GRADUATE STUDENT MANUAL
(POLICIES AND PROCEDURES)

2015-2016

GRADUATE PROGRAM IN MATERIALS SCIENCE & ENGINEERING

University of California, Riverside
Room 313, Materials Science & Engineering Building
Riverside, California 92521

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I. GENERAL INFORMATION

A. INTRODUCTION

The Graduate Program of Materials Science and Engineering at the University of California, Riverside (UCR) offers advanced study in a variety of areas encompassing the breadth of Materials Science and Engineering. The information contained in this manual is intended to help graduate students in this Program and particularly students new to the UCR campus.
Other sources of information include:

- UCR General Catalog
  http://www.catalog.ucr.edu/
- Graduate Student Handbook, Graduate Division
  http://www.graddiv.ucr.edu/StudAffairs/GSHndbk.pdf
- Thesis and Dissertation Format Guide, Graduate Division
  http://www.graduate.ucr.edu/Dissertation.html
- Policies & Regulations Governing Graduate Student Employment, Graduate Division
  http://www.graduate.ucr.edu/forms/PAFHndbk.pdf
- Financial Support Regulations, Graduate Division
  http://www.graduate.ucr.edu/RegFellows.html
- UCR Graduate Division Website
  http://www.graduate.ucr.edu/

The Program may specify more rigorous requirements for the degree than listed in the other sources. Therefore, when there appears to be a conflict in requirements for the degree, the more rigorous requirements must be satisfied. In addition to degree requirements, this manual also summarizes MSE policies and procedures. The MSE program reserves the right to modify the procedures and requirements outlined in this manual. Such modifications generally will not be considered retroactive.

B. ADMISSION

All applicants for admission to the MSE graduate program must be approved first by the MSE Graduate Advisor in charge of admission then by the Dean of Graduate Division (Graduate Dean). To be approved by the MSE Graduate Advisor in charge of admission, an applicant should have a B.S. degree in engineering with a grade point average above 3.0 (based on a 4.0 point system) in the last two years of undergraduate work, a combined (verbal and quantitative) GRE score above 1100 (old version) and 300 (new version) as well as 3 good supporting reference letters. Students from non-English speaking countries also must have a minimum TOEFL score of 550 on the paper-based test, 213 on the computer-based test, or 80 in the internet-

based test. *Typical scores are normally higher for admitted students.* Students with undergraduate degrees outside engineering, who meet the above criteria, may be required to complete remedial undergraduate course work before being granted official admission into the MSE graduate program. This remedial work may not be used to satisfy graduate degree requirements.

C. FINANCIAL ASSISTANCE

Financial awards include: research or teaching assistantships, and fellowships. These are typically awarded for a limited time in the admission package. Subsequent assistantships or fellowships are awarded on a quarterly basis. They include:

- full or part-time salary or stipend, of up to $15,000 per academic year and, in addition,
- payment of the Graduate Student Health Insurance Plan (GSHIP) fee and a Partial Fee Remission (PFR).
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Non-resident students receiving an assistantship *may also receive a partial or full non-resident tuition (NRT) remission*.

Applicants and enrolled students may apply for fellowships, which provide a stipend up to $16,000 and include full or partial payment of tuition and fees.

Assistants are expected to aid faculty members in the instructional or research programs. A 50% appointment requires an average of 20 hours per week. Administration and selection of teaching assistants (TAs) is done through the MSE Graduate Advisor in charge of Academic Affairs. Research assistantships (Graduate Student Researchers, GSRs) are selected by the faculty members directing the project and not by the Program and are supported by research contracts and/or grants. However, faculty members consult with the Graduate Advisors and Program Manager concerning the availability of qualified students seeking support.

Any MSE graduate student whose native language is not English **(in particular, international students) and will TA** ***must pass the SPEAK test or must score 23 or above on the Speaking portion of internet-based TOEFL (iBT) test***. The purpose of both tests is to evaluate English proficiency and comprehensibility.

Scores on the SPEAK test are as follows:

- 50 – 60: **Clear Pass**
- 40 – 45: **Conditional Pass**
- 20 - 35: **Fail**

Waiver: The score for the Speaking portion of the TOEFL should be 23 or above to have the SPEAK test requirement waived.
An MSE graduate student who is assigned a TA position and does not have a "Clear Pass" in the SPEAK test, must attend the English language classes offered at the UCR Extension Center until a "clear pass" is obtained. Students are provided with one quarter of free instruction at UCR Extension Center. If a student is still not able to obtain a Clear Pass, he/she is responsible for paying for the instruction until a "clear pass" is obtained on the SPEAK test. The estimated cost per quarter is $380. A student with a "conditional pass" can be appointed as a TA. However, these appointments will only be approved for one quarter at a time. Every quarter, a student with conditional pass can continue serving as TAs only if approved by the Graduate Dean. This decision is made on the basis of:

- Recommendation from the program, including an assessment of the student's academic ability;
- Student teaching evaluations;
- Other evidence of commitment to/performance in teaching (e.g., faculty evaluations or statements of support, videotapes);
- Evidence of a good-faith effort to improve English skills; and
- Relative proximity to the level of competence represented by a clear pass.

All TAs are required to take the TADP workshop series offered by the Learning Center in the beginning of every quarter. The TA training should be completed in the first quarter a TA begins teaching. Students sign up for the workshop series online at http://www.tadp.ucr.edu/.

D. ADVISING

Upon admission to the MSE graduate program by the Graduate Division, each student is assigned a preliminary faculty Advisor (generally by the Graduate Advisor in charge of admission) to assist with course selection and general curriculum guidance. New graduate students are required to consult with their Advisor before registering for classes. During the first or second quarter of graduate studies, students must select a Faculty Advisor. This Advisor becomes, in effect, the chairperson of the student's M.S. or Ph.D. committee(s). These committees are described in the Degree Requirements section of this manual.

The Ph.D. program is qualitatively different from the undergraduate or Master's program. The Ph.D. program prepares a student for a career in research. The core component of the Ph.D. program is the independent research culminating in a Ph.D. thesis. Ph.D. students admitted with a UCR Fellowship have been chosen and sponsored by a specific Professor based on the student's previous experience and stated interests. The sponsoring Professor will be the Fellowship student's Ph.D. advisor. Upon arrival at UCR, the Fellowship student is expected to join the sponsoring Professor's laboratory and begin participating in research activities under the Professor's direction.

Graduate study is individual in nature and requires frequent interaction between the student and Advisor. The Faculty Advisor must be consulted in the planning of programs of study for each quarter and the preparation of the Statement of Program (Study Plan). Other consultations should be arranged with the Advisor as needed. The Graduate Advisor in charge of Academic Advising or the Program Manager may

also be of assistance and provide counsel in non-degree related matters such as health services, housing, communication deficiencies, and career development.

It is the responsibility of the student to register and submit forms by the deadlines specified in the quarterly *Schedule of Classes*. Therefore, advisement meetings with the degree Advisor should be scheduled in anticipation of these deadlines.

E. COLLOQUIA/SEMINARS

MSE graduate students are required to register for the MSE Colloquium MSE 250 during all quarters of residence. Students have to obtain a letter grade in MSE 250 once per academic year. Alternatively, students can register a MSE 251-259 course and obtain a letter grade there. The choice of MSE 251-259 seminar requires approval by the student's faculty advisor (once assigned) or the MSE Graduate advisor. Colloquia announcements will be posted on the Program bulletin board, on the MSE website, and via email. It is the student's responsibility to watch for the announcements and attend all Program colloquia.

F. KEY PERSONNEL AND POINTS OF CONTACT

The administrative staff is located in Room 313 MSE Building. A listing of key contact personnel of the MSE program with whom graduate students may interact is given below. The complete directory for the MSE program is available at www.mse.ucr.edu.

Katie Dell, Program Manager, Room 307, MS&E, 951-827- 3392, Katie@engr.ucr.edu

Alejandra Torres, Graduate Student Affairs Officer, Room 313, MS&E, 951-827- 3383,

Javier Garay, Professor & Chair, Room 303 MS&E, 827-2881 jegaray@engr.ucr.edu

Cengiz Ozkan, Professor & Graduate Advisor for Admission and Recruitment, Room 309, MS&E, 827-5016, cozkan@engr.ucr.edu

Ludwig Bartels, Professor & Graduate Advisor for Academic and Curricular Affairs, Room 124 Pierce Hall (in the new addition), 827-2041, bartels@ucr.edu

II. AREAS OF STUDY AND DEGREE REQUIREMENTS

A. AREAS OF STUDY

The Program in Materials Science and Engineering offers advanced study and research designed to educate students in the range of areas that encompass Materials Science and Engineering. This program is interdisciplinary in nature; study and research opportunities in aspects of Materials Science and Engineering exist in the following Departments:

- Bioengineering
- Chemical and Environmental Engineering
- Chemistry
- Computer Science and Engineering
- Electrical Engineering
- Mechanical Engineering
- Physics

Proposed M.S. and Ph.D. programs of study with focus of emphasis in other departments must be approved by the MSE Graduate Advisor and must include applicable basic core courses prescribed by the MSE Program.

B. RECOMMENDED COURSES

To insure that MSE graduate students have advanced knowledge across the spectrum of Materials Science and Engineering, an MSE recommended course program has been implemented. All M.S. students must participate in the MSE recommended course program. Ph.D. students are not required to take these courses; however, they are expected to have knowledge of the material covered in these classes. Competency will be tested as part of the Comprehensive exam for M.S. students and the Preliminary exam for Ph.D. students. The MSE course program is comprised of five areas of study:

- MSE 201 – Thermodynamic Foundations of Materials
- MSE 210 – Crystal Structure and Bonding
- MSE 220 – Materials Characterization Techniques
- MSE 230 – Functional Materials: Semiconductors
- MSE 240 – Materials Synthesis and Processing

Other departments on campus offer graduate level courses that are pertinent to these 5 areas. Many of these courses are cross listed in MSE as MSE 20x, 21x, 22x, 23x, 24x. MSE students can choose to substitute an MSE 201, 210, 220, 230, 240 course with one of those courses. Substitutions with courses that are not cross-listed require approval by the Graduate Committee.

