor engineering; littoral transport and shoreline morphology; and hydrodynamics of estuaries. Prerequisites: CEE11, CEE171, or consent of instructor.

CEE277 Transport in Rivers and Estuaries (3) W. Mathematical formulation of river and estuary water-quality models. Concepts of turbulent diffusion and shear flow dispersion, computational methods for transport modeling. Prerequisite: CEE278 or consent of instructor.


CEE279A Computations in Environmental Hydraulics (3) W. Numerical solution methods for flow and transport in rivers and estuaries. Stability, accuracy, and convergence properties of schemes. Finite-difference and finite-volume formulations. High-resolution and monotonicity preserving schemes for shallow-water flow and transport. Prerequisite: CEE278 or consent of instructor.

CEE282 Stochastic Modeling: Analysis and Simulation (3) S. An introduction to techniques for modeling dynamic, stochastic systems and to the mathematical, numerical, and simulation tools used to analyze them. Topics include the role of simulation modeling in the analysis of large-scale stochastic systems, queueing systems, and verification and validation procedures. Prerequisite: knowledge of probability or consent of instructor.

CEE283 Mathematical Methods in Engineering Analysis (3) F. Matrices; eigenvalue problems; techniques for the solution of ordinary and partial differential equations; boundary value problems; special functions; introduction to numerical methods.

CEE284 Engineering Decision and Risk Analysis (3) F. Develops applications of statistical decision theory in engineering. Presents the fundamental tools used in engineering decision making and analysis of risk under conditions of uncertainty. All concepts are presented and illustrated thoroughly with engineering problems. Prerequisite: CEE11 or consent of instructor.

CEE285 Reliability of Engineering Systems I (3) W. Develops the basic concepts for the definition and assessment of safety and reliability of engineering systems. Includes probabilistic modeling of engineering problems, assessment of component reliability, systems reliability, and introduction to probability-based design. Prerequisite: CEE11 or consent of instructor.

CEE287 Random Vibrations (3) W. Stochastic response of linear, single, and multidegree of freedom systems. Probabilistic approach to dynamic response of structures to random loading such as earthquake and wind gusting. Prerequisite: consent of instructor.


CEE295 Seminars in Engineering (1 to 12) F, W, S. Seminars scheduled each year by individual faculty in major field of interest. Prerequisite: consent of instructor. May be repeated for credit.

CEE296 Master of Science Thesis Research (4 to 12) F, W, S. Individual research or investigation conducted in preparation of the thesis required for the M.S. degree in Engineering. Prerequisite: consent of instructor. May be repeated for credit.

CEE297 Doctor of Philosophy Dissertation Research (4 to 12) F, W, S. Individual research or investigation conducted in preparation for the dissertation required for the Ph.D. degree in Engineering. Prerequisite: consent of instructor. May be repeated for credit.
CEE298 Special Topics in Civil Engineering (1 to 4) F, W, S. Presentation of advanced topics and special research areas in civil engineering. Prerequisite: graduate standing or consent of instructor. May be repeated for credit as topics vary.

CEE299 Individual Research (1 to 12) F, W, S. Individual research or investigation under the direction of an individual faculty member. Prerequisite: consent of instructor. May be repeated for credit.

Ph.D. Preliminary Examination Information

The CEE preliminary examination is designed to test the student’s advanced undergraduate and basic graduate engineering understanding relative to their preparation to perform advanced study and research necessary for the Ph.D. The examination assesses the academic competence of each student to pursue the Ph.D. degree. The preliminary examination can be oral or written or a combination of both.

The preliminary exam is required of each student and must be taken prior to the start of the fourth quarter of residency in the Ph.D. program. The examination may be repeated once, but must be passed prior to the start of the seventh quarter of residency. If the preliminary exam is repeated, the second exam must cover the same topics and, except in unusual cases in which one or more of the original examining committee is unavailable, must be given by the same committee managing the first exam. Failure to pass the CEE preliminary exam within two attempts could result in dismissal from the Ph.D. program.

To take the preliminary examination students must submit a CEE Ph.D. Preliminary Exam Form to their Faculty Advisor at least 4 weeks prior to the proposed preliminary examination date. The completed form contains the following:

a) A list of graduate UCI courses and instructors that encompass the graduate-level information to be covered on the examination (If the student has transferred from another institution, equivalent UCI courses must still be identified). This list should contain at least three courses and meet any additional requirements that the CEE faculty in the specialization area require at the time of admission to the Ph.D. program (for example, the transportation area requires competency in areas defined by the M.S. cores).

b) The overall GPA and the GPA in non-research courses. A transcript should be attached.

c) The proposed Preliminary Examination Committee. This committee must have at least 3 members including the Faculty Advisor. At least two members of the committee must be UCI CEE faculty.

After approving the CEE Ph.D. Preliminary Exam form, the Faculty Advisor will submit it to the Graduate Advisor and the Department Chair for approval. The Department Chair will assign one of the committee members other than the Faculty Advisor to chair the Preliminary Examination. After the request is approved by the Department Chair, the preliminary exam should be scheduled by the student.
WAITING FOR APRIL
M.S. Plan of Study
Plan of Study goes here
WAITING FOR APRIL
M.S. Plan of Study
Plan of Study goes here
WAITING FOR APRIL
M.S. Plan of Study
Plan of Study goes here
Electrical Engineering and Computer Science

Catalogue

Graduate Study in Electrical and Computer Engineering

The Department offers M.S. and Ph.D. degrees in Electrical and Computer Engineering with a concentration in Electrical Engineering, Computer Networks and Distributed Computing, Computer Systems and Software, or Computer Graphics and Visualization. Because most graduate courses are not repeated every quarter, students should make every effort to begin their graduate program in the fall.

Detailed descriptions of the four concentrations are as follows.

ELECTRICAL ENGINEERING CONCENTRATION (EE)

The Electrical Engineering faculty study the following areas: optical and solid-state devices, including quantum electronics and optics, integrated electro-optics and acoustics, design of semiconductor devices and materials, analog and mixed-signal IC design, microwave and microwave devices, and scanning acoustic microscopy; systems engineering and signal processing, including communication theory, machine vision, signal processing, power electronics, neural networks, communications networks, systems engineering, and control systems. Related communication networks topics are also addressed by the Networked Systems M.S. and Ph.D. degrees (listed in the Interdisciplinary Studies section of the Catalogue).

COMPUTER GRAPHICS AND VISUALIZATION CONCENTRATION (CGV)

The concentration in Computer Graphics and Visualization provides students with a solid base in the design, development, and evaluation of scientific and information visualization systems. Both hardware and software aspects are addressed with a particular focus on the development of algorithms and techniques for the representation of complex scientific data. The main research activities of the faculty in this concentration are in the fields of computer graphics, scientific visualization, computer-aided geometric design, imaging, image processing, and virtual reality. Application areas include computational physics, computational chemistry, computational fluid dynamics, computational and molecular biology, medical and biomedical imaging, civil and environmental engineering, photorealistic rendering, animation, remote sensing, industrial design, and media and arts.

COMPUTER NETWORKS AND DISTRIBUTED COMPUTING CONCENTRATION (CNDC)

The concentration in Computer Networks and Distributed Computing is concerned with the design and evaluation of computer networks and distributed computer systems, and their integration into a comprehensive computing network. Both hardware and software aspects of these systems are covered. Specific topics include computer communication protocols; performance modeling and analysis of computer networks; computer network hardware; reliability, security, and fault tolerance in computer networks and distribution computer systems; distributed operating systems; distributed software architectures, distributed data bases, network-based parallel computing, and programming languages for parallel/distributed processing. Related topics are addressed by the Networked Systems M.S. and Ph.D. degrees (listed in the Interdisciplinary Studies section of the Catalogue) and within the Donald Bren School of Information and Computer Sciences.
COMPUTER SYSTEMS AND SOFTWARE CONCENTRATION (CSS)

The Computer Systems and Software Concentration is concerned with the set of engineering principles which are used for design and construction of information-processing systems and software. The engineering design procedures are based on both the computational principles and theories discovered in the field of computer science and new highly integrated component devices made by electrical engineers. The main research activities of the faculty in this concentration are in the areas of fault-tolerant computing, parallel and distributed computer systems, ultra-reliable real-time computer systems, VLSI architectures, computer design automation, numerical processing, and intelligent management.

MASTER OF SCIENCE DEGREE GENERAL REQUIREMENTS

Two plans are offered for the M.S. degree: a thesis option and a comprehensive examination option. For either option, students are required to develop a complete program of study with advice from their faculty advisor. The graduate advisor must approve the study plan. Part-time study toward the M.S. degree is available. The program of study must be completed within four calendar years from first enrollment.

Plan I: Thesis Option

The thesis option requires completion of 36 units of study; an original research investigation; the completion of an M.S. thesis; and approval of the thesis by a thesis committee. The thesis committee is composed of three full-time faculty members with the faculty advisor of the student serving as the chair. Required undergraduate core courses and graduate seminar courses, such as EECS292, EECS293, EECS294, and EECS295, may not be counted toward the 36 units. No more than four units of EECS299 and three units of undergraduate electives may be counted toward the 36 units. Up to 12 of the required 36 units may be from EECS296 (M.S. Thesis Research) with the approval of the student's thesis advisor. Additional concentration-specific requirements are as follows; a list of core and concentration courses is given at the end of this section.

Electrical Engineering Concentration: At least seven concentration courses in the Electrical Engineering concentration (EE) must be completed.

Computer Networks and Distributed Computing Concentration: Four core courses in the Computer Networks and Distributed Computing concentration (CND) must be completed with a grade of B (3.0) or better. At least three additional core or concentration courses must also be completed.

Computer Systems and Software Concentration: Four core courses in the Computer Systems and Software concentration (CSS) must be completed with a grade of B (3.0) or better. At least three additional core or concentration courses must also be completed.

Computer Graphics and Visualization Concentration: Four core courses in the Computer Graphics and Visualization concentration (CGV) must be completed with a grade of B (3.0) or better. At least three additional core or concentration courses must also be completed.

Plan II: Comprehensive Examination Option

The comprehensive examination option requires the completion of 36 course units and a comprehensive examination. Also, students should take at least 12 courses. Only one EECS299 can be counted if the EECS299 course is three or more units. Undergraduate core courses and graduate seminar courses, such as EECS292, EECS293, EECS294, and EECS295, may not be counted toward the 36 units and 12
courses requirement. No more than three units of EECS299 and six units of undergraduate electives may be counted. In fulfillment of the comprehensive examination element of the M.S. degree program, students will complete two term paper-length reports on the current state-of-the-art of two separate technical fields corresponding to the concentration area. The term papers are completed as part of the end-of-course requirements for EECS294 (Electrical and Computer Colloquium), two units of which are needed to fulfill degree requirements. Each term paper must be completed with a grade of B or better; and each Colloquium section used to meet M.S. degree requirements must be completed with a satisfactory grade. Both Colloquium sections must be completed at the student's first opportunity upon enrollment in the ECE graduate program. Additional concentration-specific requirements are as follows; a list of core and concentration courses is given at the end of this section.

Electrical Engineering Concentration: Students enrolled in the Electrical Engineering (EE) concentration who choose the Comprehensive Examination option must select one of the following plans of study.

Circuits and Devices Plan of Study: At least four courses from the following list must be completed: EECS270A, EECS270B, EECS277A, EECS277B, EECS280A, EECS285A. At least five additional courses from the list of EE concentration courses must be completed.

Systems Plan of Study: At least four courses from the following list must be completed*: EECS240, EECS241A, EECS250, EECS251A, EECS251A, EECS260A, EECS267A. At least five additional courses from the list of EE concentration courses must be completed.

*If all six courses are not offered in an academic year, students who graduate in that year can petition to replace the courses that are not offered by EECS242 and/or EECS244.

Computer Networks and Distributed Computing Concentration: Four core courses in the Computer Networks and Distributed Computing concentration (CNDC) must be completed with a grade of B (3.0) or better. At least four additional core or concentration courses must also be completed.

Computer Systems and Software Concentration: Four core courses in the Computer Systems and Software concentration (CSS) must be completed with a grade of B (3.0) or better. At least four additional core or concentration courses must also be completed.

Computer Graphics and Visualization Concentration: Four core courses in the Computer Graphics and Visualization concentration (CGV) must be completed with a grade of B (3.0) or better. At least four additional core or concentration courses must also be completed.

List of Concentration Courses


(courses denoted with * are also core courses)
**Computer Networks and Distributed Computing Concentration:** EECS211*, EECS213*, EECS215*, EECS217*, EECS218*, EECS219, EECS221, EECS222A-B-C-D, EECS223, EECS224, EECS248A*, EECS248B, EECS261B, Computer Science 233, 234, 236.

**Computer Systems and Software Concentration:** EECS207, EECS211*, EECS213*, EECS215*, EECS217*, EECS218*, EECS221, EECS222A-B-C-D, EECS223, EECS224, EECS225, EECS228, EECS229, EECS248A*.


**DOCTOR OF PHILOSOPHY DEGREE GENERAL REQUIREMENTS**

The doctoral program in Electrical and Computer Engineering is tailored to the individual background and interest of the student. There are several milestones to pass: admission to the Ph.D. program by the Graduate Committee; Ph.D. preliminary examination on the background and potential for success in the doctoral program; departmental teaching requirement which can be satisfied through service as a teaching assistant or equivalent; original research work; development of a research report and dissertation proposal; advancement to Ph.D. candidacy in the third year (second year for students who entered with a master's degree) through the Ph.D. qualifying examination conducted on behalf of the Irvine Division of the Academic Senate; completion of a significant research investigation; and completion and approval of a dissertation. A public Ph.D. dissertation defense is also required. During the Ph.D. study, four quarters of EECS294 must be completed.

The Ph.D. preliminary examination is conducted twice a year, in the spring and fall quarters. Detailed requirements for each concentration are specified in the departmental Ph.D. preliminary examination policies, available from the EECS Graduate Admissions Office. The depth examination is conducted during each spring quarter. A student must pass the Ph.D. preliminary examination within two complete academic year cycles after entering the Ph.D. program. A student has only two chances to take and pass the Ph.D. preliminary examination. A student who fails the Ph.D. preliminary examination twice will be asked to withdraw from the program, or will be dismissed from the program, and may not be readmitted into the program.

The Ph.D. degree is granted upon the recommendation of the Doctoral Committee and the Dean of Graduate Studies. Part-time study toward the Ph.D. degree is not permitted. 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.

**Courses in Electrical Engineering and Computer Science**

**UPPER-DIVISION**

**EECS101 Introduction to Machine Vision (3).** The use of digital computers for the analysis of visual scenes; image formation and sensing, color, segmentation, shape estimation, motion, stereo, pattern classification, computer architectures, applications. Computer experiments are used to illustrate fundamental principles. Prerequisite: EECS150A or consent of instructor. Formerly ECE136. (Design units: 2)

**EECS104 Fundamentals of Computer Graphics (4).** Instruction in the fundamental algorithms and data structures used in computer image generation and manipulation including: output primitives, linear transformations,
windowing, hidden-line removal, and shading. Prerequisite: EECS40 or CSE22. Formerly ECE104. (Design units: 2)

EECS105 Fundamentals of Scientific Visualization (4). Introduces visualization techniques for various types of measured or computer-simulated data. Typical applications for these visualization techniques include the study of airflows around car bodies, medical data, and molecular structures. Prerequisite: EECS104 or consent of instructor. Formerly ECE105. (Design units: 2)

EECS106 Fundamentals of Computer-Aided Geometric Design (4). Interactive graphics techniques for defining and manipulating geometrical shapes used in computer animation, car body design, aircraft design, and architectural design. Prerequisite: EECS104 or consent of instructor. Formerly ECE106. (Design units: 2)

EECS107 Fundamentals of Digital Image Processing (4). Introduces theory and practice of digital image processing. Topics presented include two-dimensional signal processing theory, image acquisition, representation, elementary operations, enhancement, filtering, coding, compressing, restoration, and analysis, as well as image processing hardware. Prerequisite: EECS152A or consent of instructor. EECS107 and Computer Science 111 may not both be taken for credit. Formerly ECE107. (Design units: 2)

EECS111 System Software (4) F. Multiprogramming, interrupt, processes, kernel, parallelism, critical sections, deadlocks, communication, multiprocessor, multilevel memory management, binding, name management, file systems, protection, resource allocation, scheduling. Experience with concurrent programming, synchronization mechanisms, interprocess communication. Prerequisites: EECS112; ICS 23 or EECS114. Only one course from EECS111 and CSE104/Computer Science 143A may be taken for credit. Formerly ECE142. (Design units: 2)

EECS112 Organization of Digital Computers (4) W. Building blocks and organization of digital computers, the arithmetic, control, and memory units, and input/output devices and interfaces. Microprogramming and microprocessors. Prerequisite: EECS31L/CSE31L. Same as CSE132. Only one course from EECS112/CSE132, EECSH112/CSEH132, and Computer Science 152 may be taken for credit. Formerly ECE132. (Design units: 4)

EECS112L Organization of Digital Computers Laboratory (3) S. Companion laboratory to EECS112. Specification and implementation of a processor-based system using a hardware description language such as VHDL. Hands-on experience with design tools including simulation, synthesis, and evaluation using testbenches. Prerequisite: EECS112. Formerly ECE132L. (Design units: 3)

EECSH112 Honors Organization of Digital Computers (4) W. Building blocks and organization of digital computers, the arithmetic, control, and memory units, and input/output devices and interfaces, including advanced microarchitecture topics such as: pipelining, superscalar, multithreading, reconfigurable and microprocessor design. Prerequisite: EECS31L/CSE31L. Same as CSEH132. Only one course from EECSH112/CSEH132, EECS112/CSE132, and Computer Science 152 may be taken for credit. (Design units: 4)

EECS113 Microprocessor Interface Techniques (3). Concepts and techniques for using microprocessor-based systems to gather data and control peripheral devices. Relationship between microprocessor hardware and software, including input/output operations. Experience with a microprocessor system is provided. Functional requirements are realized through software and I/O hardware design. Prerequisite: EECS112L. Formerly ECE143. (Design units: 3)

EECS114 Engineering Data Structures and Algorithms (4) F. Introduces abstract behavior of classic data structures, alternative implementations, informal analysis of time and space efficiency. Also introduces classic algorithms and efficient algorithm design techniques (recursion, divide-and-conquer, branch-and-bound, dynamic programming). Prerequisite: EECS40. EECS114 and EECSH114 may not both be taken for credit. Formerly ECE144. (Design units: 2)

86
EECSH114 Honors Engineering Data Structures and Algorithms (4). Covers the same material as EECS114 but in greater depth. Prerequisite: EECS40. EECSH114 and EECS114 may not both be taken for credit. (Design units: 2)

EECS115 Introduction to VLSI (4) F. A first course in the design of Very Large Scale Integrated (VLSI) systems and chips. Review of CMOS VLSI technology. Analysis and synthesis of basic and complex CMOS gates. Introduction to CAD methodology and usage of CAD Tools. Prerequisite: EECS112/CSE132. Same as CSE151. Formerly ECE151. (Design units: 4)

EECS116 Introduction to Data Management (4). Introduction to the design of databases and the use of database management systems (DBMS) for applications. Topics include entity-relationship modeling for design, relational data model, relational algebra, relational design theory, and Structured Query Language (SQL) programming. Prerequisite: either ICS 52 or Informatics 43 with a grade of C or better (for ICS or Informatics majors); either ICS 23/ICS H23 or EECS114 with a grade of C or better (for Computer Engineering majors). Same as Computer Science 122A. Formerly ECE146. (Design units: 1)

EECS117 Parallel Computer Systems (3). General introduction to parallel computing focusing on parallel algorithms and architectures. Parallel models: Flynn's taxonomy, dataflow models. Parallel architectures: systolic arrays, hypercube architecture, shared memory machines, dataflow machines, reconfigurable architectures. Parallel algorithms appropriate to each machine type area also discussed. Prerequisites: EECS20 and EECS112/CSE132. Formerly ECE137. (Design units: 1)

EECS118 Introduction to Knowledge Management for Software and Engineering (4). Introduction of basic concepts in knowledge engineering and software engineering and applications of these concepts for building intelligent engineering systems such as computer-aided circuit design and computer-aided manufacturing. Knowledge representation and reasoning, planning, modeling of engineering objects, declarative and automatic programming, maintenance, case studies. Prerequisite: EECS40 or equivalent. Formerly ECE148. (Design units: 2)

EECS123 Introduction to Real-Time Distributed Programming (4). Introduction to the techniques for programming applications involving timing-sensitive actions. Hands-on experiences with object-oriented programming styles. Timing requirements, timing specification, response times, deadlines, application programming interfaces to real-time operating systems and middleware, remote procedure call, and distributed objects. Prerequisites: CSE104/Computer Science 143A or EECS111, and EECS112. Formerly ECE147. (Design units: 2)

EECS129A-B Computer Engineering Senior Design Project (2-2) F, W. Conception, planning, implementation, programming, testing of an approved project. Options include: parallel processing, VLSI design, microprocessor-based design, among others. Prerequisite: senior standing. In-progress grading. Formerly EECS129. (Design units: 2-2)

EECS140 Engineering Probability (4) S. Sets and set operations; nature of probability, sample spaces, fields of events, probability measures; conditional probability, independence, random variables, distribution functions, density functions, conditional distributions and densities; moments, characteristic functions, random sequences, independent and Markov sequences. Prerequisite: Mathematics 2D. Formerly ECE186. (Design units: 0)

EECS141A Communication Systems I (3). Introduction to analog communication systems including effects of noise. Modulation-demodulation for AM, DSB-SC, SSB, VSB, QAM, FM, PM, and PCM with application to radio, television, and telephony. Signal processing as applied to communication systems. Prerequisites: EECS150A and EECS140. Formerly EECS141. (Design units: 1)

EECS 144 Antenna Design for Wireless Communication Links (4). Analysis and synthesis of antennas and antenna arrays. Adaptive arrays and digital beam forming for advanced wireless links. Friis transmission formula. Wireless communication equations for cell-site and mobile antennas, interference, slow and fast fading in mobile communication. Prerequisite: EECS 180 or consent of instructor. Formerly ECE 134. (Design units: 0)

EECS 145 Electrical Engineering Analysis (4) F. Vector calculus, complex functions, and linear algebra with applications to electrical engineering problems. Prerequisites: Mathematics 2J and 3D. Formerly ECE 180. (Design units: 0)

EECS 148 Introduction to Computer Networks (4). Network architectures, models, protocols, routing, flow control, and services. Queuing models for network performance analysis. Prerequisites: EECS 40 or CSE 22 or consent of instructor; EECS 112 or consent of instructor; EECS 140 or Mathematics 67. Formerly ECE 161. (Design units: 2)

EECS 150A Continuous-Time Signals and Systems (4) W. Characteristics and properties of continuous-time (analog) signals and systems. Analysis of linear time-invariant continuous-time systems using differential equation and convolutional models. Analysis of these systems using Laplace transforms, Fourier series, and Fourier transforms. Examples from applications to telecommunications. Prerequisites: EECS 70A/CSE 70A; EECS 145. Formerly ECE 120B. (Design units: 0)

EECS 150B Discrete-Time Signals and Systems (4) S. Analysis of discrete-time linear-time-invariant (DTLTI) systems in the time domain and using z-transforms. Introduction to techniques based on Discrete-Time, Discrete, and Fast Fourier Transforms. Examples of their application to digital signal processing and digital communications. Prerequisite: EECS 70A/CSE 70A. Same as CSE 120A. EECS 150B/CSE 120A and EECSH 150B may not both be taken for credit. Formerly ECE 120A. (Design units: 0)

EECSH 150B Discrete-Time Signals and Systems (4) S. Foundations of discrete-time linear-time-invariant (DTLTI) systems for analysis and design of digital signal processors. Introduction to time-domain techniques based on z-transforms, and Discrete-Time-, Discrete-, and Fast-Fourier Transforms. Unification of concepts achieved by filter design example. Prerequisite: EECS 70A/CSE 70A. EECSH 150B and EECS 150B/CSE 120A may not both be taken for credit. (Design units: 1)

EECS 152A Digital Signal Processing (3). Nature of sampled data, sampling theorem, difference equations, data holds, z-transform, w-transform, digital filters, Butterworth and Chebychev filters, quantization effects. Prerequisite: EECS 150B/CSE 120A. Same as CSE 135A. Formerly ECE 135A. (Design units: 2)

EECS 152B Digital Signal Processing Design and Laboratory (3). Students plan and perform 10 core laboratory exercises covering signal synthesis and analysis with various filter and frequency transform processes. Models of radio and radar/sonar signal processing are included. Prerequisite: EECS 152A/CSE 135A. Same as CSE 135B. Formerly ECE 135B. (Design units: 3)

EECS 160A Introduction to Control Systems (4) F. Modeling, stability, and specifications of feedback control systems. Root locus, Bode plots, Nyquist criteria, and state-space methods for dynamic analysis and design. Corequisite: EECS 160LA. Prerequisites: EECS 10, CEE 10, or MAE 10; EECS 170B, EECS 170LB; EECS 150A. Formerly ECE 140A. (Design units: 2)

EECS 160LA Control Systems I Laboratory (1) F. Laboratory accompanying EECS 160A. Corequisite: EECS 160A. Formerly ECE 140LA. (Design units: 1)

EECS 160B Sampled-Data and Digital Control Systems (3). Sampled-data and digital control systems. Sampling process and theory of digital signals; z-transform and modeling; stability; z-plane, frequency response, state-space techniques of digital control system synthesis. Prerequisites: EECS 31; EECS 160A, EECS 160LA. Formerly ECE 140B. (Design units: 2)

88
EECS161 Electric Machines and Drives (3) S. Magnetic circuits and transformers. Fundamentals of energy conversion. Application to synchronous, induction, commutator, and special purpose machines. Electric drives. Corequisite: EECS161L. Prerequisite: EECS70B or consent of instructor. Formerly ECE160. (Design units: 2)

EECS161L Electric Machines and Drives Laboratory (1) S. Laboratory exercises supplementing the content of EECS161. Corequisite: EECS161. Formerly ECE160L. (Design units: 0)


EECS163L Power Systems Laboratory (1). Experiments and field trips relevant to studies in power systems. Corequisite: EECS163. Formerly ECE163L. (Design units: 0)

EECS166A Industrial and Power Electronics (4). Power switching devices, pulse width modulation (PWM) methods, switching converter topologies, control, and magnetics. Prerequisites: EECS170C; EECS160A or consent of instructor. Concurrent with EECS267A. Formerly ECE166A. (Design units: 2)

EECS166B Advanced Topics in Industrial and Power Electronics (3). Practical design of switching converters, electromagnetic compatibility, thermal management, and/or control methods. Prerequisite: EECS166A or consent of instructor. Formerly ECE166B. (Design units: 1)

EECS170A Electronics I (4) F. The properties of semiconductors, electronic conduction in solids, the physics and operation principles of semiconductor devices such as diodes and transistors, transistor equivalent circuits, and transistor amplifiers. Corequisite: Physics 7E. Prerequisites: EECS70A, Physics 7D. Formerly ECE113A. (Design units: 1)

EECS170LA Electronics I Laboratory (1) F. For CpE and EE majors. Laboratory accompanying EECS170A to perform experiments on semiconductor material properties, semiconductor device physics and operation principles, and transistor amplifiers to improve experimental skills and to enhance the understanding of lecture materials. Corequisites: EECS170A, Physics 7E. Prerequisites: EECS70A, EECS70B, Physics 7D. Formerly ECE113LA. (Design units: 1)

EECS170B Electronics II (4) W. Design and analysis of single-stage amplifiers, biasing circuits, inverters, logic gates, and memory elements based on CMOS transistors. Corequisite: EECS170LB. Prerequisites: EECS70B, EECS170A, EECS170LA. EECS170B and EECSH170B may not both be taken for credit. Formerly ECE113B. (Design units: 2)

EECS170LB Electronics II Laboratory (1) W. Laboratory accompanying EECS170B. Corequisites: EECS170B. Prerequisites: EECS170A, EECS170LA. Formerly ECE113LB. (Design units: 2)