- MSE 200 – Materials Science and Engineering

In addition to these five areas of study, the MSE program offers an overview course of Materials Science and Engineering, MSE 200. All graduate students of the MSE program need to register for this class the first time it is offered during their residence in the MSE graduate program. This course is generally not taken for a letter grade; it counts towards the degree requirements only if taken for a letter grade.

- MSE 250/251 – Colloquium in Materials Science and Engineering

Students in Materials Science and Engineering also participate in the Colloquium in Materials Science and Engineering during all quarters of their residence. They need to give a presentation and obtain a letter grade once annually in MSE 250. With prior approval of the Graduate Advisor, presentation of a talk in a different UCR seminar can fulfill the annual requirement for a letter grade. Examples include the Surface Science Seminar, the Electrical Engineering Colloquium, etc.

C. INFORMAL AND INTERDISCIPLINARY COURSES

In addition to the courses given on a regular basis, faculty Advisors can offer *Informal Courses*. These courses are:

MSE 290 - Directed Studies – If you will study a particular subject under direction of a faculty member, and a regular course in that subject is not offered, you may enroll in MSE 290. Students are required to file a petition no later than the third week of class to enroll in MSE 290 to be able to use the units earned towards degree requirement.

MSE 297- Directed Research – If you are doing research under advisement of a faculty and this research is not directed toward your thesis or dissertation, you may enroll in MSE 297.

MSE 299- Research for Thesis/Dissertation – If you are doing research under advisement of a faculty and this research is directed toward your thesis or dissertation, you may enroll in MSE 299. This is typically taken by 2nd through 5th year students.

MSE graduate students also take courses pertinent to Materials Science and Engineering offered in other Departments/Programs of UCR. These courses improve analytical, computational, synthetic and engineering skills required for advanced studies in the MSE program.

Only graduate courses or upper-division undergraduate courses are counted toward the degree requirements described in the following sections. Upper-Division Undergraduate courses can be taken to fulfill the degree requirements with approval of the graduate advisor. Typically, approval is granted for Engineering Courses with course numbers of 128 and above or for upper division specialized Science Courses. Approval is required prior to registering for an undergraduate class and it will generally be given for only one course. Registration for courses is done by the Academic Program Manager after the courses are approved by the Graduate Advisor.

D. GENERAL REQUIREMENTS

1. Full-time Enrollment

Normally, the program of course work is formulated by each student and a Faculty Advisor by the end of the second quarter after admission to the program and must be approved by the MSE Graduate Advisor by the end of the first year. *Full-time enrollment* requires at least 12 units.

2. M.S. Program

M.S. degree can be earned by completing one of three *plans*:

Plan I: course work and completion of a thesis that reports an original investigation of a defined problem
Plan II: course work and passing of a written comprehensive examination.
Plan III: (exclusively for students who are concurrently in candidacy in a Ph.D. program at UCR) course work complementary to their concurrent studies and passing of an oral comprehensive exam.

No more than two attempts to pass the comprehensive exam may be allowed. If a student fails the exam once and then wants to switch to the Thesis Plan, he/she should contact the MSE Graduate Advisor. If a student fails twice, he/she may NOT switch to the Thesis Plan.

PLEASE SEE COURSE REQUIREMENTS FOR ALL PLANS OF FOLLOWING PAGE

***Course requirements*:**

Completion of a minimum of 36 units of approved course work. Specific plan requirements are as follows:

- **Plan I**: Students must complete 36 units of graduate or upper-division undergraduate course work, of which 24 must be graduate level units. Student must complete at least one course from 3 of the 5 areas of Materials Science and Engineering (MSE 201-209, 210-219, 220-229, 230-39, 240-249) as well as at least one unit of MSE 200 and at least five units of MSE 250. Students must enroll in MSE 200 the first time it is offered during their residency. At least two units of MSE 250-259 must be taken for a letter grade. Students can take a maximum of 12 units in Graduate Research and a maximum 6 units in Directed Studies.
- **Plan II**: All students must complete 36 units of graduate or upper division undergraduate courses, of which 18 units must be graduate level. Student must complete at least one course from each of the 5 areas of Materials Science and Engineering (MSE 201-209, 210-219, 220-229, 230-39, 240-249) as well as at least one unit of MSE 200 and at least four units of MSE 250. At least one unit of MSE 250-259 must be taken for a letter grade. None may be in graduate research (297 or 299). A maximum of 6 units may be in Directed Studies. Students must enroll in MSE 200 the first time it is offered during their residency.
- **Plan III (Only for students concurrently in candidacy in a Ph.D. program at UCR related to Materials Science and Engineering):** a graduate-level course in each of the 5 areas of Materials Science and Engineering in which the student did not complete a graduate level course for his/her Ph. D. field of study. A maximum of one of the graduate courses can be substituted with an undergraduate course with prior approval of the Graduate Advisor.

3. Ph.D. Program

The Ph.D. degree is conferred after a student passes the following three steps:

- Ph.D. Preliminary examination
- Ph.D. Qualifying examination (approval of a Ph.D. dissertation proposal)
- Defense and approval of the Ph.D. dissertation.

These procedures are shown in the following Figure and are described in Section II G in more detail.

The main component and focus of the Ph.D. program is the independent research culminating in a Ph.D. thesis. Courses are taken as necessary to prepare the student to pass the Preliminary exam and to train the student in his or her research area. Courses are taken from the Materials Science and Engineering Program and other Departments as deemed necessary by the faculty advisor.

In preparation for the Preliminary exam, a Ph.D. student in Materials Science and Engineering has to obtain knowledge in all five areas comprising the Program of Materials Science and Engineering and taking of 24 units of graduate course work is strongly recommended.

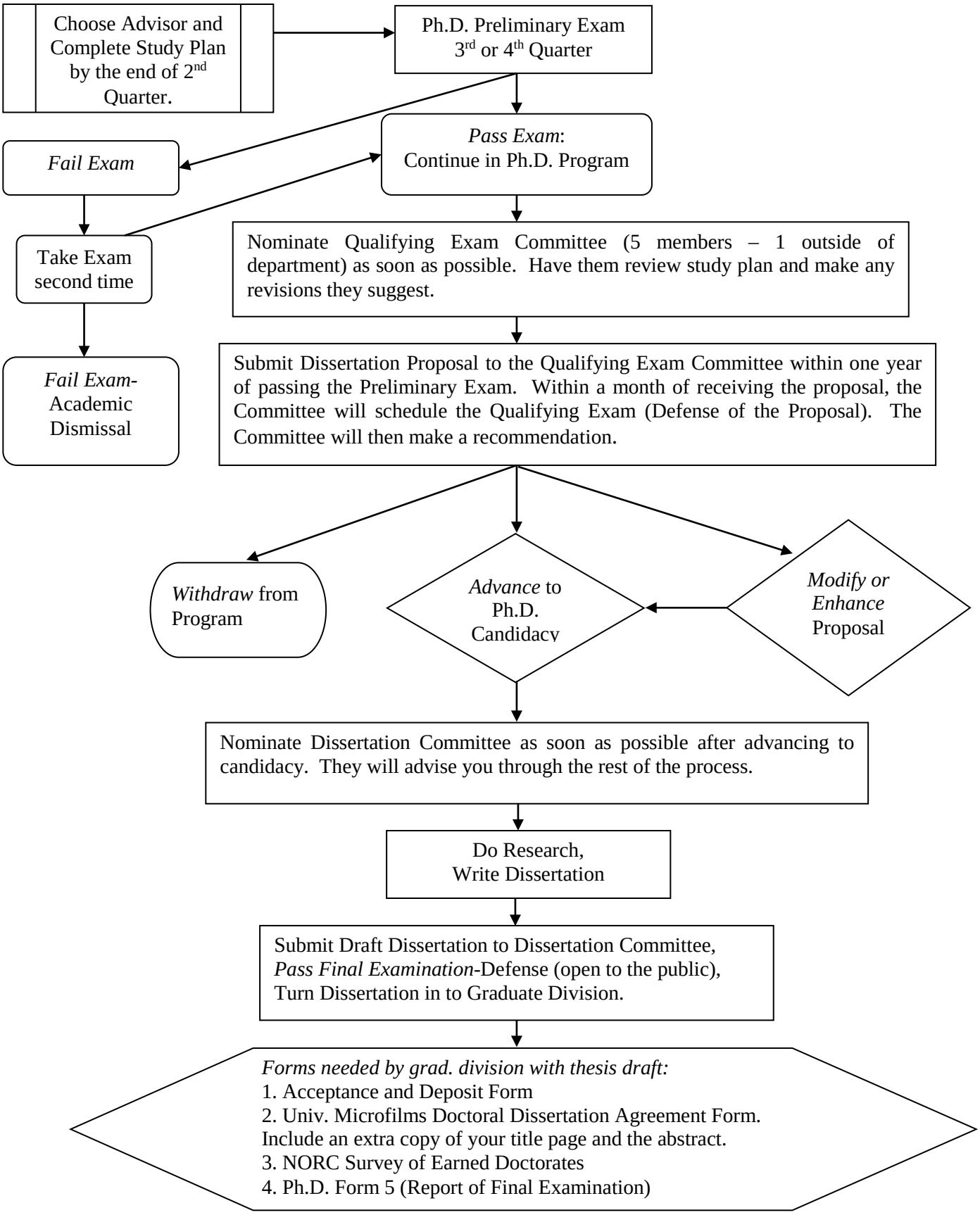
4. Grade requirements and time limits

The M.S. Program in Materials Science and Engineering has a *Normative* (typical time) is 2 years. The Ph.D. Program has a normative time of 3.5 years for students holding an M.S. degree in Materials Science and Engineering and 5 years for other students. The *maximum time limit* for either degree *is one year beyond the normative time*, excluding approved leaves of absences.