EECS170C Electronics III (4) S. Principles of operation, design, and utilization of integrated circuit modules, including multi-stage amplifiers, operational amplifiers, and logic circuits. Corequisites: EECS170LC. Prerequisites: EECS170B, EECS170LB. Formerly ECE113C. (Design units: 2)

EECS170LC Electronics III Laboratory (1) S. Laboratory accompanying EECS170C to provide hands-on training in design of digital/analog circuits/subsystems. Corequisites: EECS170C. Prerequisites: EECS170B, EECS170LB. Formerly ECE113LC. (Design units: 1)
**EECS170D Integrated Electronic Circuit Design (4)** F. Overview of design and fabrication of modern digital integrated circuits. Fabrication of CMOS process; transistor-level design simulation, functional characteristics of basic digital integrated circuits, different logic families including static and dynamic logic, layout and extraction of digital circuits; automated design tools. Prerequisites: EECS170C and EECS170LC. Formerly ECE113D. (Design units: 4)

**EECS170E Analog and Communications IC Design (4).** Advanced topics in design of analog and communications integrated circuits. Topics include: implementation of passive components in integrated circuits; overview of frequency response of amplifiers, bandwidth estimation techniques, high-frequency amplifier design; design of radio-frequency oscillators. Prerequisite: EECS170D. Formerly ECE113E. (Design units: 3)

**EECS174 Fundamentals of Semiconductor Devices (4).** Operation principle and characteristics of a broad range of semiconductor devices including bipolar junction device, field-effect transistors, quantum and nanodevices. Prerequisite: EECS170A. Formerly ECE114A. (Design units: 1)

**EECS175A Very Large Scale Integration (VLSI) Project (4)** S. Students create VLSI design projects from conception through architecture, floor planning, detailed design, simulation, verification, and submission for project fabrication. Emphasis on practical experience in robust VLSI design techniques. Prerequisites: EECS170D; EECS115 or consent of instructor. Concurrent with EECS275A. Formerly ECE115A. (Design units: 4)

**EECS175B Very Large Scale Integration (VLSI) Project Testing (4)** F. Test and document student-created Complementary Metal Oxide Semiconductor (CMOS) Very Large Scale Integration (VLSI) projects designed in EECS175A. Emphasis on practical laboratory experience in VLSI testing techniques. Prerequisite: EECS175A or consent of instructor. Concurrent with EECS275B. Formerly 115B. (Design units: 0)

**EECS176 Fundamentals of Solid-State Electronics and Materials (4).** Physical properties of semiconductors and the roles materials play in device operation. Topics include: crystal structure, phonon vibrations, energy band, transport phenomenon, optical properties and quantum confinement effect essential to the understanding of electronic, optoelectronic, and nanodevices. Prerequisites: EECS170A, EECS170LA. EECS176 and ECE116 may not both be taken for credit. (Design units: 1)

**EECS179 Microelectromechanical Systems (MEMS) (4).** Small-scale machines, small-scale phenomena, MEMS fabrication, MEMS CAD tools, MEMS devices and packaging, MEMS testing. Prerequisite: Physics 51A or consent of instructor. Formerly ECE119. (Design units: 2)

**EECS180 Engineering Electromagnetics (4)** F. Electromagnetic fields and solutions to problems in engineering applications; Maxwell's equations and plane wave propagation, reflection, and transmission. Corequisites: Mathematics 2D and 3D. Prerequisite: Physics 7E. Formerly ECE170. (Design units: 1)

**EECS182 Monolithic Microwave Integrated Circuit (MMIC) Analysis and Design (4).** Design of microwave amplifiers including low-noise amplifier, multiple stage amplifiers, power amplifiers, and introduction to broadband amplifiers. The goal is to provide the basic knowledge for the design of microwave amplifiers ranging from wireless system to radar system. Prerequisite: EECS180 or consent of instructor. Formerly ECE172. (Design units: 3)

**EECS187 Engineering Electrodymanics (4).** Time-varying electromagnetic fields including waveguides, resonant cavities, radiating systems. Motion of charged particles in electromagnetic fields, radiation by moving charges. Scattering and dispersion. Prerequisite: EECS180. Formerly ECE177. (Design units: 1)

**EECS188 Optical Electronics (4)** W. Photodiodes and optical detection, photometry and radiometry, geometric optics, lens theory, imaging system, EM wave propagation, optical waveguides and fibers, heterojunction structures, laser theory, semiconductor lasers, and optical transmission system. Prerequisite: consent of instructor. Formerly ECE178. (Design units: 1)
EECS189A-B Electrical Engineering Senior Design Project (2-2) F, W. Design projects for seniors in the Electrical Engineering program. Each project is supervised by a faculty member. Prerequisites: EECS170C, EECS150A, EECS180, and senior standing. EECS189A: In-Progress grading. Formerly ECE189A-B. (Design units: 2-2)

EECS195 Special Topics in Electrical and Computer Engineering (1 to 4). Prerequisites vary. May be repeated for credit as topics vary. Formerly ECE195. (Design units: varies)

EECS198 Group Study (1 to 4). Group study of selected topics in engineering. Prerequisites vary. Formerly ECE198. (Design units: varies)

EECS198L Group Laboratory (1 to 4). Group laboratory for experimentation or design in connection with special projects or EECS198 courses. Corequisite: EECS198. Formerly ECE198L. (Design units: varies)

EECS199 Individual Study (1 to 4). For undergraduate Engineering majors in supervised but independent reading, research, or design. 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. May be taken for credit for a total of six units. Formerly ECE199. (Design units: varies)

EECS199P Individual Study (1 to 4). Same description as EECS199. Pass/Not Pass grading only. May be repeated for credit as topics vary. Formerly ECE199P. (Design units: varies)

EECSH199 Individual Study for Honors Students (1 to 5). For undergraduate honor students majoring in Electrical Engineering. Independent reading, research, or design under the direction of a faculty member or group of faculty members in Electrical and Computer Engineering. 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. Prerequisite: consent of instructor; open only to Campuswide Honors students. May be taken for credit four times. Formerly ECEH199. (Design units: varies)

GRADUATE

EECS202A Principles of Imaging (4) F. Linear systems, probability and random processes, image processing, projection imaging, tomographic imaging. Prerequisite: Physics 51B or 61B or equivalent. Same as Physics 233A. Concurrent with Physics 147A. Formerly ECE237A-B.

EECS202B Techniques in Medical Imaging I: X-ray, Nuclear, and NMR Imaging (4) W. Ionizing radiation, planar and tomographic radiographic and nuclear imaging, magnetism, NMR, MRI imaging. Prerequisite: EECS202A. Same as Physics 233B. Concurrent with Physics 147B.

EECS202C Techniques in Medical Imaging II: Ultrasound, Electrophysiological, Optical (4) S. Sound and ultrasound, ultrasonic imaging, physiological electromagnetism, EEG, MEG, ECG, MCG, optical properties of tissues, fluorescence and bioluminescence, MR impedance imaging, MR spectroscopy, electron spin resonance and ESR imaging. Prerequisite: EECS202C. Same as Physics 233C. Concurrent with Physics 147C.

EECS203A Digital Image Processing (3). Pixel-level digital image representation and elementary operations; Fourier and other unitary transforms; compression, enhancement, filtering, and restoration; laboratory experience is provided. Prerequisite: EECS152A. Formerly ECE234A.

EECS204 Advanced Computer Graphics (4). Provides the fundamental understanding of mathematical and physical models used in computer graphics applications: physics of color image formation, polygon approximations, ray tracing, radiosity and image-based modeling and rendering, visualization and geometric modeling. Prerequisite: EECS104 and ICS 183, or consent of instructor. Formerly ECE204.
EECS205 Advanced Scientific Visualization (4). Introduces advanced visualization techniques for various types of measured or computer-simulated data. Typical applications for these visualization techniques include the study of airflows around car bodies, medical data, and molecular structures. Prerequisite: EECS105 or consent of instructor. Formerly ECE205.

EECS206 Advanced Computer-Aided Geometric Design (4). Mathematical background for three-dimensional realistic graphics, CAD/CAM, and geometric modeling. Polynomials, vector spaces, divided differences, techniques for the definition and manipulation of curves and surfaces, Coon's patches, Bezier curves and surfaces, B-spline curves and surfaces, beta-splines, box-splines. Prerequisite: EECS106 or consent of instructor. Formerly ECE206.

EECS207A Advanced Digital Image Processing (4). Introduces image and texture segmentation and symbolic representation, three-dimensional modeling, relational structures, three-dimensional object recognition, three-dimensional scene analysis and interpretation. An application area of particular interest is biomedical imaging. Prerequisite: EECS107 or consent of instructor. Formerly ECE207A.

EECS208 Principles of Virtual Reality (4). Introduces cutting-edge virtual reality technology. Provides an introduction to the physical principles, technological challenges, possibilities, and limitations for the creation of virtual environments. Programming projects emphasize the visualization, exploration, and modification of scientific data in virtual environments. Prerequisite: EECS104 or consent of instructor. Formerly ECE208.

EECS209A Rendering Techniques for Biomedical Imaging (4). Image acquisition techniques (overview), combining different modalities (CT/MRI/fMRI/PET), 2-D image enhancement techniques, image storage (wavelet compression), feature detection, 3-D surface reconstruction, volume rendering, scalability, final project (hands-on experience). Formerly ECE209A.

EECS210 Modeling and Rendering for Image Synthesis (3). Provides the fundamental understanding of mathematical and physical models used in image synthesis applications: geometric models, physics of color image formation, polygon approximations, ray tracing, and radiosity. Formerly EECS207.

EECS211 Advanced System Software (3) W. Study of operating systems including interprocess communication, scheduling, resource management, concurrency, reliability, validation, protection and security, and distributed computing support. System software design languages and modeling analysis. Prerequisite: EECS112 and EECS111; or consent of instructor. Formerly ECE231.

EECS213 Computer Architecture (3). Problems in hardware, firmware (microprogram), and software. Computer architecture for resource sharing, real-time applications, parallelism, microprogramming, and fault tolerance. Various architectures based on cost/performance and current technology. Prerequisites: EECS112, EECS112L. Formerly ECE233.

EECS215 Design and Analysis of Algorithms (3). Computer algorithms from a practical standpoint. Algorithms for symbolic and numeric problems such as sorting, searching, graphs, and network flow. Analysis includes algorithm time and space complexity. Formerly ECE235.

EECS217 VLSI System Design (4) S. Overview of integrated fabrication, circuit simulation, basic device physics, device layout, timing; MOS logic design; layout generation, module generation, techniques for very large scale integrated circuit design. Prerequisite: EECS112. Formerly ECE251.

EECS218 Distributed Computer Systems (3) S. Design and analysis techniques for decentralized computer architectures, communication protocols, and hardware-software interface. Performance and reliability considerations. Design tools. Prerequisites: EECS211 and EECS213. Formerly ECE252. Same as Networked Systems 261.
EECS219 Distributed Software Architecture and Design (3). Practical issues for reducing the software complexity, lowering cost, and designing and implementing distributed software applications. Topics include the distributed object model distributed environment, platform-independent software agents and components, the middleware architecture for distributed real-time and secure services. Prerequisite: EECS211. Formerly ECE255.

EECS220 Advanced Digital Signal Processing Architecture (3). Studies the latest DSP architectures for applications in communication (wired and wireless) and multimedia processing. Emphasis given to understanding the current design techniques and to evaluate the performance, power, and application domain of the latest DSP processors. Prerequisite: EECS 213 or consent of instructor.

EECS221 Topics in Computer Engineering (3). New research results in computer engineering. May be repeated for credit. Formerly ECE238.


EECS223 Real-Time Computer Systems (3). Time bases, clock synchronization, real-time communication protocols, specification of requirements, task scheduling. Validation of timelines, real-time configuration management. Prerequisites: EECS211 and EECS213. Formerly ECE253.

EECS224 Fault-Tolerant Computing (4). Various aspects of fault-tolerant computing systems. Includes hardware and software failures, reliability, and mechanism to recover from failures. Prerequisite: EECS211. Formerly ECE254.

EECS225 Advanced Data Engineering (3). Advanced data models, data analysis, intelligence and integration, distributed database management systems, parallel databases, multimedia and visual databases, Web database management, advanced database applications. Prerequisite: EECS116 or Computer Science 122A. Formerly ECE257.


EECS241A Digital Communications I (3). Concepts and applications of digital communication systems. Baseband digital transmission of binary, multi-amplitude, and multidimensional signals. Introduction to and performance analysis of different modulation schemes. Formerly ECE228A.

EECS241B Digital Communications II (3). Concepts and applications of equalization, multicarrier modulation, spread spectrum, and CDMA. Digital communications through fading memory channels. Prerequisite: EECS241A. Formerly ECE228B.

EECS242 Information Theory (3). Fundamental capabilities and limitations of information sources and information transmission systems. An analytical framework for modeling and evaluating communication systems: entropy, mutual information asymptotic equipartition property, entropy rates of a stochastic process, data compression, channel capacity, differential entropy, the Gaussian channel. Prerequisite: EECS240. Formerly ECE225.

EECS243 Error Correcting Codes (3) S. Different techniques for error correcting codes and analyzing their performance. Linear block codes; cyclic codes; convolutional codes. Minimum distance; optimal decoding; Viterbi decoding; bit error probability. Coding gain; trellis coded modulation. Prerequisite: EECS240. Formerly ECE226.

EECS244 Wireless Communications (3). Introduction to wireless communications systems. Wireless channel modeling. Single carrier, spread spectrum, and multi-carrier wireless modulation schemes. Diversity techniques. Multiple-access schemes. Transceiver design and system level tradeoffs. Brief overview of GSM, CDMA (IS-95) and 2.5, 3G cellular schemes. Prerequisite: EECS241A. Formerly ECE224.

EECS245 Space-Time Coding (3). A fundamental study of: capacity of MIMO channels, space-time code design criteria, space-time block codes, space-time trellis codes, differential detection for multiple antennas, spatial multiplexing. BLAST. Prerequisite: EECS242.

EECS248A Internet (4) F. A broad overview of basic Internet concepts. Internet architecture and protocols, including addressing, routing, TCP/IP, quality of service, and streaming. Prerequisite: EECS148, Computer Science 132, or consent of instructor. Same as Computer Science 232 and Networked Systems 201.