In addition, M.S. and Ph.D. students must maintain a GPA (grade point average) above 3.00, with the scale of A (4.00), B (3.00), and C (2.00). Namely, the students are considered to be making unacceptable progress and become subject to dismissal when:

- the overall GPA falls below 3.00;
- the quarterly GPA falls below 3.00 for two consecutive quarters;
- they have 12 or more units of incomplete courses ("I") outstanding;
- they fail to take their oral qualifying exams within five years, if applicable;
- they fail to fulfill program requirements such as exams or research in a timely and satisfactory manner;
- they have not completed their programs within one year after reaching the normative time;
- they fail to pass comprehensive or qualifying examinations in two attempts.

Ph.D. Progress



5. Transfer of Credits Taken at Other Universities

Units from another University of California campus may be used to satisfy one of the three quarters of the residence requirement and may be counted for up to one half of the total units required for the M.S. degree. MSE Program and Graduate Division approval must be obtained before such units can be accepted for credit.

A maximum of 8 quarter units from institutions within the University of California may be counted toward the M.S. degree at UCR. All transfer work must have been completed in graduate standing with a minimum grade of "B." MSE Program and Graduate Division approval must be obtained before these units can be accepted for credit. These units cannot be used to reduce the minimum residency requirement at this University. Unit credit only is posted on the UCR transcript (grade points are not transferred).

UCR undergraduates who have no more than two courses or 8 units of course work remaining in their bachelor's programs and who have been admitted to graduate status may begin course work for their advanced degrees at the beginning of the final quarter of undergraduate study. Bringing forward units from undergraduate status requires that the students inform the MSE Graduate Advisor before beginning the course work in question and that they petition the Graduate Division for credit once they are enrolled as graduate students.

Students may apply Summer Session course work from any University of California campus toward their graduate degree requirements if they have prior approval of the MSE Program and of the Graduate Dean.

UCR Extension is considered an outside institution that also offers "concurrent enrollment" courses (prefix XRC) as regularly offered UCR courses. The students may transfer in up to 8 units of concurrent enrollment credit if:

- A grade of "B" or better was received;
- These units were taken prior to graduate enrollment.

Matriculated graduate students may not use the University Extension concurrent enrollment mechanism. Graduate students who withdraw before completing their program are required to wait one year before applying XRC courses to their degrees. (Please note that a student could transfer-in 8 additional units from the category 'Non-UC Campuses' described above.)

6. Undergraduate Courses

Students wishing to use an undergraduate course to partially fulfill their graduate degree requirements must submit an approval request to the Graduate Advisor before the undergraduate course is taken. Retroactive approval will not be granted. Such courses are limited to upper division courses numbered 100 and above. Approval must be noted on the Quarterly Advising form.

7. Deadlines

It is the responsibility of the student to meet all deadlines specified by the MSE Program and the Graduate Division. Students should consult the *Graduate Student Handbook* of the Graduate Division and the quarterly *UCR Class Schedule* for deadline information.

8. Grading

For a graduate student only the grades A, A-, B+, B, B-, C+, C and S represent satisfactory scholarship and are applied toward degree requirements. A grade of C- at UCR may be accepted in partial satisfaction of the degree requirements if the student has a GPA of at least 3.0 in all courses applicable to the degree. These include all upper division undergraduate and graduate courses in the student's program of study, and must be taken while registered in graduate status.

Individual study and research, or other individual graduate work is normally evaluated by the grades Satisfactory/No Credit. Only the grade S is credited towards degree requirements. Academic work applicable to a graduate program may be graded S/NC only if the course descriptions so indicate. Undergraduate courses that do not have any significant relationship to the graduate program are considered as pure electives. These courses may be taken S/NC with the approval of the Graduate Dean, and do not count towards the student's degree requirements.

The grade Incomplete (I) is given only when a student's work is satisfactory but is incomplete because of circumstances beyond his or her control, and the student has been excused in advance from completing the quarter's work. Although incomplete grades do not affect the student's GPA, they are an important factor in evaluating academic progress. A student with 12 units of "I" grades is deemed to be making unacceptable progress. Students may not be employed as TA's, GSR's, or Teaching Fellows if they have more than 7 units of "I" grades.

The incomplete portion of the work needed to earn a grade must be received by the instructor no later than the last day of the quarter following the assignment of the "I". If not made up within the time allowed, the "I" lapses to an F (“Fail”) or NC. An advanced degree cannot be awarded if there is an Incomplete on the student's record.

9. Student Progress

An overall written evaluation of each student's academic progress is done by the Program faculty at least once each academic year. This evaluation includes a brief review of the student's work to date, with particular attention to the period since the last report. Evaluation criteria that need to be addressed are listed above in Section D. This report also addresses academic objectives for the next period. The Graduate Advisor, the Graduate Division, and the student receive copies of this report.

10. Leaves of Absence

A graduate student is expected to enroll for each regular academic session unless a formal Leave of Absence is granted. A Leave of up to one year's duration may be granted if it has been determined that the Leave is consistent with the student's academic objective. This must be approved by both the academic unit and the Graduate Dean.

Graduate students granted a Leave of Absence forfeit the use of University facilities and faculty time. The student who will be absent from the campus while continuing to pursue graduate research or scholarly activity should register (in absentia if outside the State of California). Students who must leave the academic program for more than three quarters normally should withdraw and apply for readmission at the time they expect to resume graduate study at UCR.

A Leave ordinarily may be granted when a student is to be away from the University of California for any of the following reasons:

- Serious illness or temporary disability
- An occupation not directly related to the student's academic program
- Temporary interruption of the student's academic program for other appropriate reasons, such as family responsibilities

Generally, Leaves of Absence are limited to a total of three regular academic quarters and may be granted retroactively, after the start of a quarter, under exceptional circumstances. A Leave may not be granted if a student has not completed at least one quarter's work, or has not demonstrated satisfactory academic progress. (A student who has more than eight units of "I" outstanding on their transcript is considered to be making unsatisfactory progress.)

While on a Leave of Absence, a student is not eligible for University fellowship support, University research grants, or financial aid. A graduate student on Leave may not usually work on campus and may not hold an appointment as a Graduate Student Researcher, Teaching Assistant, or similar academic employment which requires full-time registration as a graduate student.

The immigration status of foreign students might be affected by a Leave depending on circumstances and whether they are staying in the U.S., or, returning to their own country. It is imperative that foreign students considering a Leave of Absence seek counseling at the International Services Center.

Students should pick up a General Petition for a Leave of Absence from the Graduate Division or it can be downloaded from the Graduate Division's website. The petition must be signed by the Graduate Advisor, and a memo of justification from the Program must be submitted with the petition.

The student is also required to secure the signatures of the Cashier and Business Office (to determine if there are any outstanding debts or loan provision that must be considered), and International Services (if foreign) before a final decision can be made. The petition must be into the Graduate Division by the published deadline dates. While a Leave of Absence may be granted retroactively to the beginning of the current

quarter, a request for Leave submitted after beginning of classes ordinarily should be accompanied by an explanation of the circumstances justifying the late request. Students should not expect an answer until two weeks after their petition has been submitted.

E. MASTER OF SCIENCE (M.S.) DEGREE PROGRAM

As indicated above, the M.S. degree in Materials Science and Engineering can be earned by:

Plan I: completion of a thesis that reports an original investigation of a defined problem, or
Plan II: passing a comprehensive examination.
Plan III: (exclusively for students who are concurrently in candidacy in a Ph.D. program at UCR) course work complementary to their concurrent studies and passing of an oral comprehensive exam.

1. Thesis Committee (Plan I)

M.S. thesis committees consist of three members. The committee is nominated by the Graduate Advisor or Program Chair after discussion with the student and faculty Advisor. Nominations are reported to the Graduate Dean using the Advancement to Candidacy forms. The Graduate Dean reviews the nominations and appoints the Committee. The committee, once approved by the Graduate Dean, becomes fully responsible for the student's academic guidance and evaluation.

The chairman of the Committee is the director of the candidate's research and is normally a faculty member of the MSE program, or a cooperating faculty member. A member may be appointed who is a researcher on campus, who is from off-campus, or who is a visiting lecturer within the Program; however, a memo indicating the academic degree and affiliation of the nominated member, as well as curriculum vitae, must accompany such a request. (Memos need not accompany the nomination of an Adjunct faculty member.) If a change in the thesis committee is made, a memo to the Graduate Dean must be submitted explaining why a change is being requested and who is being added or removed.

After the committee is formed, the subject of the thesis must be approved by the committee. A joint meeting of the committee members and the student should be held before work on the thesis is begun to ensure the topic is clear and acceptable to all. All three members of the committee must approve the thesis and sign the title page of the thesis upon completion. Normally, M.S. students conducting a thesis are required to give a seminar presentation of their thesis work.

2. Comprehensive examination (Plan II)

The exam is administered by the Graduate Committee and is combined with the Ph.D. Preliminary examination. The examination will normally be given the week following finals week in spring and the first week of fall. It is recommended that the students take the exam prior to the end of the third or the fourth quarter of their studies.

A student may take the exam twice. A student who failed in the first attempt has two options. The student may switch to Plan I, or the student must take the examination again at the time of the *next immediate*

examination. A student who has failed the examination twice is automatically removed from the program. A student who registered for the exam but did not show up is considered to have failed.

To complete their education, *the students must pass the Comprehensive exam prior to the end of the second year of their studies*. Exceptions can be made for those students who were admitted to the program with substantial deficiencies in their education, and for this reason were assigned to the remedial undergraduate courses covering these deficiencies. Students for whom the above requirements present an undue hardship, may petition the Graduate Committee for an appropriate extension of time.

The Comprehensive Examination is a five-hour written, closed-book exam held on one (1) day. A total of five questions must be answered, one from each area of Materials Science or one from 4 different areas of Materials Science and one associated with a specialization of the student, in which he took a graduate course or obtained Directed Study units.