EECS248B Performance Analysis of Computer Communication Networks (3) W. Mathematical modeling and optimization of network performance and design. Data link layer and media access protocols. Queuing models for communication networks. Routing and congestion control. Prerequisite: EECS248A. Same as Networked Systems 250. Formerly ECE229B.

EECS250 Digital Signal Processing I (3). Fundamental principles of digital signal processing, sampling, decimation and interpolation, discrete Fourier transforms and FFT algorithms, transversal and recursive filters, discrete random processes, and finite-word effects in digital filters. Prerequisites: EECS152A or equivalent. Formerly ECE230A.


EECS260A Linear Systems I (3). State-space representation of continuous-time and discrete-time linear systems. Controllability, observability, stability. Realization of rational transfer functions. Prerequisite: EECS160A. Formerly ECE240A.

EECS260B Linear Systems II (3). Continuation of deterministic linear multivariable systems. Linear state feedback and observers in continuous-time and discrete-time system control. Introduction to stochastic systems. Prerequisite: EECS260A. Formerly ECE240B.

EECS261A Linear Optimization Methods (3). Formulation, solution, and analysis of linear programming and linear network flow problems. Simplex methods, dual ascent methods, interior point algorithms and auction algorithms. Duality theory and sensitivity analysis. Shortest path, max-flow, assignment, and minimum cost flow problems. Prerequisite: Mathematics 2J or consent of instructor. Same as Networked Systems 253. Formerly ECE281A.

EECS261B Nonlinear Optimization Methods (3). Formulation, solution, and analysis of nonlinear programming problems. Unconstrained optimization, optimization over a convex set, Lagrange multiplier theory, Lagrange multiplier algorithms, duality theory, convex programming, dual methods, and multi-objective optimization theory. Emphasizes mathematical analysis. Prerequisite: Mathematics 2J or consent of instructor. Same as Networked Systems 254. Formerly ECE281B.


EECS266 Advanced Topics in Power Systems (3). Economic dispatch, unit commitment, power system planning and operation, and power production. Power system problems of current interest. Prerequisite: EECS163 or consent of instructor. Formerly ECE263. Offered upon sufficient demand.

EECS267A Industrial and Power Electronics (4) W. Power switching devices, pulse width modulation (PWM) methods, switching converter topologies, control, and magnetics. Prerequisite: EECS170C, EECS160A, or consent of instructor. Concurrent with EECS166A. Formerly ECE266A.

EECS267B Topics in Industrial and Power Electronics (3). Practical design of switching converters, electromagnetic compatibility, thermal management, and/or control methods. Prerequisite: EECS267A or consent of instructor. Formerly ECE266B.

EECS270A Advanced Analog Integrated Circuit Design I (3). Basic transistor configurations; differential pairs; active load/current sources; supply/temperature-independent biasing; op-amp gain and output stages; amplifier frequency response and stability compensation; nonidealties in op-amps; noise and dynamic range in analog circuits. Prerequisites: EECS170C and 170LC, or equivalent; or consent of instructor. Formerly ECE213A.

EECS270B Advanced Analog Integrated Circuit Design II (3) W. Advanced transistor modeling issues; discrete-time and continuous-time analog Integrated Circuit (IC) filters; phase-locked loops; design of ICs operating at radio
frequencies; low-voltage/low-power design techniques; A/D and D/A converters; AGC circuits. Prerequisite: EECS270A or consent of instructor. Formerly ECE213B.

EECS270C Design of Integrated Circuits for Broadband Applications (3) S. Topics include: broadband standards and protocols; high-frequency circuit design techniques; PLL theory and design; design of transceivers; electrical/ optical interfaces. Prerequisite: EECS 270A or consent of instructor. Formerly ECE213C.

EECS270D Complementary Metal-Oxide Semiconductor (CMOS) Radio-Frequency Integrated Circuit Design (3) S. Topics include: CMOS RF component modeling; matching network design; transmission line theory/ modeling; Smith chart and S-parameters; noise modeling of active and passive components; high-frequency amplifier design; low-noise amplifier (LNA) design; mixer design; RF power amplifier. Prerequisite: EECS270A or consent of instructor. Formerly ECE213D.

EECS272 Topics in Electronic System Design (3). New research results in electronic system design. May be repeated for credit. Formerly ECE212.

EECS273 Electronics Packaging (3) Materials, processes, techniques, and principles in interconnect and packaging of electronic products after the device-containing semiconductor wafer is fabricated. The electronic, optical, thermal, mechanical, and reliability properties of the materials are evaluated in the context of modern electronics manufacturing processes. Prerequisite: consent of the instructor.

EECS274 Biomedical Microdevices (MEMOS) (3). Construction, lithographic patterning and etching, sealing and connecting, molding, and testing of microdevices. Prerequisite: EECS179 or consent of instructor. Formerly ECE219.

EECS275A Very Large Scale Integration (VLSI) Project (4) S. Students create VLSI design projects from conception through architecture, floor planning, detailed design, simulation, verification, and submission for project fabrication. Emphasis on practical experience in robust VLSI design techniques. (Successful students are expected to take EECS275B.) Prerequisite: EECS170D, EECS115, or consent of instructor. Concurrent with EECS175A. Formerly ECE215A.

EECS275B Very Large Scale Integration (VLSI) Project Testing (4) F. Test and document student-created Complementary Metal Oxide Semiconductor (CMOS) Very Large Scale Integration (VLSI) projects designed in EECS275A. Emphasis on practical laboratory experience in VLSI testing techniques. Prerequisite: EECS275A or consent of instructor. Concurrent with EECS175B. Formerly ECE215B.

EECS276 Solid-State Electronics (3). Covers the fundamentals of solid-state electronics which govern the operating principles of semiconductor devices. Specific topics include crystal structure, energy band, carrier transport, carrier generation and recombination, optical properties, heterostructure, quantum confinement effect, and nanostructures. Prerequisites: EECS170A, EECS180, or consent of instructor. Formerly ECE216. Offered alternate years.

EECS277A Advanced Semiconductor Devices I (3) W. Advanced complementary metal-oxide-semiconductor field-effect transistors (CMOSFET), device scaling, device modeling and fabrication, equivalent circuits, and their applications for digital, analog, RF. Prerequisite: EECS174. Formerly ECE217A.

EECS277B Advanced Semiconductor Devices II (3) S. Metal-semiconductor field-effect transistors (MESFET), heterojunction bipolar transistors (HBT), microwave semiconductor devices, equivalent circuits, device modeling and fabrication, microwave amplifiers, transmitters, and receivers. Prerequisite: EECS174. Formerly ECE217B.

EECS277C Nanotechnology (3). Fabrication and characterization techniques of electrical circuit elements at the nanometer scale. Quantized conductance, semiconductor quantum dots, single electron transistors, molecular wires,
Prerequisites: EECS170A and Physics 51A; or consent of instructor. Formerly ECE217C.

EECS278 Micro-System Design (4) W. Covers the fundamentals of the many disciplines needed for design of Micro-Electro-Mechanical Systems (MEMS): microfabrication technology, structural mechanics on micro-scale, electrostatics, circuit interface, control, computer-aided design, and system integration. Same as MAE247. Formerly ECE247.

EECS279 Micro-Sensors and Actuators (4) S. Introduction to the technology of Micro-Electro-Mechanical Systems (MEMS). Fundamental principles and applications of important microsensors, actuation principles on micro-scale. Introduction to the elements of signal processing; processing of materials for micro sensor/actuator fabrication; smart sensors and microsensor/ microactuator array devices. Same as MAE249. Formerly ECE249.

EECS280A Advanced Engineering Electromagnetics I (3). Stationary electromagnetic fields, Maxwell's equations, circuits and transmission lines, plane waves, guided waves, and radiation. Prerequisite: EECS180 or equivalent. Formerly ECE279A.

EECS280B Advanced Engineering Electromagnetics II (3) W. Two- and three-dimensional boundary value problems, dielectric waveguides and other special waveguides, microwave networks and antenna arrays, electromagnetic properties of materials, and electromagnetic optics. Prerequisite: EECS280A or equivalent. Formerly ECE279B.

EECS282 Monolithic Microwave Integrated Circuit (MMIC) Analysis and Design II (3) S. Design of microwave amplifiers using computer-aided design tools. Covers low-noise amplifiers, multiple stage amplifiers, broadband amplifiers, and power amplifiers. Hybrid circuit design techniques including filters and baluns. Theory and design rules for microwave oscillator design. Prerequisite: EECS 180, EECS182, or consent of instructor. Formerly ECE272.

EECS285A Optical Communications (3). Introduction to fiber optic communication systems, optical and electro-optic materials, and high-speed optical modulation and switching devices. Prerequisite: EECS180 or consent of instructor. Formerly ECE275A.

EECS285B Lasers and Photonics (3) W. Covers the fundamentals of lasers and applications, including Gaussian beam propagation, interaction of optical radiation with matters, and concepts of optical gain and feedback. Applications are drawn from diverse fields of optical communication, signal processing, and material diagnosis. Prerequisite: undergraduate course work in electromagnetic theory and atomic physics. Formerly ECE275B.

EECS285C Integrated and Fiber Optics (3) S. Propagation in dielectric waveguides and in optical fiber, grating structures and their applications in wavelength filtering and multiplexing, dynamic tunable passive components, signal dispersion and compensation, polarization effects, optical switching. Prerequisite: EECS285B or consent of instructor. Formerly ECE275C.

EECS292 Preparation for M.S. Comprehensive Examination (1 to 3) F, W, S. Individual reading and preparation for the M.S. comprehensive examination. Satisfactory/Unsatisfactory only. May be repeated for credit. Formerly ECE292.

EECS293 Preparation for Ph.D. Preliminary Examination (1 to 6) F, W, S. Individual reading and preparation for the Ph.D. preliminary examination. Satisfactory/Unsatisfactory only. May be repeated for credit. Formerly ECE293.

EECS294 Electrical Engineering and Computer Science Colloquium (1 to 4) F, W, S. Invited speakers discuss their latest research results in electrical engineering and computer science. Prerequisite: consent of instructor. Satisfactory/Unsatisfactory only. May be repeated for credit. Formerly ECE294.
EECS295 Seminars in Engineering (1 to 4) F, W, S. Scheduled each year by individual faculty in major field of interest. Prerequisite: consent of instructor. May be repeated for credit. Formerly ECE295.

EECS296 Master of Science Thesis Research (4 to 12) F, W, S. Individual research or investigation conducted in the pursuit of preparing and completing the thesis required for the M.S. degree in Engineering. Prerequisite: consent of instructor. May be repeated for credit. Formerly ECE296.

EECS297 Doctor of Philosophy Dissertation Research (4 to 12) F, W, S. Individual research or investigation conducted in preparing and completing the dissertation required for the Ph.D. degree in Engineering. Prerequisite: consent of instructor. May be repeated for credit. Formerly ECE297.

EECS298 Topics in Electrical Engineering and Computer Science (3) F, W, S. Study of Electrical and Computer Engineering concepts. Prerequisite: consent of instructor. May be repeated for credit as topics vary. Formerly ECE298.

EECS299 Individual Research (1 to 12) F, W, S. Individual research or investigation under the direction of an individual faculty member. Prerequisite: consent of instructor. May be repeated for credit. Formerly ECE299.

**Ph.D. Preliminary Examination Information**

- **First, you should secure a Ph.D. advisor to do research.**
- **Ph.D. Preliminary Examination**

The Ph.D. preliminary examination will consist of a written and an oral examination. The exam will be offered twice per year (tentatively in Dec and May). Students can take the exam only twice and have to pass the exam by the end of the 2nd full year of Ph.D. study. Students should pass both exams and only students who pass the written exam would be eligible to take the oral exam. Failing in the written exam is counted as one of the two tries. For more information about the courses covered by the preliminary examination for all four EECS concentrations, please see the website at: http://www.eng.uci.edu/dept/eecs/graduate/programs/roadmap_phd
OK
M.S. Plan of Study
Plan of Study goes here
OK

M.S. Plan of Study

Plan of Study goes here
OK
M.S. Plan of Study
Plan of Study goes here
OK
M.S. Plan of Study
Plan of Study goes here
Environmental Engineering

Catalogue

Environmental Engineering addresses the development of strategies to control anthropogenic emissions of pollutants to the atmosphere, waterways, and terrestrial environment; the remediation of polluted natural systems; the design of technologies to treat waste; fire safety; noise suppression; energy efficiency; and the evaluation of contaminant fate in urban environments. Environmental engineering issues are now an important component in the development of many engineering technologies and consequently are an important aspect of an engineering education. The discipline itself is interdisciplinary and requires a curriculum that provides students with an understanding of fundamentals in air- and water-quality sciences, contaminant fate and transport, and design concepts for pollutant emission control and treatment. To avoid the development of environmental engineering solutions which only transform one form of pollution to another, modern engineering education programs must require exposure and familiarity with a greater number of subjects than ever before.

Environmental engineers with an interdisciplinary background are particularly sought to address the complex infrastructure needs of today's society, where they must be able to communicate with teams of scientists and engineers from different disciplines. Environmental engineering graduates who meet this description can expect to remain in strong demand in the private and public employment sectors, and their range of career opportunities is highly diverse. Examples of career fields and activities include the development of new technologies to genetically engineer microorganisms for waste treatment, design of combustion and control processes that minimize pollutant emissions and maximize energy efficiency, resolution of complex pollutant transport processes in naturally heterogeneous systems, development of new physical-chemical treatment approaches, and characterization of pollutant transformation mechanisms in natural systems.

Curricular and research subjects of interest in Environmental Engineering include environmental air and water chemistry, environmental microbiology, combustion technologies, aerosol science, transport phenomena, reactor theory, unit operations and systems design, mathematical modeling, energy systems, soil physics, fluid mechanics, hydrology, and meteorology. Interdisciplinary research endeavors commonly bridge many of these different subjects and a current focus is maintained on new and emerging technologies. Curriculum objectives have also been set to maintain a balance between the depth and breadth of program scope for each student.

Students may pursue either the M.S. or Ph.D. degree in Engineering.

Required Background

The interdisciplinary nature of the program allows students with a variety of backgrounds to undertake studies in this field. Students with a background in engineering—particularly chemical, civil, environmental, and mechanical engineering—as well as scientists from biology, chemistry, environmental science, and physics, are encouraged to participate.