Test problems will draw primarily from material related to the pertinent graduate courses; however, a minor portion of the test may involve problems drawn from upper division courses. The examination committee following its evaluation of the written exam may request an oral follow-up session.

If a student fails 2 or fewer questions on the first attempt, the student only needs to re-take the failed questions on the second attempt. If more than 2 questions are failed on the first attempt, the exam must be re-taken in its entirety.

To take the exam, *the students must register by notifying the Academic Program Manager at least one month prior to the exam date*.

3. Students concurrently in Ph.D. candidacy in a related field (Plan III)

The M.S. degree exam committees consist of five members similar to a Ph.D. qualifying exam, i.e. one member is to be from outside the MSE program. The committee is nominated by the Graduate Advisor or Program Chair after discussion with the student and faculty Advisor. Nominations are reported to the Graduate Dean using the Advancement to Candidacy forms. The Graduate Dean reviews the nominations and appoints the Committee. The committee, once approved by the Graduate Dean, becomes fully responsible for the student's academic guidance and evaluation.

The chairman of the committee is different from the director of the candidate's research and is normally a faculty member of the MSE program. A member may be appointed who is a researcher on campus, who is from off-campus, or who is a visiting lecturer within the Program; however, a memo indicating the academic degree and affiliation of the nominated member, as well as a curriculum vitae, must accompany such a request. (Memos need not accompany the nomination of an Adjunct faculty member.) If a change in the thesis committee is made, a memo to the Graduate Dean must be submitted explaining why a change is being requested and who is being added or removed.

For the exam, the student is to prepare two research proposals, one original that is far removed from the area of research of the student yet pertinent to Materials Science and Engineering, and one that details the aspects of the student's research for his Ph.D. thesis that are pertinent to Materials Science and Engineering. Each of

the research proposals shall exceed on published findings and contain original ideas (1st proposal) or work (2nd proposal) of the M.S. degree candidate. The student is to obtain forms for the research proposal from the MSE program office and has to distribute his proposals at least one week prior to the exam to all members of the committee. At this point the committee chairperson has to approve that the original proposal is far removed from the primary field of study of the candidate yet within the scope of Materials Science and Engineering. If the committee chairperson comes to the conclusion that this is not the case, the exam is rescheduled and the student has to prepare a new original proposal. Upon request of the student, the entire committee convenes and if a majority of its members find that the proposal is acceptable, the original exam schedule can proceed. On the day of the exam, the committee will evaluate the originality and professional execution of the research proposals. If deemed satisfactory by a majority of the committee members, the committee will hear an oral presentation of the research proposal unrelated to the student's area of research. If deemed satisfactory, it will request the student to present his research proposal related to his Ph.D. research work. Subsequently, the committee will decide on pass or fail of the comprehensive oral exam. A pass requires at least 4 of the committee members' support.

The exam (but not the deliberation of the committee) is open to the public unless the candidate requests otherwise. The candidate has the right to request exclusion of the public at any point during the exam. It is open to members of the Academic Senate.

4. Advancement to Candidacy and Degree Conferral

Students must be advanced to candidacy for M.S. degree no later than the first week of the quarter in which their degree is expected to be awarded. Deadlines for submission are published each quarter in the Schedule of Classes and in the annual Graduate Division Calendar. If the application is not received by the deadline date, the degree may be deferred until the following quarter.

If the Master's degree requires a thesis (Plan I), a thesis committee should be nominated. The Student Affairs Section certifies the candidacy of the student and checks for the completion of the University and Programmatic requirements. The student is sent a "Certificate of Candidacy" when certified. All requirements for the degree must be satisfied within a calendar year from the time of completion of the required course work. Should the student be unable to complete the degree requirements within this time, candidacy will lapse. The student must then file a General Graduate Student Petition requesting a reinstatement of Master's Candidacy with the Graduate Division.

The Master's degree is conferred at the end of the academic quarter in which all requirements have been satisfied (the official conferral day is the last day of the quarter). The students must have been formally advanced to candidacy during the quarter in which they finish their degree. Ordinarily, a graduate student will be registered or on Filing Fee status the quarter in which all degree requirements are completed and the degree is to be conferred. However, students may complete the requirements during the quarter break. If they were enrolled or on Filing Fee status the quarter before, they may complete degree requirements before the next quarter officially begins and not be assessed registration fees for that quarter.

If a student wishes to complete degree requirements during the Summer months, they must have had student status (be enrolled or on Filing Fee status) every quarter of the previous academic year to complete without

paying additional fees. If they were withdrawn or on Leave any one of those quarters, they must use Filing Fee status or enroll in two units of Summer Session course work to complete during the Summer.

If a student does not complete the necessary courses by the end of the quarter in which degree conferral is expected, or does not attain the required level of scholarship, registration for the next regular academic session is mandatory - otherwise student status will lapse and candidacy for the degree may lapse. Once student status lapses, the degree can be conferred only after readmission of the student, followed by at least one quarter of registration or Filing Fee status.

Students are advised by mail of formal degree award at the end of the quarter in which the degree is conferred. As soon as all degree requirements are completed, the student may request a formal letter of certification of completion bearing the Graduate Dean's signature and University Seal from the Graduate Division. A formal certification of completion is the equivalent of the diploma or the official academic transcript posting for employment and career advancement purposes.

Once the diploma is ready, the Registrar will notify students by postcard that they may pick-up their diploma at that office. If they want it mailed to them they must pay the Registrar for postage. They should make these arrangements with the Registrar's Office.

A graduate student pursuing the Master's degree as a terminal degree may not continue to register as a graduate student once the degree has been awarded unless they have been formally admitted to another program.

F. DOCTOR OF PHILOSOPHY (PH.D.) DEGREE PROGRAM

The Ph.D. degree provides an opportunity for students to pursue a program of in-depth research in a specialized area. As pointed in Section II B, the procedure consists of three parts:

- passing a Ph.D. Preliminary examination
- passing a Ph.D. Qualifying examination (approval of a Ph.D. dissertation proposal)
- defense and approval of the Ph.D. dissertation.

There is no comprehensive course requirement for the Ph.D. degree; only a few courses are mandatory. The faculty recommends that the student take a minimum of 36 units of graduate or upper-division undergraduate course work covering all five areas of study in Materials Science and Engineering: Thermodynamic Foundation of Materials, Crystal Structure and Bonding, Materials Characterization Techniques, Functional Materials, and Materials Synthesis and Processing (MSE 201-209, 210-219, 220-229, 230-39, 240-249). Students must enroll in MSE 200 the first time it is offered during their residency. Students must enroll in MSE 250 during all quarters of residency and must obtain a letter grade in an MSE 250-259 course once during each academic year of residency except for the first one.

The courses may include graduate course work used for the M.S. degree. The course of study needs to be approved each quarter by the research advisor (when determined) and the MSE graduate advisor. Students may need to take considerably more than the courses indicated above to prepare for and conduct their Ph.D. research.

1. Ph.D. Preliminary Examination

The purpose of the preliminary examination is to screen candidates for continuation in the doctoral program. The examination is administered by the graduate program committee jointly with the M.S. comprehensive examination. Candidates must solve at least one problem in each of the five areas of study in Material Science and Engineering. Plan II M.S. candidates who took the combined M.S. comprehensive and Ph.D. preliminary examination and successfully passed at the Ph.D. level are given credit for having passed the Ph.D. preliminary examination. The structure of the exam and all procedures are described in Section E, page 14.

2. Ph.D. Qualifying Examination

After passing the preliminary examination at the Ph.D. level, doctoral candidates must prepare and submit a dissertation proposal to their qualifying examination committee at least one month before the qualifying examination. The format of the proposal is flexible, but the proposal should clearly indicate the proposed problem under study, demonstrate substantial knowledge of the topic and related issues, state the progress made towards a solution, and indicate the work remaining to be done. The new approaches and methods to be used in the research should also be discussed. An extensive bibliography for the problem under study should be attached to the proposal. Within one week after submission, the student is informed whether the proposal meets these standards and the student is permitted to proceed to the oral exam. The oral qualifying examination focuses on the dissertation problem. It includes considerable depth in the student's area of specialization, as required for a successful completion of the dissertation. The examination is a three-hour session, which begins with the student's presentation of the dissertation topic and is followed with questions and suggestions by the doctoral committee.

Typically, each Ph.D. student must submit a dissertation proposal to the Ph.D. Qualifying Committee **within one year** after successfully completing the preliminary examination. The Ph.D. Qualifying Committee chairperson will normally schedule an oral defense within one month of the written proposal submission. The presentation is given to the Ph.D. Qualifying Committee members. It is open to members of the Academic Senate.

The oral presentation/defense of the proposal focuses on the dissertation problem. Students should demonstrate considerable depth of knowledge in the student's area of specialization and a clear understanding of the research methods that are needed for successful completion of the dissertation research. The oral presentation/defense will begin with a presentation by students on their dissertation topic and will be followed by questions and suggestions from the Ph.D. Qualifying Committee.

Based on the written proposal and oral defense, a recommendation will be made by the Ph.D. Qualifying Committee that the student either 1) be advanced to Ph.D. candidacy, 2) be asked to modify and enhance the proposal, or 3) be requested to withdraw from the Ph.D. program.

3. Ph.D. Qualifying Committee

By Academic Senate Regulation and Graduate Council policy, the Qualifying Committee is comprised of five members, a majority of whom, but not all, are affiliated with the program. The Chair of the Qualifying Committee is normally the student's Ph.D. Advisor, who must be a voting member of the Academic Senate. (All committee members should normally be voting members of the UC Academic Senate.) Any exceptions must hold Ph.D.s, be qualified for a UC faculty appointment and must be supported by a memo of justification from the Graduate Advisor. A memo need not be written for those holding Adjunct faculty positions.