Students admitted to the program are expected to have had rigorous undergraduate exposure to a number of relevant subject areas including air quality, environmental chemistry, fluid mechanics, microbial processes, and reactor theory and design. The degree to which each student meets the program's background requirement is determined by participating faculty at the time of admission. Students with an insufficient background who are offered admission will be required to take a set of appropriate
prerequisite courses. Prerequisite work typically involves at least two and frequently as many as five or six upper-division, undergraduate courses each of which must be completed with a final grade of B or better. Occasionally, lower-division work in chemistry, mathematics, or physics is required. The student's specific prerequisite course work requirement, if any, is stated in the letter of admission.

The background requirement establishes a common foundation for graduate study in the program. Not all students are required to take prerequisite course work; those who are may do so following matriculation in the graduate program. In addition, M.S. students may use a limited amount of upper-division course work taken to meet the background requirement in partial fulfillment of graduate degree requirements.

Although this list is not exhaustive, commonly required prerequisite courses within each of the required background areas are as follows:

**Air Quality:** Engineering MAE110, MAE162, or MAE164.

**Environmental Chemistry:** CEE162 or Earth System Science 102.

**Environmental Microbiology:** CBEMS112 or CBEMS116/216.

**Fluid Mechanics:** CEE170, CBEMS120A, or MAE130A.

**Reactor Theory and Design:** CBEMS110.

**Core Requirement**

Students must complete an advanced mathematics course, either CBEMS230 (Applied Engineering Mathematics I), CEE283 (Mathematical Methods in Engineering Analysis), or MAE200B (Engineering Analysis II).

**Areas of Emphasis**

Each student selects a primary area of emphasis within Environmental Engineering: Water Quality, Water Resources, or Air Quality and Combustion. To achieve the interdisciplinary objectives of the program, students are required to take at least two electives outside their primary area, one each in two different areas. These outside electives may also be taken from approved courses in other academic units, including the Schools of Social Ecology, Physical Sciences, and Medicine. Electives within each of the emphasis areas in Engineering are listed below.

**Water Quality:** CBEMS210 (Reaction Engineering), CBEMS214 (Bioremediation), CBEMS216 (Field Practicum), CBEMS218 (Bioengineering with Recombinant Organisms), CBEMS220 (Transport Phenomena), CBEMS234 (Bioreactor Engineering), CEE263 (Advanced Biological Treatment Processes), CEE265 (Advanced Physical-Chemical Treatment Processes), CEE266 (Aqueous Geochemistry), CEE267 (Advanced Treatment Models), CEE269 (Hazardous Waste Treatment and Disposal), Earth System Science 201B (Global Biogeochemistry).

**Water Resources:** CEE271 (Flow in Unsaturated Media), CEE272 (Stochastic Geohydrology), CEE274A (Transport Phenomena in Saturated Porous Media), CEE274B (Transport Phenomena in Unsaturated Porous Media and Fractures), CEE275 (Coastal Engineering), CEE276 (Surface Water Hydrology), CEE277 (Transport in Rivers and Estuaries), CEE278 (Flow in Rivers and Estuaries), CEE279A
(Computations in Environmental Hydrologies), CEE279B (Computation in Subsurface Hydrology), Earth System Science 201C (Earth System Change).


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 36 units of study. Study plans for both options must also include two graduate courses from outside the student's primary area of emphasis.

Plan I. Thesis Option

A thesis option is available to students who prefer to conduct a focused research project. Students selecting this option must complete an original research investigation and a thesis, and obtain approval of the thesis by a thesis committee. Of the 36 required units, at least 20 must be graduate courses (numbered 200-289), including either CBEMS230, MAE200B, or CEE283. A maximum of eight M.S. research units and up to eight units of upper-division undergraduate elective courses may be applied to the degree with the prior approval of a faculty advisor.

Plan II. Comprehensive Examination Option

Alternatively, students may select a comprehensive examination option in which they must successfully complete 36 units of study and pass a comprehensive examination. At least 24 units must be graduate courses (numbered 200-289), including either CBEMS230, MAE200B, or CEE283. Up to 12 units may be taken as upper-division undergraduate elective courses.

DOCTOR OF PHILOSOPHY DEGREE

The Ph.D. concentration in Environmental Engineering requires the achievement of original and significant research that advances the discipline. Doctoral students are selected on the basis of an outstanding record of scholarship and potential for research excellence.

The doctoral study program is tailored to the individual student in consultation with a faculty advisory committee. There are no specific course requirements, however, additional mathematics courses beyond those required for an M.S. degree may be required. Within this flexible framework, the School maintains specific guidelines that outline the milestones of a typical doctoral program. All doctoral students should consult the Environmental Engineering program guidelines for details, but there are several milestones to be passed: admission to the Ph.D. program by the faculty, passage within the first year of a preliminary examination, formal advancement to candidacy by passing a qualifying examination in the third year (or second year for students who entered with a master's degree), completion of a significant research investigation, and the submission and oral defense of an acceptable dissertation.

Committees for preliminary and Ph.D. qualifying examinations and the doctoral committee must have at least one Environmental Engineering faculty member from outside the student’s area of emphasis. The
student's dissertation topic must be approved by the student's doctoral committee. The degree is granted upon the recommendation of the doctoral committee and the Dean of Graduate Studies. 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.

**Ph.D. Preliminary Examination Information**

The exam is oral and administered by an ad-hoc committee of three Environmental Engineering faculty selected by the student. The exam is scheduled by the student in accordance with the availability of the participating faculty. The purpose of the exam is to ensure that the student has comprehended and assimilated important Environmental Engineering topics covered by B.S. and/or M.S. course work, and the student passes the exam by demonstrating the level of comprehension necessary for independent research, as judged by the ad-hoc committee. The exam emphasizes, but is not limited to, three specific areas of study corresponding to three upper division or graduate level courses and the expertise of the three participating faculty. Students should consult with faculty prior to the exam to clarify the topics that will be emphasized during the exam.
OK
M.S. Plan of Study
Plan of Study goes here
Materials and Manufacturing Technology

Catalogue

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—into the whole of materials and manufacturing technology. Such integration will breed 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: MSE205 (Materials Physics); CEE242 (Advanced Strength of Materials); MAE252 (Fundamentals of Microfabrication); MAE247/EECS278 (Micro-Systems Design).

Electives

These electives are grouped into four areas of emphasis.

Chemical Processing and Production: Chemistry 213 (Chemical Kinetics), CBEMS210 (Reaction Engineering), CBEMS220 (Transport Phenomena), CBEMS230 (Applied Engineering Mathematics I), CBEMS240 (Chemical Engineering Thermodynamics), MSE210 (Materials Characterization Techniques and Analysis).

Electronic and Photonic Materials and Devices: BME210 (Cell and Tissue Engineering), EECS174 (Fundamentals of Semiconductor Devices), EECS188 (Optical Electronics), EECS274 (Biomedical Microdevices), EECS276 (Solid-State Electronics), EECS277A-B (Advanced Semiconductor Devices I, II), EECS277C (Nanotechnology), EECS285A (Optical Communications), EECS285B (Lasers and Photonics), EECS280A-B (Advanced Engineering Electromagnetics I, II), MSE272 (Microelectronic and Photonic Materials and Technology).

Electronic Manufacturing and Packaging: EECS273 (Electronics Packaging), CBEMS280 (Optoelectronics Packaging), EECS279/MAE249 (Micro-Sensors and Actuators), EECS285A (Optical Communications), EECS285B (Lasers and Photonics), EECS285C (Integrated and Fiber Optics), MSE272 (Microelectronic and Photonic Materials and Technology), MAE253 (BIOMEMS).


It should be noted that specific course requirements within the areas of emphasis are decided based on consultation with the Director of the MMT concentration, and in selecting electives, students are encouraged to take courses which are not in their area of emphasis.

MASTER OF SCIENCE DEGREE

A minimum of 36 units is required for the M.S. degree. Two options are available, a thesis option and a comprehensive examination 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 21 units must be taken from courses numbered 200-289, among which
12 units are from MMT core courses and nine units are in the area of emphasis approved by the faculty advisor and the graduate advisor. Up to eight units of CBEMS296, EECS296, MAE 296, BME 296, or CEE296 and up to eight units of upper-division undergraduate elective courses taken as a graduate student at UCI can be applied toward the 36-unit requirement. For the comprehensive examination option, students are required to complete 36 units of study. At least 24 units must be taken from courses numbered 200-289, among which 12 units are from MMT core courses and 12 units are in the area of emphasis approved by the faculty advisor and the graduate advisor. Up to eight units of upper-division undergraduate elective courses taken as a graduate student at UCI can be applied toward the 36-unit 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 and the Graduate Dean.

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 year two, development of a research proposal, passing the qualifying examination during year three, and the successful completion and defense of the dissertation during the fourth or fifth year. There is no foreign language requirement.

The preliminary examination, to be taken during the second year of the Ph.D. program, is based on the core courses in MMT and courses taken in the area of emphasis. The examination committee is appointed by the MMT Director with subsequent approval by the School's Associate Dean of Graduate Studies. Students must advance to candidacy in their third year (second year for those who entered with a master's degree). The degree is granted upon the recommendation of the doctoral committee and the Dean of Graduate Studies. 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.

Ph.D. Preliminary Examination Information

The MMT Ph.D. preliminary examination is designed to test the student’s knowledge of graduate coursework in preparation for Ph.D. research. To take the preliminary examination the student must complete and submit the MMT Ph.D. Preliminary Examination Signup Form at least four weeks prior to the examination date. The completed form contains the following:
a) A list of six UCI graduate courses that encompass the graduate-level background and knowledge to be covered on the examination. If the student has transferred from another institution, equivalent UCI courses must still be identified.

b) The proposed Preliminary Examination Committee consisted of MTT concentration faculty. Only one of the members can be an adjunct faculty.

After approving the MMT Ph.D. Preliminary Exam form, the Faculty Advisor will submit it to the Director of the MMT Program for approval.
OK

M.S. Plan of Study

Plan of Study goes here
Materials Science and Engineering

Catalogue

Graduate Study in Materials Science and Engineering

Materials Science and Engineering focuses on the development of new materials and new applications for materials in engineering. Current research programs include nanomaterials, nanostructures, nanoelectronics, nanodevices, nanocharacterization, device/system packaging materials, materials for advanced energy and fuel cells, biocompatible materials, soft materials such a biological materials and polymeric materials, electronic and photonic materials, hybrid materials, interfacial engineering of materials, and multifunctional materials. Faculty with relevant research are affiliated with the Integrated Nanofabrication Research Facility (INRF), the National Fuel Cell Research Center (NFCRC), the California Institute for Telecommunications and Information Technology (Calit2), and the Materials Characterization Nanofabrication Facility (MCNF), among others.

The MSE graduate degree program is hosted by the Department of Chemical Engineering and Materials Science (ChEMS). Faculty who may serve as advisors are listed as affiliated with the ChEMS Department and include faculty with strong materials science and engineering research programs from other departments. The formal degree that is awarded upon successful completion of the program is either the M.S. or Ph.D. in Materials Science and Engineering. The Henry Samueli School of Engineering also offers M.S. and Ph.D. degrees in Engineering with a concentration in Material Science and Engineering (MSE).

Recommended Background

Given the nature of Materials Science and Engineering as a cross-disciplinary program, students having a background, and suitable training, in Materials, Engineering (Mechanical, Electrical, Civil, Chemical, Aerospace), and the Physical Sciences (Physics, Chemistry, Geology) are encouraged to participate. A student with an insufficient background may be required to take remedial undergraduate courses. Recommended background courses include an introduction to materials, thermodynamics, mechanical behavior, and electrical/optical/magnetic behavior.

Specific Fields of Emphasis

The Materials faculty at UCI have special interest and expertise in all areas of modern materials and technologies, including biomaterials, energy materials, advanced ceramics, polymers and nanocomposite materials, structural and nanostructured metallic materials, micro/nano-device materials, device/system packaging materials, multifunctional materials.

Required Courses

Students are required to take one course from each area for the M.S. degree and as a basis for the Ph.D. preliminary examination.


Electrical and Optical Behavior: MSE 205 (Materials Physics).

Thermodynamics and Kinetics: one course from MSE252 (Theory of Diffusion), MSE253 (Kinetic Phenomena in Materials), MSE265 (Phase Transformations), CBEMS240 (Thermodynamics).


Electives

Faculty advisors should be consulted on the selection of elective courses. All graduate courses offered in CBEMS are potential electives. Graduate-level courses offered in other Engineering departments and relevant graduate courses from other schools may also be taken as electives.

MASTER OF SCIENCE DEGREE

The M.S. degree reflects achievement of an advanced level of competence for professional practice of materials science and engineering. Two options are available: a thesis option and a comprehensive examination option.

Plan I: Thesis Option

For the M.S. thesis option, students are required to complete a research study of great depth and originality and obtain approval for a complete program of study. A committee of three full-time faculty members is appointed to guide development of the thesis. A minimum of 36 units is required for the M.S. degree. For the thesis option, at least 21 units must be taken from courses numbered 200-289, among which 15 units are from MSE core courses and at least six units are from elective courses approved by the graduate advisor. Up to eight units of 296 and up to eight units of undergraduate elective courses can be applied toward the 36-unit requirement. Full-time graduate students must enroll in the departmental seminar each quarter unless exempt by petition.

Plan II: Comprehensive Examination Option

For the comprehensive examination option, students are required to complete 36 units of study and a comprehensive examination. At least 24 units must be taken from courses numbered 200-289, among which 15 units are from MSE core courses and at least nine units are from elective courses approved by the graduate advisor. Up to eight units of undergraduate elective courses can be applied toward the 36-unit requirement. Full-time graduate students must enroll in the departmental seminar each quarter unless exempt by petition.

DOCTOR OF PHILOSOPHY DEGREE

The Ph.D. degree in Materials Science and Engineering 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. After substantial preparation, Ph.D. candidates work under the supervision of faculty advisors. The process involves extended 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 in order to remain in good standing include the following: acceptance into a research group by the faculty advisor at the end of the student's first year of study; successful completion of the Ph.D. preliminary examination by the end of the second year; preparation for pursuing research and the development of a research proposal culminating in passing the Qualifying Examination by the end of the third year of the Ph.D. program. Students must advance to candidacy in their third year (second year for students who entered with a master's degree).

The course requirements for the Ph.D. are the same as for the M.S. Students must enroll in the departmental seminar each quarter unless exempt by petition. However, most Ph.D. students take several courses beyond the M.S. degree requirements. The preliminary examination is based on the five core courses for the M.S. Students who have completed an MSE M.S. degree elsewhere must have a written approval by the graduate advisor to waive required MSE core courses, if they have taken the equivalent courses elsewhere.

Final examination involves the oral presentation and defense of an acceptable dissertation in a seminar attended by students and faculty. The Ph.D. degree is granted upon the recommendation of the Doctoral Committee and the Dean of the 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.

**Relationship of M.S. and Ph.D. programs.** Students applying with the objective of a Ph.D. are admitted to the M.S./Ph.D. program only if they are likely to successfully complete a Ph.D. program. These students do not formally reapply to the Ph.D. program after completing the M.S. degree. Students who apply to the M.S.-only program must formally apply for the Ph.D. program if they desire to continue on for a Ph.D. Financial support is usually reserved for those students who plan to complete the Ph.D. The normative time to complete M.S. and Ph.D. degrees is two and five years, respectively.

**Courses in Materials Science**

**GRADUATE**

**MATERIALS SCIENCE**

**MSE200 Crystalline Solids: Structure, Imperfections, and Properties (3).** Principles and concepts underlying the study of advanced materials including alloys, composites, ceramics, semiconductors, polymers, ferroelectrics, and magnetics. Crystal structure and defects, surface and interface properties, thermodynamics and kinetics of phase transformations, and material processing, related to fundamental material properties. Prerequisites: Chemistry 1A-B-C, Physics 7A, 7LA.

**MSE205 Materials Physics (3).** Covers the electronic, optical, and dielectric properties of crystalline materials to provide a foundation of the underlying physical principles governing the properties of existing and emerging electronic and photonic materials.

**MSE210 Materials Characterization Techniques and Analysis (3).** Introduction to microcharacterization techniques, and their application to the study of bulk and thin-film materials; methods of analysis, including electron beam-induced excitations (SEM, SAM, EDX, STEM), x-ray and photon-induced interactions (PEX, ESCA), ion processes (RSB, SIMS, PIXE), submicron optical techniques, and electromagnetic field-induced methods (STM, AFS). Prerequisites: Chemistry 1A-B-C, Physics 7A, 7LA.
MSE220 Analytical Methods in Materials Science (3). Selected topics in modern analysis and their application to material problems in such areas as thermodynamics, crystallography, deformation and fracture, diffusion, phase transformations. Prerequisite: graduate standing or consent of instructor.

MSE251 Dislocation Theory (3). Theory of elasticity and symmetry of crystals, plasticity and slip systems, stress field of dislocation, dislocation reaction, theories of yielding and strengthening, application of reaction-rate kinetics to thermally activated dislocation motion. Prerequisite: ENGR54 or consent of instructor.

MSE252 Theory of Diffusion (3). Solid-state diffusion, analysis of diffusion in solids, thermodynamics of diffusion, application of diffusion theory to phase transformation and deformation problems. Prerequisite: ENGR54 or consent of instructor.

MSE255A Design with Ceramic Materials (3). Dependence of ceramic properties on bonding, crystal structure, defects, and microstructure. Ceramic manufacturing technology. Survey of physical properties. Strength, deformation, and fracture of ceramics. Mechanical design with brittle, environment-sensitive materials exhibiting time-dependent strengths. Prerequisite: ENGR54 or consent of instructor.

MSE255B Science of Composite Materials (3). Properties of intentionally inhomogeneous materials, especially composites manufactured for extreme environments, elevated temperatures, wear resistance. Chemical compatibility of constituents, microstructural stability, environmental effects. Micromechanics of particulate and fiber-reinforced composites. Strength criteria, toughness, and failure mechanisms. Thermomechanical effects. Prerequisites: ENGR54 and ENGR150 or consent of instructor.


MSE256B Fracture of Engineering Materials (3). Fracture mechanics and its application to engineering materials. Elastic properties of cracks, the stress intensity factor, the crack tip plastic zone, the J Integral approach, fracture toughness testing, the crack tip opening displacement, fracture at high temperatures, fatigue crack growth. Prerequisite: CBEMS155 or MAE156; or consent of instructor.

MSE257B Recent Developments in Advanced Materials (3). Concepts underlying the evolution of the microstructure and the mechanical behavior of advanced metallic systems during processing; correlation between microstructures and mechanical behavior. Emphasis on current research areas in materials.

MSE259 Transmission Electron Microscopy (4). The theory and operation of the transmission electron microscope (TEM), including the basic construction, electron optics, electron diffraction and reciprocal space, formation of image and image contrast, interpretation of images and electron diffraction information, microanalysis, and specimen preparation. Includes laboratory component. Prerequisite: MSE200 or consent of instructor.

MSE261 High-Temperature Deformation of Engineering Materials (3). Theoretical and practical aspects of creep and superplasticity in metallic and non-metallic systems are presented. Topics include: creep testing methods, diffusional creep, deformation mechanism maps, and superplasticity in non-metals. Prerequisites: ENGR54; CBEMS155 or MAE156; or consent of instructor.

MSE263 Computer Techniques in Experimental Materials Research (3). Principles and practical guidelines of automated materials testing. Computer fundamentals, programming languages, data acquisition and control hardware, interfacing techniques, programming strategies, data analysis, data storage, safeguard procedures. Prerequisite: consent of instructor. Concurrent with CBEMS163.
MSE264 Scanning Electron Microscopy (3). The theory and operation of the scanning electron microscope (SEM) and x-ray microanalysis. Topics covered include the basic design and electron optics, electron beam-specimen interactions, image formation and interpretation, x-ray spectrometry, and other related topics and techniques. Includes laboratory. Prerequisite: MSE200 or consent of instructor.

MSE265 Phase Transformations (3). Advanced thermodynamics and kinetics of phase transformations and phase transitions. Prerequisite: CBEMS165 or CBEMS 240 or equivalent.

MSE266 Science of Nanoscale Materials and Devices (3). Covers the properties of nanoscale materials and aspects of current research on next-generation electronic devices. Topics include nanofabrication, characterization of nanostructure materials, and device concepts that take the advantage of quantum mechanical phenomena on the nanoscale. Prerequisite: ENGR54 and consent of instructor. Concurrent with CBEMS166.

MSE267 Environmentally Sustainable Manufacturing (3). Multidisciplinary case study approach to environmentally sustainable manufacturing with a focus on electronic products. Engineering, economic, public policy, and industrial ecology aspects. Design, manufacture, policy, and environmental impact reviewed as a function of the entire life-cycle of the materials from extraction through disposal or recycling. Prerequisite: graduate standing. Concurrent with CBEMS167.


MSE269 Biosensors (3). Provides an introduction to the field of biosensors: basic design concepts, fabrication, and performance of biologically selective sensing devices. Topics include the immobilization of biological components to transducers, electrochemical, optical, mass sensitive, and electronic-based transducers. Prerequisites: undergraduate chemistry and biology.

MSE270 Materials Processing (4). Principles of control of structure, properties, and shape in material processing. Design considerations in manufacturing processes. Materials covered: polymers, ceramics, semiconductors, and metals. Special topics lectures in self-assembly and nanofabrication are included. Prerequisite: consent of instructor.

MSE272 Microelectronic and Photonic Materials and Technology (3). Covers materials, processes, and principles involved in manufacturing of microelectronics and photonics after the silicon has been fabricated. Considerations of electronic, optical, thermal mechanical, and reliability properties of the materials are viewed in the context of current microelectronics manufacturing processes. Prerequisites: ENGR54, Chemistry 1C, Mathematics 2J, and Physics 7A-B-D-E. Concurrent with CBEMS172.

Ph.D. Preliminary Examination Information

WAITING FOR CONFIRMATION
Information regarding the Materials Science and Engineering preliminary exam is forthcoming and will be distributed at a later date.
WAITING FOR UPDATED PLAN
M.S. Plan of Study
Plan of Study goes here
Mechanical and Aerospace Engineering

Catalogue

Graduate Study in Mechanical and Aerospace Engineering

The Mechanical and Aerospace Engineering faculty have special interest and expertise in four thrust areas: continuum mechanics; power, propulsion, and environment; micro/nanomechanics; and systems and design.

Continuum mechanics faculty study the physics of fluids, physics and chemistry of solids, and structural mechanics. Areas of emphasis in fluid mechanics include incompressible and compressible turbulent flows, multiphase flows, chemically reacting and other nonequilibrium flows, aeroacoustics, aerooptics, and fluid-solid interaction. In the field of solid mechanics, research and course work emphasize theoretical and computational approaches which contribute to a basic understanding of and new insight into the properties and behavior of condensed matter. General areas of interest are large-strain and large-rotation inelastic solids, constitutive modeling, and fracture mechanics. Computational algorithms center on boundary element methods and the new class of meshless methods. Studies in structural mechanics involve the analysis and synthesis of low-mass structures, smart structures, and engineered materials, with emphasis on stiffness, stability, toughness, damage tolerance, longevity, optimal life-cycle costs and self-adaptivity.

Research in power, propulsion, and environment encompasses aerospace propulsion, combustion and thermophysics, fuel cell technologies, and atmospheric physics and impacts. In aerospace propulsion, particular emphasis is placed in the areas of turbomachinery, spray combustion, combustion instability, innovative engine cycles, and compressible turbulent mixing. The topic of combustion and thermophysics addresses the fundamental fluid-dynamical, heat-transfer, and chemical mechanisms governing combustion in diverse settings. Fuel cell research encompasses the development of fuel-cell technology, hybrid engines, and thermionic devices. Activities cover the thermodynamics of energy systems, the controls associated with advanced energy systems, and systems analyses. The area of atmospheric physics and impacts deals with the modeling and controlling of chemical pollution, particle dispersion, and noise emission caused by energy-generation and propulsion devices. Research on atmospheric turbulence addresses the energy exchanges between the Earth's land and ocean surfaces and the overlying atmosphere.

Micro/nanomechanics encompasses the thrusts of miniaturization engineering, mechatronics, and biotechnology. Miniaturization engineering is relevant to the development of small-scale mechanical, chemical and biological systems for applications in biotechnology, automotive, robotic, and alternative energy applications. It involves the establishment of scaling laws, manufacturing methods, materials options and modeling from the atom to the macro system. Mechatronic design is the integrated and optimal design of a mechanical system and its embedded control system. Main focus research is the design, modeling, and characterization of Micro Electro Mechanical Systems (MEMS). Particular emphasis is placed on analysis and design of algorithmic methods and physical systems that realize sensor-based motion planning. The thematic area of biotechnology involves the understanding, modeling, and application of fundamental phenomena in mechanical engineering, electrical engineering, and chemistry towards the development of bio-sensors and actuators.

Systems and design research is conducted in the areas of dynamic systems optimization and control, biomechanical engineering, robotics and machine learning, and design engineering. Advanced concepts in
dynamics, optimization and control are applied to the areas of biobotics, flight trajectory design, guidance and navigation, learning systems, micro sensors and actuators, flexible structures, combustion, fuel cells, and fluid-optical interactions. Biomechanical engineering integrates physiology with engineering in order to develop innovative devices and algorithms for medical diagnosis and treatment. The focus of robotics and machine learning is the creation of machines with human-like intelligence capabilities for learning. Faculty in design engineering develop methodologies to address issues ranging from defining the size and shape of components needed for force and motion specifications, to characterizing performance in terms of design parameters, cost and complexity.

Aerospace engineering research efforts combine specialties from each of the four thrust areas toward the design, modeling, and operation of complex systems.

The Department offers the M.S. and Ph.D. degrees in Mechanical and Aerospace Engineering.

MASTER OF SCIENCE DEGREE

Two plans are available to pursue study toward the M.S. degree: a thesis option and a comprehensive examination option. Opportunities are available for part-time study toward the M.S. degree. The Plan of Study for both options must be developed on consultation with a Faculty Advisor and approved by the Department Graduate Advisor.

Plan I: Thesis Option

The thesis option requires completion of 47 units of study; the completion of an original research project with a Faculty Advisor, the writing of the thesis describing it; and approval of the thesis by a thesis committee. This plan is available for those who wish to gain research experience or as preparation for study toward the doctoral degree. To complete the required 47 units, students must complete 32 units (eight courses) in graduate courses numbered MAE200-289, 12 units of MAE296, and 3 units of MAE298. This program of study must be developed in consultation with the graduate advisor.

NOTE: Students who enter prior to fall of 2008 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 or 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 (i.e., at least 8 graduate-level courses to meet the 24, 200-289 level unit requirement).

Plan II: Comprehensive Examination Option

The comprehensive examination option requires completion of 47 units of study, 44 units (11 courses) of which must be from graduate courses numbered MAE200-289, and 3 units of which must be MAE298. The program of study must be developed in consultation with the graduate advisor. Up to 8 units in the MAE200-289 range may be replaced by an equal number of units of MAE294, which includes execution and documentation of a research or design project.

NOTE: Students who entered prior to fall of 2008 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 or 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 (i.e., at least 8 graduate-level courses to meet the 24, 200-289 level unit requirement).
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 requirements (i.e., at least 11 graduate-level courses to meet the 33, 200-289 level unit requirement.

**DOCTOR OF PHILOSOPHY DEGREE**

The doctoral program in Mechanical and Aerospace Engineering is tailored to the individual needs and background of the student. The detailed program of study for each Ph.D. student is formulated in consultation with a faculty advisor who takes into consideration the objectives and preparation of the candidate.

Within this flexible framework the Department maintains specific guidelines that outline the milestones of a typical doctoral program. All doctoral students should consult the Departmental Ph.D. guidelines for program details, but there are several milestones to be passed: admission to the Ph.D. program by the faculty; completion of six non-research courses beyond M.S. degree requirements; passage of a preliminary examination or similar assessment of the student's background and potential for success in the doctoral program; course work; meeting departmental teaching requirements, which can be satisfied through service as a teaching assistant or equivalent; research preparation; formal advancement to candidacy in the third year (second year for students who entered with a master's degree) through a qualifying examination conducted on behalf of the Irvine division of the Academic Senate; development of a research proposal; completion of a significant research investigation, and completion and defense of an acceptable dissertation. There is no foreign language requirement. The degree is granted upon the recommendation of the Doctoral Committee and the Dean of Graduate Studies. Students enrolled in the Ph.D. program must take a full-time load (minimum of 12 units). 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.