One member of the Qualifying Committee, designated the "outside member," must be a voting member of the UC Academic Senate who does not hold an appointment in the MSE program. This person represents the faculty at large and acts most importantly, as a "third party ensuring fairness." Special expertise in the area of the student's dissertation is not expected; this member's academic field may be unrelated to the field of study of the student and the other committee members, and this member is expected to be unaffiliated with the Program.

The student and his/her Advisor nominate the Committee with the concurrence of the Program Chair or Graduate Advisor. After review of the nominations, the Graduate Dean appoints the Committee. This Committee, once approved by the Graduate Dean, becomes responsible for the student's academic guidance and evaluation until advanced to candidacy.

The proposed Qualifying Committee and the date set for the exam must be submitted to the Graduate Division Office on the Ph.D. Form 2 (Nomination for Qualifying Examination for the Degree of Doctor of Philosophy) at least two weeks (preferably one month) prior to the date of the final qualifying examination date. If any nominee is not a member of the University of California Academic Senate, a curriculum vitae and a memo justifying the appointment from the Graduate Advisor or Program Chair should be submitted with the Form 2.

Once the committee has been formally appointed, the date and time of the oral proposal presentation/defense will be scheduled. Any changes in the exam date or in the composition of the Committee must be communicated in writing to the Graduate Division not less than twenty-four (24) hours before the oral examination is held.

The recommendation of the committee must be reported to the Graduate Council within forty-eight (48) hours on Ph.D. Form 3 (Report on Qualifying Examination and Nomination of Dissertation Committee) which is provided by the Graduate Division to Programs on request. Each committee member must sign the form. No one can sign for them.

The Graduate Dean will accept a unanimous committee report for or against approval for the Graduate Council. If a student has failed the qualifying examination, the committee is required to make a recommendation for or against a second examination, ordinarily not to be given until at least three months have elapsed. The date of the second oral examination shall be communicated to the Graduate Division in writing at least two weeks prior to its occurrence. A third examination is not permitted. The student will be notified of the results immediately following the exam when a unanimous vote is reached.

If there is an initial divided vote, the committee will make every effort to arrive at unanimity. Failing unanimity, a committee reports which contains only one negative vote will be deemed a pass, and committee's report containing two (or more) negative votes will be considered a failure. When the vote is split, the committee or any member of the committee can petition (in writing) the Graduate Council to consider a reversal of the judgment. In that event, the Administrative Committee of the Graduate Council will make the final determination as to whether the student has passed. In such cases no statement is made to the student regarding his/her passing or failure until the final determination has been made. The student shall be informed within forty-eight (48) hours that the vote is split and the final determination will be made by the Graduate Council.

When the Committee meets to conduct the oral Qualifying Examination, it must report the vote and/or action to the Graduate Council via the Graduate Dean. 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. Once a committee convenes an examination, that committee must report either a pass or fail. All committee members must sign the Form 3 at the time the qualifying examination is concluded, and submitted even if the examination was failed.

4. Advancement to Candidacy

After successful completion of the qualifying examinations and completion of all University and program requirements, the student is eligible for formal advancement to candidacy. At that time, the MSE program submits the "Report of Departmental Requirements for Ph.D. Degree" to the Graduate Division to conduct a degree check. The student will be billed the Candidacy Fee after the degree check has been completed. After a successful degree check, the student and MSE program are notified of the formal advancement to candidacy.

All students who are considered nonresidents for tuition purposes and are advanced to candidacy for the Ph.D. *receive a reduction of 100 percent of the non-resident tuition. Each student is eligible for a maximum of 9 quarters of non-resident tuition reduction.* Time spent not registered (withdrawn, on leave, or on filing fee status) will count toward the three-year total unless the Graduate Dean grants an exception. A student must be advanced by the first day of the academic term to qualify for that quarter.

Candidacy for the Ph.D. will normally lapse 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. may be required to again advance to candidacy and thereafter enroll as a candidate for at least one academic quarter before the Ph.D. will be conferred. If less than three years has passed since the student withdrew, the candidacy will normally remain in effect. If three or more years have passed since Advancement to Candidacy, candidacy status will be determined by consultation between the Graduate Dean and the Program.

Following advancement to Ph.D. candidacy, students formally begin their dissertation research. The student's Ph.D. Dissertation Committee monitors the progress of the dissertation. It is recommended that Ph.D. candidates interact frequently with members of their dissertation committee to insure that dissertation progress is acceptable.

After completion of the dissertation research, a written copy of the dissertation must be submitted to and approved for defense by the student's Ph.D. Dissertation Committee. Once a draft has been approved for defense, an oral defense of the dissertation will be scheduled. This defense consists of a seminar open to the entire academic community, followed by a question/answer period conducted by the Ph.D. Dissertation Committee.

5. The Doctoral Dissertation Committee

A doctoral dissertation should be an original and substantial contribution to knowledge in the student's major field. The dissertation must demonstrate the student's ability to carry out a program of independent advanced research and to report the results in accordance with standards observed in recognized scientific journals. When the doctoral committee determines that a suitable draft of the dissertation has been presented, a dissertation examination and defense for the student is scheduled. The defense consists of a public seminar followed by questions from the committee members and the audience.

Upon recommendation of the Graduate Advisor or MSE Chair, doctoral dissertation committees are appointed by and responsible to the Graduate Council through the Graduate Dean. At this stage, the Dissertation Committee becomes responsible for the student's academic guidance and evaluation for the remainder of their degree studies.

All members of the dissertation committee shall normally be faculty members in the student's department and members of the Academic Senate. These criteria assume that any nominated person will be affiliated with this campus throughout the time that the student is working on the dissertation. For any nominee who does not fit the above criteria (other than Adjunct faculty), the Graduate Division requires supporting justification from the Program for review and consideration. All committee members must have a doctoral degree.

If the Chairperson of the dissertation committee leaves the campus, he or she leaves the Program as well as the Academic Senate. If the student has already completed a major portion of the dissertation research under this chairperson, the outgoing faculty member may remain on the student's committee in the capacity of Co-Chairperson, serving with a member of the student's Program who does meet the above criteria appointed as Co-Chairperson. Of course, the outgoing faculty member would need to be willing to continue serving on this committee.

If a committee member other than the Chairperson leaves the campus, a faculty member meeting the above stated criteria normally replaces the outgoing member. Exceptions to this practice have been made when the student has already completed a substantial portion of the dissertation research, and the departing member is willing to continue to serve on the committee. As a safeguard for the student, *the appointment of a minimum of three UCR Academic Senate members to dissertation committees is normally required.*

Dissertation committees are charged with guiding the students in their research and passing judgment on the final merits of their dissertation. The committee arranges for such conferences with the candidate as are necessary for the development and elucidation of the research treated in the dissertation.

The dissertation committee has responsibility for both the content and the style of the dissertation. 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. After the Doctoral Committee has approved a dissertation, two copies of the dissertation must be submitted to the Graduate Division. (See Instructions for the Preparation and Submission of Theses and Dissertations for complete information about UCR dissertation requirements.) During the process of accepting the dissertation, the committee in a final oral examination normally examines the candidate.

The Doctoral Committee supervises a *final examination*, the focus of which is the content of the doctoral dissertation. The results of the exam are reported on Ph.D. Form 5 (Report of Final Examination). Under unusual circumstances, the exam may be waived with the unanimous consent of the committee and the approval of the Graduate Dean. The final examination may be given either just prior to the completion of the dissertation and while the student is in residence during a regular academic session or after the acceptance of the dissertation, and will be open to all members of the academic community.

Upon completion or waiver of the final examination and approval of the dissertation, the Doctoral Committee recommends, by submission of Ph.D. Form 5, that the Ph.D. be conferred. All members of the committee must sign the form. They may not have anyone else sign for them.

6. Degree Conferral

Ph.D. degrees are conferred, subject to the final approval of the Graduate Council, as of the last day of the regular academic quarter in which all requirements have been satisfied (the last day of the quarter), including the final positive recommendation of the Doctoral Committee, and the acceptance of the approved dissertation by the Graduate Division on behalf of the University. A graduate student must be registered or on Filing Fee status the quarter in which the dissertation is submitted and the degree is to be conferred. No fee for filing the manuscript itself is required.

Unless payment of a Filing Fee or a Leave of Absence is approved, all graduate students must register each regular academic quarter (excluding Summer Session) until all degree requirements are completed - otherwise, student status and candidacy for the Ph.D. will normally lapse. Once status lapses, the degree can be conferred only after readmission of the student, followed by at least one quarter of registration or Filing Fee status and possibly re-advancement to candidacy. Students are advised by mail of formal degree conferral at the end of the quarter in which the degree is completed. As soon as all degree requirements are completed, the student may request a formal letter of certification of completion bearing the Graduate Dean's signature from the Division office. A formal certification of completion is the equivalent of formal degree conferral for faculty and postdoctoral appointments and other employment and career advancement purposes.

Once the diploma is ready, the Registrar will notify the student by postcard that they may pick-up their diploma at that office. If they want it mailed to them they must pay the Registrar for postage. They should make these arrangements with the Registrar's Office.

III. SAMPLE PROGRAMS AND COURSE DESCRIPTION

A. SAMPLE PROGRAMS

This section presents a sample program for MSE students.