Before seeking admission, Ph.D. applicants are encouraged to communicate directly and in some detail with prospective faculty sponsors. The student's objectives and financial resources must coincide with a faculty sponsor's research interests and research support. Financial aid in the form of a teaching assistantship or fellowship may not cover the period of several years required to complete the program. During the balance of the period the student will be in close collaboration with the faculty research advisor.

**Courses in Mechanical and Aerospace Engineering**

**UPPER-DIVISION**

**MAE106 Mechanical Systems Laboratory (4) S.** Experiments in linear systems, including op-amp circuits, vibrations, and control systems. Emphasis on demonstrating that mathematical models can be useful tools for the analysis and design of electro-mechanical systems. Prerequisites: MAE140 and EECS70A. (Design units: 2)

**MAE107 Fluid Thermal Science Laboratory (4) F.** Fluid and thermal engineering laboratory. Experimental analysis of fluid flow, heat transfer, and thermodynamic systems. Probability, statistics, and uncertainty analysis. Report writing is emphasized and a design project is required. Corequisite: MAE120. (Design units: 1)
MAE108 Aerospace Laboratory (4) F. Analytical and experimental investigation in aerodynamics, fluid dynamics, and heat transfer. Emphasis on study of flow over objects and lift and drag on airfoils. Introduction to basic diagnostic techniques. Report writing is emphasized and a design project is required. Prerequisite: MAE130B. (Design units: 2)


MAE112 Propulsion (4) W. Application of thermodynamics and fluid mechanics to basic flow processes and cycle performance in propulsion systems: gas turbines, ramjets, scramjets, and rockets. Prerequisite: MAE135. (Design units: 1)

MAE113 Electric Propulsion (4) S. Space propulsion requirements and maneuvers, stressing those best suited to electric propulsion. An introduction to plasma physics. Electrothermal, electromagnetic and electrostatic accelerators, with emphasis in technologies (ion engines, Hall thrusters and colloidal thrusters) belonging to the latter family. Prerequisite: MAE112 or equivalent. Concurrent with MAE213.

MAE115 Applied Engineering Thermodynamics (4) F. Application of thermodynamic principles to compressible and incompressible processes representative of practical engineering problems—power cycles, refrigeration cycles, multicomponent mixtures, air conditioning systems, combustion and compressible flow. Design of a thermodynamic process. Prerequisite: MAE91. MAE115 and CBEMS45C may not both be taken for credit. (Design units: 2)

MAE117 Solar and Renewable Energy Systems (4). Basic principles, design, and operation of solar and other renewable energy systems including solar photo-voltaic, solar thermal, hydroelectric, wind, and biomass gasification and combustion. Includes power generation and storage, and renewable fuels for transportation and stationary power generation. Prerequisite: MAE115. (Design units: 1)

MAE120 Heat Transfer (4) S. Fundamentals of heat transfer. Conduction, convection in laminar and turbulent flow, radiation heat transfer, and combined heat transfer. Application to insulation requirements and heat exchangers. Prerequisites: Mathematics 2D, Physics 7C, and MAE91, each with a grade of C- or better; and MAE130B. MAE120 and CBEMS125B may not both be taken for credit. (Design units: 0)

MAE130A Introduction to Fluid Mechanics (4) F. Fundamental concepts; fluid statics; fluid dynamics; Bernoulli's equation; control-volume analysis; basic flow equations of conservation of mass, momentum, and energy; differential analysis; potential flow; viscous incompressible flow. Prerequisites: Physics 7C, Mathematics 2D, Mathematics 2E, MAE30, and MAE80, each with a grade of C- or better. Only one course from MAE130A, MAEH130A, CEE170, CEEH170, and CBEMS125A may be taken for credit. (Design units: 0)

MAEH130A Honors Introduction to Fluid Mechanics (4). Fundamental concepts; fluid statics; fluid dynamics; Bernoulli's equation; control-volume analysis; basic flow equations of conservation of mass, momentum, and energy; differential analysis; potential flow, using complex potential; vorticity dynamics; Kelvin-Helmholtz instability; tensor notation; constitutive relations; viscous incompressible flow. Prerequisites: Physics 7C, Mathematics 2D, Mathematics 2E, MAE30, and MAE80, each with a grade of C- or better. Only one course from MAEH130A, MAE130A, CEE170A, CEEH170A, and CBEMS125A may be taken for credit. (Design units: 0)

MAE130B Introduction to Viscous and Compressible Flows (4) W. Introduction to the analysis of viscous flows including fully developed laminar and turbulent flow in a pipe, viscous flow over immersed bodies, evaluation of boundary layer characteristics, lift and drag, compressible flow in a duct and normal shock waves. Prerequisites: Mathematics 2D, Physics 7C, and MAE91 each with a grade of C- or better; MAE130A and MAE140. (Design units: 1)
MAE135 Compressible Flow (4) S. Compressibility effects in fluid mechanics. One-dimensional flow with area variation, friction, heat transfer, and shocks. Design of gas supply systems. Two-dimensional flow with oblique shocks and isentropic waves. Supersonic airfoil theory and design, wind-tunnel design. Basic diagnostics. Prerequisites: MAE91, MAE130A, MAE130B. (Design units: 1)

MAE136 Aerodynamics (4) F. Analysis of flow over aircraft wings and airfoils, prediction of lift, moment, and drag. Topics: fluid dynamics equations; flow similitude; viscous effects; vorticity, circulation, Kelvin's theorem, potential flow; superposition principle, Kutta-Joukowski theorem; thin airfoil theory; finite wing theory; compressibility. Prerequisites: MAE130A, MAE130B. (Design units: 1)


MAE145 Theory of Machines and Mechanisms (4) S. Presents the basic mathematical theory of machines. Focuses on the principles of cam design, gearing and gear train analysis, and the kinematic and dynamic analysis of linkages, together with an introduction to robotics. Prerequisites: Engineering MAE80; Mathematics 2J. (Design units: 2)

MAE146 Astronautics (4) W. Motion in gravitational force fields, orbit transfers, rocketry, interplanetary trajectories, attitude dynamics and stabilization, navigation, reentry, the space environment. Prerequisite: MAE80. (Design units: 1)

MAE147 Vibrations (4) W. Analysis of structural vibrations of mechanical systems. Modeling for lumped and distributed parameter systems. Topics: single- and multi-degree of freedom systems, free and forced vibrations, Fourier series, convolution integral, mass/stiffness matrices, and normal modes with design project. Prerequisites: MAE80, MAE140, Mathematics 2E. (Design units: 1)

MAE150 Mechanics of Structures (4) F, S, Summer. Stresses and strains. Torsion. Bending. Beam deflection. Shear force and moment distributions in beams. Yielding and buckling of columns. Combined loading. Transformation of stresses and strain. Yielding criteria. Finite elements analysis of frames. Dynamics of a two-bar truss. Prerequisites: Engineering MAE30 or ENGR30; Mathematics 2J. Same as ENGR150. Only one course from MAE150/ENGR150, ENGRH150, CEE150, and CEEH150 may be taken for credit. (Design units: 2)

MAE150L Mechanics of Structures Laboratory (1). Experimental techniques for the measurement of mechanical properties of materials and structures. Tension, torsion, bending, compression. Determination of strength, stiffness, toughness for metals, polymers, ceramics and composite. Weibull's analysis. Corequisite: MAE150. Prerequisite: MAE30. MAE150L and CEE150L may not both be taken for credit.

MAE151 Mechanical Engineering Design (4) W. A comprehensive group design project experience that involves identifying customer needs, idea generation, reverse engineering, preliminary design, standards, prototype development, testing, analysis, and redesign of a product involving fluid, thermal, and mechanical components. Introduces design for manufacturing and the environment. Prerequisites: MAE120, MAE145, and MAE170; senior standing. (Design units: 3)

MAE152 Introduction to Computer-Aided Engineering (4). Elements and principles of computer-aided engineering with modern hardware and software are presented with a design focus. Case studies are used to assist in finite-element method techniques. Prerequisites: ENGR150, MAE120. Formerly MAE152A. (Design units: 2). Not offered every year.

MAE155 Composite Materials and Structures (4). Motivation for composite materials. Different classifications according to the nature of the matrix (PMC, MMC, CMC) and the reinforcement topology (fibers, whiskers, particulates). Mechanical properties. Failure mechanisms. Designing with composite materials. Advantages and
limitations of homogenization techniques for numerical modeling. Prerequisites: ENGR54; MAE150 or CEE150 or ENGR150. Concurrent with MAE255.

**MAE156 Mechanical Behavior and Design Principles (4) W.** Principles governing structure and mechanical behavior of materials, relationship relating microstructure and mechanical response with application to elasticity, plasticity, yielding, necking, creep, and fracture of materials. Introduction to experimental techniques to characterize the properties of materials. Design parameters. Prerequisites: ENGR54. Same as CBEMS155. (Design units: 2)

**MAE157 Lightweight Structures (4) W.** Fundamentals of torsion and bending. Analysis and design of thin-walled and composite beams. Stress analysis of aircraft components. Stiffness, strength, and buckling. Introduction to the Finite Element method and its application to plates and shells. Prerequisite: MAE150 or CEE150 or ENGR150. (Design units: 2)

**MAE158 Aircraft Performance (4) W.** Fundamentals of flight theory applied to subsonic propeller and jet aircraft. Nature of aerodynamic forces, drag and lift of wing and fuselage, high-lift devices, level-flight performance, climb and glide performance, range, endurance, take-off and landing distances, static and dynamic stability and control. Prerequisites: MAE130A. (Design units: 2)

**MAE159 Aircraft Design (4) S.** Preliminary design of subsonic general aviation and transport aircraft with emphasis on layout, aerodynamic design, propulsion, and performance. Estimation of total weight and weight distribution, design of wings, fuselage, and tail, selection and location of engines, prediction of overall performance. Prerequisites: MAE112, MAE136, MAE158. (Design units: 4)

**MAE164 Air Pollution and Control (4).** Sources, dispersion, and effects of air pollutants. Topics include emission factors, emission inventory, air pollution, meteorology, air chemistry, air quality modeling, impact assessment, source and ambient monitoring, regional control strategies. Prerequisites: MAE91; MAE130A or CEE170. (Design units: 2)

**MAE170 Introduction to Control Systems (4) F.** Feedback control systems. Modeling, stability, and systems specifications. Root locus, Nyquist, and Bode methods of analysis and design. Prerequisites: Mathematics 2D, Physics 7C, Engineering MAE80, each with a grade of C- or better; and MAE106. MAE170 and MAEH170 may not both be taken for credit. (Design units: 2)

**MAEH170 Honors Introduction to Control Systems (4).** Feedback control systems. Modeling, stability, and systems specifications. Root locus, Nyquist, and Bode methods of analysis and design. Contour integration, advanced frequency-domain concepts, and design tools. Prerequisites: Mathematics 2D, Physics 7C, Engineering MAE80, each with a grade of C- or better; and MAE106. MAEH170 and MAE170 may not both be taken for credit. (Design units: 2)


**MAE172 Design of Computer-Controlled Robots (4).** Students design a small robotic device and program it to exhibit sentient behaviors. The basic aspects of mechatronic design are covered, including motor and sensor selection, control strategies, and microcomputer programming for the implementation of control paradigms. Corequisite: MAE180. Prerequisite: MAE170. (Design units: 3)

MAE180 Electric Circuits and Interfaces (4) W.  The use of semiconductor devices, digital and linear circuits in the design of interfaces to mechanical engineering systems. The design of interfaces to mechanical engineering system. Emphasis on design and use of microprocessor interfacing for control and data acquisition. Prerequisite: MAE106. (Design units: 3).

MAE183 Computer-Aided Mechanism Design (4) F. Focuses on the design of planar, spherical, and spatial mechanisms using computer algebra and graphics. Topics include both exact and approximate analytical design techniques. Students are required to use the existing software (or develop new algorithms) to design various mechanisms for new applications. Prerequisite: Mathematics 2J. (Design units: 4)


MAE188 Engineering Design in Industry (4). Presents the principles of engineering design in the context of an industrial application. Local manufacturing firms define an engineering design project to be completed by students in 10 weeks. Projects include initial brainstorming to final design, with a formal presentation of the result. (Design units: 4)

MAE189 Senior Project—Special Topics (1 to 4) F, W, S. Group or individual senior project of theoretical or applied nature involving design. Prerequisites: senior standing and consent of instructor. May be taken for credit for a total of 12 units. (Design units: 1-4)

MAE195 Seminars in Engineering (1 to 4). Seminars by individual faculty in major fields of interest. Prerequisite: consent of instructor. May be repeated for credit. (Design units: varies)

MAE198 Group Study (1 to 4). Group study of selected topics in engineering. Prerequisite: consent of instructor. May be repeated for credit as topics vary. (Design units: varies)

MAE199 Individual Study (1 to 4). For undergraduate Engineering majors in supervised but independent reading, research, or design. 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. May be taken for credit for a total of eight units. (Design units: varies)

MAE199P Individual Study (1 to 4). Same description as MAE199. Pass/Not Pass grading only. May be repeated for credit as topics vary. (Design units: varies)

MAEH199 Individual Study for Honors Students (1 to 5). Independent reading, research, or design under the direction of a faculty member or group of faculty members in Mechanical and Aerospace Engineering. 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. Open only to members of the Campuswide Honors Program who are Mechanical or Aerospace Engineering majors. May be repeated for credit. (Design units: varies)

GRADUATE


MAE210 Advanced Fundamentals of Combustion (4) S. Premixed, nonpremixed, and heterogeneous reactions, with emphasis on kinetics, thermal ignition, turbulent flame propagation, detonations, explosions, flammability limits, diffusion flame, quenching, flame stabilization, and particle and spray combustion. Prerequisite: MAE224 or MAE230B. Not offered every year.