RECOMMENDED COURSES FOR THE MS DEGREE

MSE 200 Materials Science and Engineering***
MSE 201 Thermodynamic Foundations of Materials
MSE 210 Crystal Structure and Bonding
MSE 220 Materials Characterization Techniques
MSE 230 Functional Materials: Semiconductors
MSE 240 Materials Synthesis and Processing
MSE 250 Colloquium in Materials Science and Engineering (during all quarters)
One additional course

***MSE200 is a required course for all graduate students

B. MSE GRADUATE COURSES

MSE 200 Materials Science and Engineering

2-unit course, Introduces to graduate studies in materials science and engineering. Provides overview of the areas of the specialization of the academic program as well as research opportunities and facilities at UCR. Covers fundamental methods of the discipline. Summarizes areas of employment of graduates in materials science and engineering. Graded S or NC.
Fall

MSE 20x series: Foundations of Materials

MSE 201 Thermodynamic Foundations of Materials

4-unit course, which covers the laws of thermodynamics, fundamental equation for multicomponent elastic solids and electromagnetic media, equilibrium criteria. Application to solution thermodynamics, point defects in solids, phase diagrams. Phase transitions, interfaces, nucleation theory, elastic effects. Kinetics: diffusion of heat, mass and charge; coupled flows.
Winter

MSE 204 Thermodynamics and Statistical Mechanics

4-unit course which covers concepts in thermodynamics including fundamental equations, statistical mechanics, ideal Bose systems, ideal Fermi systems, and bulk motion
Cross-listing of PHYS212A Thermodynamics and Statistical Mechanics
Fall

MSE 205 Advanced Physical Chemistry: Thermodynamics

3-unit course which covers concepts in thermodynamics including fundamental equations, potentials, Maxwell relations, and stability criteria
Cross-listing of CHEM 201D. Advanced Physical Chemistry: Thermodynamics

MSE 207 Applied Quantum Mechanics

Covers topics in quantum mechanics including Schroedinger equation, operator formalism, harmonic oscillator, quantum wells, spin bosons, and fermions; solids; perturbation theory; Wentzel- Kramers- Brillouin approximation; tunneling; tight-binding model; quantum measurements; quantum cyptography; and quantum computing.

Cross-listing of EE 201 Applied Quantum Mechanics

Fall

MSE 208 Mechanics and Physics of Materials

Introduces the structure and properties of materials; the characterization and modeling of mechanical, thermal, electric, and magnetic properties of materials; and coupling properties. Topics include phase transformations and brittle-to-ductile transitions

Cross-listing of ME 266 Mechanics and Physics of Materials

Fall

MSE 21x series: Materials Structure

MSE 210 Crystal Structure and Bonding

4-unit course, which covers regular, irregular arrays of points, spheres; lattices, direct, reciprocal; crystallographic point and space groups; atomic structure; bonding in molecules; bonding in solids; ionic Pauling rules, covalent, metallic bonding; structure of elements, compounds, minerals, polymers.

MSE 214 Condensed Matter Physics

Topics include classical and quantum theories of the electron gas; crystal and reciprocal lattices; x-ray diffraction; crystal symmetries; electrons in a periodic potential; nearly free electrons; tight binding; semiclassical dynamics; and semiclassical transport

Cross-listing of Phys240A Condensed Matter Physics

MSE 217 Fundamentals of Semiconductors and Nanostructures

Examines principles of semiconductor materials and nanostructures. Topics include periodic structures, electron and phonon transport, defects, optical properties, and radiative recombination. Also covers absorption and emission of radiation n nanostructures and nonlinear optics effects. Emphasizes properties of semiconductor superlattices, quantum wells, wires, and dots

Cross-listing of EE 202 Fundamentals of Semiconductors and Nanostructures

MSE 218 Imperfections in Solids

Covers fundamental of crystal structures and crystal defects, I ncluding the generation of point defects; nucleation and propagation of dislocations; perfect and partial dislocations; twins, stacking faults, and transformations; mechanics of semiconductor and metallic thin films and multilayered structures

Cross-listing of ME 278 Imperfections in Solids

MSE 22x series: Materials Characterization and Simulation

MSE 220 Materials Characterization Techniques

4-unit course, which covers basic principles of techniques used in the characterization of engineering materials by electron microscopy, diffraction, and spectroscopy; provides analysis of defects responsible for materials properties. Modern electrical, optical and particle beam techniques for the material characterization. Examples include Hall Effect and Raman spectroscopy.

MSE 221 Electron Microscopy & Analysis

3-unit course, Introduces electron microscopy and microanalysis of inorganic solids including synthetic nanomaterials and minerals. Provides the underlying physical principles of electron microscopy and microanalysis; the strengths and limitations of the method; and the potential applications in characterization of morphology, structure, composition, and defects of inorganic materials and nanostructures. . Optional related laboratory courses are available MSE 222L, MSE 223L

MSE 225A Physical Organic Chemistry

Utilizes modern spectroscopic techniques such as IR, mass spectrometry and 1H and 13C NMR to determine the structure of complex organic molecules. Topics include advanced NMR techniques such as 2D NMR, NMR pulse sequences, diffusion NMR and MRI
Cross listing of CHEM 216A. Physical Organic Chemistry

MSE 225B Chemical Spectroscopy

Provides an overview of modern analytical optical spectroscopic techniques including theory, instrumentation, and applications.
Cross listing of CHEM 221B. Advanced Analytical Chemistry: Optical Spectroscopy

MSE 225C Introduction to Computational Quantum Chemistry

Introduces computational techniques in quantum chemistry. Includes Hartree-Fock theory, Density Functional Theory, and electron correlation methods. Emphasizes practical applications in a research setting
Cross listing of CHEM 206A. Introduction to Computational Quantum Chemistry

MSE 226 Optical Methods in Biology, Chemistry, & Engineering

Covers the origin of fluorescence and other emission processes that modulate the characteristics of molecular emissions. Presents emission-based analytical and bioanalytical methods and techniques. Reviews state-of-the-art instrumentation, including their applicability, limitations, and source. Also provides interpretation and meaning of the measured signals as applied to biological systems.

Cross-listing of BIEN 245 Optical Methods in Biology, Chemistry, & Engineering

MSE 227 Nanoscale Characterization Techniques

An in-depth study of nanoscale materials and device characterization techniques. Laboratory emphasizes atomic force microscopy (AFM) and scanning tunneling microscopy (STM). Topics include semiconductor fabrication fundamentals; metrology requirements; in situ monitoring; interconnects and failure analysis; principles of AFM, STM, and scanning electron microscopy; X-ray methods; optical and infrared techniques; and electrical characterization

Cross listing of EE 206 Nanoscale Characterization Techniques

MSE 23x series: Functional Materials

MSE 230 Functional Materials: Semiconductors

4-unit course, which covers semiconductor crystal growth techniques; purification; doping, radiation damage; annealing; metal-semiconductor interfaces; defects and impurities; major electronic and optical methods for the analysis of semiconductors; semiconductor device fabrication issues.

MSE 234A Physics of Nanoscale Systems

Explores the fundamental concepts and techniques of nanoscale fundamental concepts and techniques of nanoscale physics, including nanoscale fabrication and characterization techniques, electronic properties in reduced dimensions, properties of carbon nanotubes, nanoelectromechanical systems, superconductivity in reduced dimensions, and nanophotonics.
Cross-listing of Phys 234 Physics of Nanoscale Systems

MSE 234B Spintronics and Nanoscale Magnetism

Provides an overview of contemporary issues in nanoscale magnetism and spin- dependent phenomena in solids, including the fundamentals of magnetism, magnetism in reduced dimensions, novel magnetic materials, spin-polarized transport. Spin coherence in semiconductors, magnetization dynamics, and device applications.
Cross-listing of Phys 235 Spintronics and Nanoscale Magnetism

MSE 236 Nanomaterials for Regenerative Medicine

Cross-listing with BIEN 236 Nanomatierials for Regenerative Medicine

MSE 237A Applied Ferromagnetism

Introduces fundamentals of ferromeagnetism necessary to develop next-generation nanomangnetic and spintronics-related devices. Includes basics of magnetism, magnetic circuits, ferromagnetic resonance (FMR), nuclear magnetic resonance (NMR), spintronics, and analyses of application
Cross-listing of EE 220 Applied Ferromagnetism

MSE 237B Nanoscale Phonon Engineering

Studies acoustic and optical phonons that affect electrical, thermal, and optical properties of materials. Focuses on the confinement-induced changes of phonon properties in nanostructures and their implications for performance of electronic, thermoelectric, and optoelectronic devices. Explores phonon theory, Raman spectroscopy and other phonon characterization techniques, thermal conductivity and related measurements
Cross-listing of EE 216 Nanoscale Phonon Engineering

MSE 237C Solid-State Device

Covers electronic devices including p-n junctions, field-effect transistors, heterojunction bipolar transistors, and nanostructure devices, explores electrical and optical properties of semiconductor heterostructures, superlattices, quantum wires, and dots, as well as devices based on these structures.
Cross-listing of EE 203 Solid-State Device

MSE 238 Introduction to Microelectromechanical Systems

An introduction to the design and fabrication of microelectromechanical systems (MEMS). Topics include micromachining processes; material properties; transduction; applications in mechanical, thermal, optical, radiation, and biological sensors and actuators; microfluidic devices; Bio-MEMS and applications; packaging and reliability concepts; and metrology techniques for MEMS
Cross-listing of ME 270 Introduction to Microelectromechanical Systems

MSE 24x series: Materials Synthesis and Processing

MSE 240 Materials Synthesis and Processing

4-unit course, which covers methods the synthesis and formation of functional materials including semiconductors, metals, polymers and nanoscaled-materials such as nanotubes, nanoparticles, etc.

MSE 245A Advanced Organic Reactions

Covers modern organic reactions and reagents and their mechanistic pathways. Emphasizes recent developments
Cross-listing of CHEM 210: Advanced Organic Reactions
Fall

MSE 245B Structure and Bonding in Inorganic Chemistry

Covers advanced synthesis structure, and bonding in inorganic, coordination, and organometallic chemistry
Cross-listing of CHEM 231A: Structure and Bonding in Inorganic Chemistry

MSE 245C Nanoscience and Nanotechnology

Provides a condensed, interdisciplinary overview of selected fields of nanoscience and emerging nanotechnological applications. Focuses on applications relevant for the campus research community that are not based on electronic applications of silicon
Cross-listing of CHEM 203. Nanoscience and Nanotechnology

MSE 245D Semiconductor Processing

An interdisciplinary overview of present-day semiconductor processing. Introduces topics such as properties of semiconductors, cleanroom environment, epitaxy, ion implantation, etching, lithography, device architecture, testing, and fault detection. May offer field trips
Cross-listing of CHEM 208/Phys 202. Interdisciplinary

MSE 246 Cellular and Molecular Engineering

Emphasize biophysical and engineering concepts intrinsic to specific topics at the cellular and molecular level. Includes receptor-ligand dynamics in cell signaling and function; DNA replication and RNA processing; cellular and protein sorting; control of gene expression; membrane structure, transport and traffic; biological signal transduction; and mechanics of cell division
Cross-listing of BIEN 224: Cellular and Molecular Engineering

MSE 248 Nanoscale Science and Engineering

An overview of the machinery and science of the nanometer scale. Topics include patterning of materials via scanning probe lithography; electron beam lithography; nanoimprinting; self-assembly; mechanical, electrical, magnetic, and chemical properties of nanoparticles, nanotubes, nanowires, and biomolecules (DNA, protein); self-assembled monolayers; and nanocomposites and synthetic macromolecules
Cross-listing of ME 272 Nanoscale Science and Engineering

MSE 25x series: Colloquia and Seminars

MSE 250/251 Colloquium in Materials Science and Engineering

Colloquium, 1-unit course; Prerequisite(s): graduate standing. Lectures on current research topics in electrical engineering presented by faculty members and visiting scientists. Can be taken for Letter Grade or Satisfactory (S)/No Credit (NC). Course is repeatable.

MSE 29x Series

MSE 290 Directed Studies

1-6-unit course; individual study, 3-18 hours; prerequisite(s): graduate standing; consent of instructor and Graduate Advisor. Individual study, directed by a faculty member, of selected topics in electrical engineering. Graded Satisfactory (S) or No Credit (NC). Course is repeatable to a maximum of 12 units.

MSE 297 Directed Research

1-6-unit course; outside research, 3-18 hours; prerequisite(s): graduate standing; consent of instructor. Research conducted under the supervision of a faculty member on selected problems in electrical engineering. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

MSE 299 Research for the Thesis or Dissertation

1-12-unit course; outside research, 3-36 hours; prerequisite(s): graduate standing; consent of instructor. Research in electrical engineering for the M.S. thesis or Ph.D. dissertation. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

IV. FACULTY PROFILES

This section presents information concerning the MSE graduate faculty and their research interests, office numbers, phone numbers, and e-mail addresses.

A. MSE PROGRAM FACULTY

Dr. Reza Abbaschian

Distinguished Professor, Bourns College of Engineering
Dean, Bourns College of Engineering
Ph.D., University of California Berkeley, 1971
Email: rabba@engr.ucr.edu
MSE areas: materials processing, solidification, functionally graded composites; high pressure-high temperature growth of diamond crystals.

Dr. Alexander Balandin

Professor, Electrical Engineering
Ph.D., University of Notre Dame, 1996
Email: balandin@ee.ucr.edu
MSE areas: electronic, photovoltaic and thermoelectric materials; graphene properties and applications; thermal and electrical characterization of nanostructured and carbon materials; Raman spectroscopy of solids and nanostructures; phonon transport and phonon engineering in advanced materials.

Dr. Christopher J. Bardeen

Professor, Chemistry
Ph.D., University of California Berkeley, 1995
Email: christopher.bardeen@ucr.edu
MSE areas: spectroscopy and photophysics of novel organic photovoltaic materials, exciton fission and diffusion, characterization and laser control of photomechanical properties of organic nanostructures, nonlinear microscopy of photochemistry in biological tissue.

Dr. Ludwig Bartels

Professor, Chemistry & MES Graduate Academic Advisor
Dr. Rer. Nat., Freie Universität Berlin, 1997
Email: ludwig.bartels@ucr.edu
MSE areas: investigation and design of surface roughness, surface properties, surface reactivity, in particular with regards to organic materials and metals surfaces.

Dr. Krassimir N. Bozhilov

Research Scientist and Academic Coordinator, Earth Sciences
Ph.D., The Johns Hopkins University, 1997
Email: bozhilov@ucr.edu
MSE areas: electron microscopy and microanalysis of nanomaterials, zeolite structure and properties, crystal chemistry and crystallography of ino- and phyllosilicates.

Dr. Phillip Christopher

Assistant Professor, Chemical and Environmental Engineering
Ph.D., Chemical Engineering, University of Michigan, 2011
Email: phillip.christopher@ucr.edu
MSE areas: Heterogeneous catalysis, photocatalysis, elecrocatalysis, nanomaterials synthesis, solar energy conversion, molecular modeling

Dr. Pingyun Feng

Professor, Chemistry
Ph.D., University of California Santa Barbara, 1998
Email: pingyun.feng@ucr.edu
MSE areas: porous materials, porous semiconducting materials, catalytic, electronic, and optical materials, templated self-assembly, and targeted drug delivery.

Dr. Javier Garay

MSE Chairman & Professor, Mechanical Engineering
Ph.D., University of California Davis, 2004
Email: jegaray@engr.ucr.edu
MSE areas: advanced material synthesis and processing; nanocomposites; mass transport, nucleation, electric current effects and defects in materials.

Dr. Harry W. Green

Distinguished Professor of Geology and Geophysics
Research Geophysicist
Ph.D., University of California Los Angeles, 1968
Email: harry.green@ucr.edu
MSE areas: synthetic and natural ceramics and rocks; mechanisms of plastic deformation; pressure effect on flow properties of solids; effect of stress on phase transformations; shearing instabilities at high pressure; nonhydrostatic thermodynamics; transmission electron microscopy; application of materials science to understanding the deep interior of Earth.

Dr. Juchen Guo

Assistant Professor, Chemical and Environmental Engineering
Ph.D., University of Maryland, College Park, 2007
Email: juchen.guo@ucr.edu
MSE areas: Ion Conducting Block Copolymers, Polymer-Nanoparticle Composite Materials, Rechargeable Batteries beyond Li-ion, Transport Phenomena in Polymer membranes

Dr. Elaine Haberer

Associate Professor, Electrical Engineering
Ph.D., University of California Santa Barbara, 2005
Email: haberer@ee.ucr.edu
MSE areas: Bio-templated materials for electronic, optoelectronic, and energy applications; nano-structured hybrid materials; and novel top-down and bottom-up assembly techniques.

Dr. Robert Haddon

Distinguished Professor, Chemistry and Chemical & Environmental Engineering
Director, Center for Nanoscale Science and Engineering
Ph.D., Penn State, 1971
Email: haddon@ucr.edu
MSE areas: chemistry and applications of carbon nanotubes and graphite; neutral radical conductors.

Dr. Roland Kawakami

Adjunct Professor, Physics and Astronomy
Ph.D., University of California Berkeley, 1999
Email: roland.kawakami@ucr.edu
MSE areas: spin transport in graphene; electronic, magnetic, and optical properties of metal-doped graphene; molecular beam epitaxy of magnetic multilayers, semiconductors, and oxides; spin and magnetization dynamics probed by ultrafast optics; semiconductor spintronic devices; magneto-optic Kerr effect.

Dr. David Kisailus

Professor, Chemical and Environmental Engineering
Ph.D., University of California Santa Barbara, 2002
Email: david@engr.ucr.edu
MSE areas: bio-mimetics, bio-inspired materials synthesis for nanomaterials, energy storage and conversion materials, biomineralization, ceramic processing, thin film growth.

Dr. Sandeep Kumar

Assistant Professor, Mechanical Engineering
Ph.D., Pennsylvania State University, 2012
Email: skumar@engr.ucr.edu
MSE areas: thermo-electro-mechanical coupling in thin films at nanoscale, performance issues with Li-ion battery electrodes and high temperature material characterization.

Dr. Roger K. Lake

Professor, Electrical Engineering
Ph.D., Purdue University, 1992
Email: rlake@ee.ucr.edu
MSE areas: theory of electron transport through nanostructured, disordered and amorphous materials; computational electronics and optoelectronics; ultra-scaled devices and device physics; novel materials

Dr. Chun Ning (Jeanie) Lau

Professor, Physics
Ph.D., Harvard University, 2001
Email: lau@physics.ucr.edu
MSE areas: electrical, thermal and mechanical properties of nanoscale systems, such as graphene, carbon nanotubes and metal oxide devices; mesoscopic superconductivity; nanofabrication; novel electronic and electromechanical devices.

Dr. Huinan Liu

Assistant Professor, Bioengineering
Ph.D., Biomedical Engineering, Brown University, 2008
Email: huinan.liu@ucr.edu
MSE areas: Design fabrication and evaluation of biodegradable materials for tissue regeneration, controlled drug delivery and medical impants/devices.

Dr. Jianlin Liu

Assistant Professor, Electrical Engineering
Ph.D., University of California Los Angeles, 2003
Email: jianlin@ee.ucr.edu
MSE areas: semiconductor materials and devices; molecular beam epitaxial growth of ZnO and SiGe

Dr. Lorenzo Mangolini

Assistant Professor, Mechanical Engineering
Ph.D., University of Minnesota, 2007
Email: lmangolini@engr.ucr.edu
MSE areas: development of devices based on nanostructured materials for the solution of energy-related issues. Characterization of nano-materials. Plasma Enhanced Chemical Vapor Deposition (PECVD) synthesis of nanostructures and semiconductor quantum dots. Advanced process characterization and modeling of gas-phase reactive systems.

Dr. Suveen Mathaudhu

Assistant Professor, Mechanical Engineering Department and Materials Science & Engineering Program
Ph.D., Texas A&M University, 2006
E-mail: smathaudhu@engr.ucr.edu
MSE areas: 1) Synthesis and processing of bulk nanostructured structural and functional alloys and composites

Dr. Umar Mohideen

Professor, Physics
Ph.D., Columbia University, 1992
Email: umar.mohideen@ucr.edu

MSE areas: experimental condensed matter physics

Dr. Dimitrios Morikis

Professor, Bioengineering
Ph.D., Northeastern University, 1990
Email: dimitrios.morikis@ucr.edu
MSE areas: computational modeling of biomolecular structure, dynamis, and interactions; NMR spectroscopy, protein and peptide engineering, drug design.