MAE213 Electric Propulsion (4) S. Space propulsion requirements and maneuvers, stressing those best suited to electric propulsion. An introduction to plasma physics. Electrothermal, electromagnetic and electrostatic accelerators, with emphasis in technologies (ion engines, Hall thrusters and colloidal thrusters) belonging to the latter family. Prerequisite: MAE112 or equivalent. Concurrent with MAE113.

MAE214 Fuel-Cell Fundamentals and Technology (4) S. Fuel-cell systems design, operation, and materials. Electrochemistry and electrocatalysis, cell degradation, nature of fuel-cell electrodes and electrolytes, fuels, and fuel processing. Provides broad insight into fuel-cell science, technology, system design, and operation. Prerequisite: MAE110.

MAE215 Advanced Combustion Technology (4) S. Emphasis on pollutant formation and experimental methods. Formation of gaseous pollutants and soot; transformation and emission of fuel contaminants in gas, liquid, and solid fuel combustion; methods employed to measure velocity, turbulence intensity, temperature, composition, and particle size; methods to visualize reacting flows. Prerequisite: MAE110, MAE200A, and MAE230A or MAE270A. Not offered every year.

MAE216 Statistical Thermodynamics (4). Statistics of independent particles, development of quantum mechanical description of atoms and molecules, application of quantum mechanics, evaluation of thermodynamic properties for solids, liquids, and gases, statistical mechanics of dependent particles (ensembles). Prerequisite: MAE91 or equivalent. Not offered every year.

MAE217 Generalized Thermodynamics (4) S. Generalized thermodynamics develops the laws of continuum thermodynamics from a set of plausible and intuitive postulates. The postulates are motivated qualitatively by a statistical description of matter and are justified by a posterior success for the resulting theory. Prerequisites: MAE91, MAE115 or equivalent. Not offered every year.

MAE220 Conduction Heat Transfer (4). Steady state and transient conduction heat transfer in one- and multi-dimensional geometries. Analytical methods, exact and approximate. Numerical techniques are also included. Prerequisite: MAE120.


MAE226 Special Topics in Fluid and Thermal Sciences (1 to 4). Special topics of current interest in fluid mechanics, heat and mass transfer, multiphase flows, or combustion. Emphasis could be placed on theory, computational methods, or experimental techniques. Prerequisite: consent of instructor.


MAE237 Computational Fluid Dynamics (4). Mathematical, physical, and computational fundamentals of computational fluid dynamics, numerical methods for solving the Euler and Navier-Stokes equations. Topics include: finite-difference and finite-volume discretization, time marching methods, von Neumann analysis, upwinding, flux splitting, TVD, and other high-resolution shock-capturing schemes. Prerequisite: MAE230C or consent of instructor.


MAE241 Dynamics (4) W. Kinematics and dynamics of three-dimensional motions. Lagrange's equations, Newton-Euler equations. Applications include robot systems and spinning satellites. Prerequisite: MAE147 or equivalent.


MAE244 Theoretical Kinematics (4). Spatial rigid body kinematics is presented with applications to robotics. Orthogonal matrices, Rodrigues' formula, Quaternions, Plücker coordinates, screw theory, and dual numbers are studied using modern projective geometry and multi-linear algebra. Applications include trajectory planning, inverse kinematics, and workspace analysis. Not offered every year.

MAE245 Spatial Mechanism Design (4) W. Fundamental kinematic theory required for planar, spherical, and spatial mechanism design. The focus is on algebraic methods for the exact solution of constraint equations. Not offered every year.

MAE246 Algebraic Geometry in Kinematics (4). Examines the algebraic constraint equations that define modern robotic systems. Begins with basic projective geometry, introduces polynomial ideal theory, and applies it to polynomial elimination for the direct kinematics of robotic platforms.

MAE247 Micro-System Design (4) F. Covers the fundamentals of the many disciplines needed for design of Micro-Electro-Mechanical Systems (MEMS): microfabrication technology, structural mechanics on micro-scale, electrostatics, circuit interface, control, computer-aided design, and system integration. Same as EECS278.

MAE248 Differential Kinematics (4). An introduction to differential geometry of rigid motion in the plane, on the sphere, and in three-dimensional space; curvature properties of trajectories of points and lines; and local properties of constraint manifolds that define the workspace of kinematic connections. Prerequisite: consent of instructor.

MAE249 Micro-Sensors and Actuators (4) S. Introduction to the technology of Micro-Electro-Mechanical Systems (MEMS). Fundamental principles and applications of important microsensors and actuation principles on microscale. Introduction to the elements of signal processing; processing of materials for micro sensor/actuator fabrication; smart sensors and microsensor/ microactuator array devices. Same as EECS279.

MAE250 Biorobotics (4) W. Sensors, actuators, and circuits for biological movement control from an engineering perspective. Current approaches to robotic and mechatronic devices that support and enhance human movement.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisite(s)</th>
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<tbody>
<tr>
<td>MAE252</td>
<td>Fundamentals of Microfabrication (4) F.</td>
<td>Introduces Engineering and Science students to the science of miniaturization. Different options to make very small machines (micro and nano size) are reviewed, materials choices are discussed, scaling laws are analyzed, and many practical applications are listed.</td>
</tr>
<tr>
<td>MAE253</td>
<td>BIOMEMS (4) W.</td>
<td>Introduction of BIOMEMS to engineering and science students. After study of various sensing technique fundamentals, various biosensors are introduced. The biological principles involved are introduced via examples. Nanomachining and biomimetics are also discussed.</td>
</tr>
<tr>
<td>MAE254</td>
<td>Mechanics of Solids and Structures (4) W.</td>
<td>Finite deformation kinematics; stress and strain measures; invariance in solid mechanics; objective rates; constitutive theory of elastic and inelastic solids; rate formulations; computational approaches; theories of plates and shells; applications to aerospace vehicles.</td>
</tr>
<tr>
<td>MAE255</td>
<td>Composite Materials and Structures (3).</td>
<td>Motivation for composite materials. Different classifications according to the nature of the matrix (PMC, MMC, CMC) and the reinforcement topology (fibers, whiskers, particulates). Mechanical properties. Failure mechanisms. Designing with composite materials. Advantages and limitations of homogenization techniques for numerical modeling. Prerequisites: ENGR54; MAE150 or CEE150 or ENGR150. Concurrent with MAE155.</td>
</tr>
<tr>
<td>MAE260</td>
<td>Current Issues Related to Tropospheric and Stratospheric Processes (4).</td>
<td>Examination of current issues related to the atmosphere, including energy usage; toxicology; effects on humans, forest, plants, and ecosystems; particulate matter (PM10); combustion; modeling, and meteorology; airborne toxic chemicals and risk assessment; application of science to development of public policies. Prerequisite: One course selected from Chemistry 245, Earth System Science 202, Engineering MAE164, Engineering MAE261, or consent of instructor. Same as Chemistry 241. Not offered every year.</td>
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<tr>
<td>MAE261</td>
<td>Air Quality Modeling (4).</td>
<td>Fundamental principles necessary to understand the dynamics of air pollutants. Derivation and description of mathematical techniques for the numerical solution of the atmospheric equation. Formulation and development of air quality models. Prerequisites: MAE230A and MAE230B or consent of instructor; MAE10 or equivalent FORTRAN knowledge. Not offered every year.</td>
</tr>
<tr>
<td>MAE264</td>
<td>Combustion Particulates and Aerosols (4).</td>
<td>Behavior of airborne solid and liquid particles in air resources engineering. Description of air drag, gravity, Brownian motion, light scattering, charging phenomena, coagulation, size distributions. Applications include generation and classification of aerosols, lung deposition, formation and characteristics of atmospheric aerosols. Prerequisites: MAE130A, MAE130B. Not offered every year.</td>
</tr>
<tr>
<td>MAE270A</td>
<td>Linear Systems I (4) F.</td>
<td>Input-output and state-space representations of continuous-time linear systems. State transition matrices. Controllability and observability. Irreducible realizations. State feedback and observer design. Prerequisite: MAE170 or EECS160A.</td>
</tr>
<tr>
<td>MAE271</td>
<td>System Identification (4) F.</td>
<td>Covers the latest techniques in system identification. Materials covered encompass techniques in both frequency and time domain. Linear and nonlinear dynamic processes, correlation, regression, stochastic approximation, etc., are among the topics covered. Prerequisite: MAE270A. Not offered every year.</td>
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MAE274 Optimal Control (4). Introduction to the principles and methods of optimal control. Topics include: objectives and issues in controlling nonlinear systems; linear variational and adjoint equations; optimality conditions via variational calculus, maximum principle, and dynamic programming; solution methods; applications to control of robots and aerospace vehicles. Not offered every year.

MAE275 Nonlinear Feedback Systems (4). Advanced tools for feedback control system analysis and synthesis. Norms, operators, Lp spaces, contraction mapping theorem, Lyapunov techniques along with their extensions. Circle criterion, positivity and passivity. Applications to nonlinear control methods, such as sliding mode or adaptive techniques. Prerequisite: MAE270B. Not offered every year.

MAE276 Geometric Nonlinear Control (4). Using the mathematics of differential geometry, a number of the concepts and results of linear systems theory have been extended to nonlinear systems. Describes these extensions and illustrates their use in nonlinear system analysis and design. Prerequisites: MAE200A, MAE270A. Not offered every year.


MAE279 Special Topics in Mechanical Systems (4). Selected topics of current interest in mechanical systems. Topics include robotics, kinematics, control, dynamics, and geometric modeling. Prerequisites: MAE241, MAE270A. May be repeated for credit as topics vary. Not offered every year.


MAE294 M.S. Project (4) F, W, S. Tutorial in which master's-level students taking the comprehensive examination option undertake a master's-level research project. May be repeated for credit.

MAE295 Special Topics in Mechanical and Aerospace Engineering (1 to 4) F, W, S. Special topics by individual faculty in major fields of interest. May be repeated for credit as topics vary.

MAE296 Master of Science Thesis Research (4 to 12) F, W, S. Individual research or investigation conducted in the pursuit of preparing and completing the thesis required for the M.S. in Engineering. Prerequisite: consent of instructor. May be repeated for credit.

MAE297 Doctor of Philosophy Dissertation Research (4 to 12) F, W, S. Individual research or investigation conducted in the pursuit of preparing and completing the dissertation required for the Ph.D. in Engineering. Prerequisite: consent of instructor. May be repeated for credit.

MAE298 Seminars in Mechanical and Aerospace Engineering (1) F, W, S. Presentation of advanced topics and reports of current research efforts in mechanical engineering. Required of all graduate students in mechanical engineering. Satisfactory/Unsatisfactory grading only. May be repeated for credit as topics vary.

MAE299 Individual Research (1 to 12) F, W, S. Individual research or investigation under the direction of an individual faculty member. Prerequisite: consent of instructor. May be repeated for credit.
Ph.D. Preliminary Examination Information

Purpose:

The Preliminary Exam determines whether the Ph.D. Candidate has the intellectual strength to continue in the pursuit of the degree. In particular, certain qualifications must be demonstrated: the Preliminary Exam establishes whether the Ph.D. Candidate understands sufficiently well some important fundamental material in the fields of mechanical engineering and aerospace engineering; he/she must show the ability to synthesize different elements of knowledge to solve open-ended problems; and a capability for sound scientific scrutiny and judgment must be observed. The Preliminary Exam serves as a filter to keep students who do not possess the required abilities and skills from continuing with the Ph.D. studies. The exam cannot be taken by those students who have not clearly established a mutual agreement with a research advisor for their doctoral work.

Format:
The Preliminary exam has three parts (A), (B), and (C), which need not be given on the same days during the Exam week. All portions of the Exam remain oral, without any written components.

(A) Applied Mathematics

(B) Dynamics and Control or
Fluid Mechanics or
Solid Mechanics or
Thermal Science and Transport

(C) Synthesis and Integration

The total time of the exam is 150 minutes.
Part A: 30 minutes. Required by all students
Part B: 60 minutes. Major area of student
Part C: 60 minutes. Required by all students

Leaders:
The Graduate Studies Committee chooses examiners, including exam chairs, for the five topical portions of the Parts A and B of the exam. The examiners for 2008-2009 and 2009-2010 years are indicated below:

Part A
Applied Math – FL (Chair), DD, AS, BV

Part B
Dynamics & Controls – KDM (Chair), JEB, FJ, JMM, DJR, AMS
Fluid Mechanics – SEE (Chair), HC, JCL, DP, WAS
Solid Mechanics – SNA, LV, Farghalli Mohamed, and Lizhi Sun
Transport / Thermo – DDR (Chair), MGC, MM, RHR, GSS, YW

Part C
Variable leadership. See document related to System and Integration for details
These teams shall take responsibility for formulating and conducting their corresponding parts of exam for the next two years, 2008-2009 and 2009-2010.
Schedule:
The dates for the two annual offerings of the Preliminary Exam beginning in 2008-2009 are:
• Fall Quarter: the week immediately prior to Thanksgiving week
• Spring Quarter: the third week of Spring Quarter.

It is intended that second-year M.S./Ph.D. graduate students shall normally take the Preliminary Exam for the first time during the Fall Quarter. If a second chance is required for the examination, it shall normally be taken during the Spring Quarter of the second year. Students who join the Department with a M.S. degree must take the Preliminary Exam (for their first time) within 15 months of entry.

Students who do not take the Preliminary Exam in a timely fashion as defined above will not be considered to be in good academic standing and may not be allowed to continue in the Program.

Students taking the Preliminary Exam for the first time must adhere to the new format. Exceptions will only be made for students who failed their first Preliminary Exam prior to Commencement day, 2008. Those students can choose either the old or new format for the second try.

Grading:
Each of the Exam portions will receive a separate pass or fail grade from the responsible faculty team. Any portion failed in the first taking must be retaken. If any portion is failed twice, the student has failed the Preliminary Examination and may not continue for the Ph.D. degree. Students must pass all three portions. At least four faculty members will be in each exam committee for Parts A and B. Only 3 will be present during the exam. The candidate’s advisor should not be present during Part A and Part B of the exam. After the week of exams the group of 3 examiners will meet and vote on the performance of all students. In order to pass, two 2 out of the 3 examiners must vote on “pass”. See document related to System and Integration for details.

Specific Information on each part of the prelim can be found at http://mae.eng.uci.edu/grad/New_Prelim_2008.pdf
OK

M.S. Plan of Study

Plan of Study goes here