Dr. Leonard J. Mueller

Professor, Chemistry
Ph.D., California Institute of Technology, 1997
Email: leonard.mueller@ucr.edu
MSE areas: Solid-state NMR of materials; electronic and structural characterization of catalysts, organic conductors, fullerenes, and nanotubes.

Dr. Ashok Mulchandani

Professor, Chemistry and Chemical & Environmental Engineering
Ph.D., McGill University, 1985
Email: adani@engr.ucr.edu
MSE areas: Nanobiotechology - nanotechnology and biotechnology for the creation of (bio)analytical devices, novel (bio) remediation technologies and nanostructured materials.

Dr. Nosang V. Myung

Professor & Chairman, Chemical and Environmental Engineering
Ph.D., University of California Los Angeles, 1998
Email: myung@engr.ucr.edu
MSE areas: nanoscale science and engineering, sensors, MEMS/NEMS, nanoelectronics, spintronics, thermoelectrics, materials electrochemistry, electrodeposition.

Dr. Cengiz Ozkan

Professor, Mechanical Engineering & MSE Graduate Admissions Advisor
Ph.D., Stanford University, 1997
Email: cozkan@engr.ucr.edu
MSE areas: Bottom-up fabrication of bio-nano systems, metal-organic chemical vapor deposition of nanostructures, chemical vapor deposition of graphene, nanowire fabrics, photovoltaics and nanoelectronics.

Dr. Mihri Ozkan

Professor, Electrical Engineering
Ph.D., University of California San Diego, 2001
Email: mihri@ee.ucr.edu
MSE areas: hybrid nanoarchitectonics, hybrid photovoltaics and bionanotechnology.

Dr. Masaru Rao

Assistant Professor, Mechanical Engineering
Ph.D., University of California Santa Barbara, 2001
Email: mprao@engr.ucr.edu
MSE areas: Novel materials, fabrication processes, and devices for biomedical applications including cardiovascular intervention, diabetes management, neuroprostheses, pulmonary drug delivery, and cellular engineering.

Dr. Victor G. J. Rodgers

Professor & Chairman, Bioengineering
D.Sc., Washington University, 1989
Email: vrodgers@engr.ucr.edu
MSE areas: polymeric drug delivery vehicles, membrane separations.

Dr. Jing Shi

Professor, Physics and Astronomy
Ph.D., University of Illinois, 1994
Email: jing.shi@ucr.edu
MSE areas: spin-dependent transport and tunneling; nanoscale magnetism; graphene physics and devices; transition metal oxide thin films and devices.

Dr. Harry W.K. Tom

Professor, Physics and Astronomy
Ph.D., University of California Berkeley, 1984
Email: harry.tom@ucr.edu
MSE areas: nonlinear optical and ultrafast optical studies of interfacial magnetism and spin transport across interfaces, magnetic nanowire devices, optical biosensors, terahertz spectroscopy of biomolecules in liquids, orientation of biological molecules at solid/liquid interfaces.

Dr. Kambiz Vafai

Professor, Mechanical Engineering
Ph.D., University of California Berkeley, 1980
Email: vafai@engr.ucr.edu
MSE areas: transport through porous media; multiphase transport; analysis of porous insulations; high heat flux applications; transport through biological membranes; thermal design and modeling; heat transfer augmentation investigations, feasibility, optimization and parametric studies for various engineering applications.

Dr. Valentine Vullev

Assistant Professor, Bioengineering
Ph.D., Boston University, 2001
Laboratory web-site
Email: vullev@engr.ucr.edu
MSE areas: biophysics, microfluidics and charge transfer.

Dr. Junlan Wang

Adjunct Associate Professor, Mechanical Engineering
Ph.D., University of Illinois at Urbana-Champaign, 2002
Email: junlan@u.washington.edu
MSE areas: nano- and micromechanics of materials.

Dr. Bryan Wong

Assistant Professor, Chemical and Environmental Engineering and Materials Science & Engineering
Ph.D., Massachusetts Institute of Technology, 2007
Email: bmwong@engr.ucr.edu
MSE areas: time-dependent density functional theory for photovoltaic materials, electron transport in chromophore-functionalized carbon nanosystems, optoelectronic effects in core-shell semiconductor nanowires, and large-scale, first-principles calculations for predicting growth and electronic properties of nanomaterials.

Dr. Jianzhong Wu

Professor, Chemical and Environmental Engineering
Ph.D., University of California Berkeley, 1998
Email: jwu@engr.ucr.edu
MSE areas: statistical-mechanical models for colloidal processing of nanocomposites and for the design and fabrication of antifouling surfaces and self-healing materials.

Dr. Guanshui Xu

Professor, Mechanical Engineering
Ph.D., Brown University, 1994
Email: gxu@engr.ucr.edu
MSE areas: solid mechanics; mechanical behavior of materials.

Dr. Yadong Yin

Associate Professor, Chemistry
Ph.D., University of Washington, 2002
Email: yadong.yin@ucr.edu
MSE areas: colloidal inorganic nanostructures: synthesis and surface modification; self-assembly approaches to nanoscale electronic and photonic devices; composite nanomaterials for catalytic applications; biomedical applications of nanostructures; colloidal and interface chemistry; nanofabrication using unconventional methods.

V. MISCELLANEOUS INFORMATION

A. FACILITY ACCESS AND KEYS

Chung Hall, Bourns Hall, and the MSE use card access for most of the doors in the building. The "key" is the student ID card, "UCR Connection Card," students receive when first registered at UCR. Card key access to general MSE graduate student areas is granted to students when they first apply for a computer and e-mail account during the graduate student orientation. This access will be continuous as long as a student is in good academic standing. Access to research laboratories must be requested on a quarterly basis by the faculty member supervising the specific research laboratory. The MSE Program Manager grants access to instructional laboratories to TAs on a quarterly basis. Please see the Program Manager if you are having problems with access or need additional access.

The MSE building currently requires a hard key to most of the laboratories. Please see the MSE Program Manager for an approval form.

Students whose research Advisor or Lab is not housed in Chung Hall or Bourns Hall will have to make arrangements through their research advisor for access.

B. OFFICE AND DESK SPACE

The MSE Program Manager and Chairman assign office and desk space, as available, to full-time students. Preference is given to full-time students with teaching assistant appointments, full-time students with research assistant appointments, other full-time students, and finally part-time students, in that order. It may not be possible for every student to be assigned desk space.

C. REMUNERATION AND DISBURSEMENT

Direct Deposit statements are available on-line; students employed by other departments should verify the disbursement location and time from the administrative office of the employing department. The Material Science and Engineering Program strongly encourages each employee to participate in the Direct Deposit program. Should you desire a traditional paycheck, you will need to request a waiver and the paycheck will be sent to your residence via U.S. Postal Service (USPS). It is incumbent upon the employee to ensure your local address is current in the Payroll/Personnel System (PPS).

D. TELEPHONE/FACSIMILE

Student offices and laboratories have telephone service, which is restricted either to the local calling area or to within UCR, although long distance calls can be received. If long distance calls of an official nature are required, they should be made through the Advisor's phone and a charge slip completed.

Use of the facsimile (fax) machine is restricted to official university business only. Obtain your advisor's consent and ask the Program manager for permission to use the fax machine. You will need to complete the fax log upon completion of your transmittal.

E. PHOTOCOPYING

There are photocopying machines in many of the Departments graduate students do research in and may have teaching obligations with. Please inform yourself about the pertinent regulations from the respective Departments before using.

> PERSONAL PHOTOCOPYING, INCLUDING COPYING OF NOTES, HOMEWORK, EXAM SOLUTIONS, THESIS DRAFTS, TEXTBOOKS AND JOURNAL ARTICLES, NOT ASSOCIATED WITH RESEARCH OR TEACHING ASSISTANT DUTIES, IS NOT PERMITTED ON DEPARTMENTAL PHOTOCOPIERS. Commercial photocopy machines are located in the UCR Bookstore, Rivera Library, Science Library, and the Copy Service store in the Commons.

G. MACHINE SHOP

The machine shop facilities are located in the ground-floor of the laboratory wing of Bourns Hall, Room B155, and in the ground-floor of the Physics Building. Students may borrow equipment and use certain machine tools with supervision and prior approval of Robert Wright, Mechanical Engineering Principal Mechanician or Michael Fournier, CNAS Machine Shop Supervisor. Such use is limited to research and is not for personal work.

H. SAFETY

Safety precautions shall be exercised, observed and complied with at all times. NO EXCEPTIONS! All graduate students are required to attend General Safety Orientation and Laboratory Safety Orientation. In addition, lab specific or task specific training may be required depending upon requirements of the laboratory assigned or employed. Students must become acquainted with all safety rules and procedures before working in the machine shop or laboratories. Graduate students should contact the Lab Safety Coordinator of the Department that houses their research labs.

I. EMAIL

All Engineering students are **REQUIRED** to have an ENGR email account. This has been setup in advance and should forward automatically to your RMAIL account. The Program will communicate with students at this ENGR email address ONLY. It is your responsibility to check your email frequently; this is the primary method of information dissemination regarding deadlines, seminars, etc. If you feel like you are not receiving departmental emails please contact the MSE Program Manager immediately.

J. THESES AND DISSERTATIONS

Typing and submittal of a thesis or dissertation to the specifications of the Graduate Division is the responsibility of the student. See the *Thesis & Dissertation Format Guide* from the Graduate Division for specific information

K. UNIVERSITY LETTERHEAD

The use of University letterhead is for official business only. See the MSE Program Manager should you feel the use of letterhead is warranted.

L. DEADLINES

It is the responsibility of the student to submit the proper forms, paperwork, etc. on time to both the Program and the Graduate Division, and in all other respects satisfy the requirements for a degree as specified by the Department and the Graduate Division.

VI. APPENDIX

*** The following forms are frequently referenced Graduate Division documents