

Materials Science and Engineering M.S. and Ph.D. Student Handbook

Department of Materials Science and Engineering

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For Incoming MSE Graduate Students Entering
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Welcome Message from MSE Graduate Advisor

We would like to welcome you to UCI and to the graduate program in Materials Science and Engineering. This handbook is designed to help you navigate your way through your graduate career and lists useful resources.

We would encourage you to become active in the MSE Graduate Student Association (MSE GSA) to get to know other students and to have a voice in aspects of graduate student life. Watch for announcements at the Thursday Seminars and in your e-mail or contact **K. Acord (kacord@uci.edu)**. Another opportunity is the Engineering & ICS DECADE Council that supports diversity, <https://www.facebook.com/EngDECADE/>

The first year of graduate school can seem very challenging. Most successful students have found additional resources on campus that have helped them. I will remind you that if you feel stressed and at a loss as to how to balance competing demands on your time, there are free campus resources designed for you at the Counseling Center (949) 824-6457. The UCI Graduate Resource Center is another excellent place to find support for writing, career planning, or just general advice (<https://grad.uci.edu/>).

The majority of entering MSE PhD students have already selected an advisor after the visitation interviews. For the PhD students who are conducting 3-4 week research rotations, you must be matched with an advisor by the end of the fall quarter to remain in good academic standing. M.S. students may get involved in research as space permits, but have no financial support.

TA training each fall is required for PhD students, and must be completed prior to serving as a TA. International students must demonstrate proficiency in English by the Spring Quarter of the first year to be eligible for any departmental financial support such as a TA, passing the TOEP (with a score of 5), TSE or SPEAK (with a score of 50) or have a TOEFL iBT score of 26 or higher on the Speaking portion.

Lastly, feel free to e-mail us or set an appointment to meet.

Professor Martha Mecartney martham@uci.edu ET744C
Graduate Advisor for MSE, Fall 2019 and Spring 2020

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Graduate Advisor for Materials Science and Engineering, Winter 2020

Key Personnel in Materials Science and Engineering (MSE) (Engineering Tower)

- **Desiree Rios** (916 ET) – Academic Coordinator
Source for **all graduate paperwork**, answers on rules and regulations. *Exceptions* require the Graduate Advisor's written approval but see Desiree for proper forms and protocols first.
- **Amy Nguyen** (916 ET) – Payroll & Personnel Coordinator
Handles all appointments (TA, Reader, GSR).
Faculty must initiate requests for support a month in advance.
- **Elizabeth Randall** (916 ET)–Front Desk/Business Office Analyst
Provides keys to labs, handles mail and package deliveries, reserving rooms.
- **Amy Ricks** (544D ET) – Department Manager for MSE
- **Steve Weinstock** (944G ET) – Lab Manager and Technical Support
- **Professor Julie Schoenung** (544 ET) – MSE Department Chair

Purchasing and Travel Reimbursement –

For purchases of lab supplies, please follow instructions on the School's website, where you can download the latest forms:

<http://intranet.eng.uci.edu/intranet/school-information/purchasing>

For travel or other reimbursements, please follow instructions on this site, where you can download the latest forms:

<http://intranet.eng.uci.edu/intranet/school-information/purchasing-reimbursement/reimbursements>

YOUR STUDENT MAILBOX is in room 937A ET. Be sure to check it regularly.

The faculty and staff in the Department and School will regularly send important messages to your **@uci.edu** e-mail, so check it daily. You must activate your student ID. Check your electronic directory listing at UCI to be certain that you can be e-mailed by faculty and other students.

Information on filing for Advancement to Candidacy for the M.S., Ph.D. and other forms can be found at <https://grad.uci.edu/>

COURSE SELECTION

Below is the expected course schedule for the first year of graduate study for students without an M.S. in MSE. Beyond the first year for PhD students, only 2 additional graduate courses are required. M.S. students who elect the thesis option are only required to take 3 elective courses instead of 5.

	FALL	WINTER	SPRING
<i>Required Core</i>	ENGRMSE 200	ENGRMSE 265	ENGRMSE 205
<i>Required Core</i>	ENGRMAE 259		
<i>Research Units</i> (<u>Required</u> for PhD and M.S. Thesis)	ENGRMSE 299 – PhD rotations <i>or</i> M.S. research/no thesis option ENGRMSE 297 – Ph.D. dissertation units with permanent research advisor ENGRMSE 296 – M.S. thesis units with research advisor	ENGRMSE 299/297/296	ENGRMSE 299/297/296
<i>Required MSE Departmental Seminar</i>	ENGRMSE 298	ENGRMSE 298	ENGRMSE 298
<i>Required Electives</i>	1 graduate level elective	2 graduate level electives	2 graduate level electives
<i>Highly Recommended for PhD Students</i>	ENGRMSE 249 Scientific Communication Part 1 (2 units) by Prof. Ragan		ENGRMSE 249 Scientific Communication Part 2 (2 units) by Prof. Ragan

Required Classes

You should become familiar with the Schedule of Classes online at UCI.

<https://www.reg.uci.edu/perl/WebSoc>

Each quarter check ENGRMSE listings in the Schedule of Classes and other related disciplines (Chemistry, Physics, CBE, ENGRMAE, etc.) for courses of interest.

The following MSE core courses are REQUIRED for all new students, unless you have taken the equivalent graduate course elsewhere as an M.S. student. *You must seek approval in writing from the Graduate Advisor before the quarter the class is offered to receive credit for an equivalent course taken elsewhere.* The Ph.D. preliminary exams and M.S. comprehensive exams are based on material covered in these required core classes. To remain in good academic standing you must take these courses in the first year the quarter they are offered.

- EngrMSE 200 Crystalline Solids **FALL 2019**
- EngrMSE 256A Mechanical Behavior of Engineering Materials (replaced by EngrMAE 259 – Atomistic Theories in **FALL 2019**)
- EngrMSE 265 Phase Transformation **WINTER 2020**
- EngrMSE 205 Materials Physics **SPRING 2020**
- 6 units of ENGRMSE 298 Department Seminar (Fall 2019, Winter 2020 and Spring 2020)
- PhD students without an M.S. are expected to enroll in 3-5 additional graduate elective academic courses in the first year.

Every MSE graduate student should have completed a basic Introduction to Materials Science and Engineering undergraduate course (ENGR 54 at UCI) prior to enrolling in graduate courses, and EngrMSE 200 assumes you have learned the material covered in that class. If you have not taken such a course you will need to review on your own the material covered in an undergraduate Introduction to Materials Science and Engineering textbook. Materials Science and Engineering: An Introduction by William D. Callister is the book used for ENGR 54.

EngrMSE 265 assumes knowledge of the fundamentals of phase diagrams, phase equilibria, and transformation kinetics taught at the undergraduate level.

EngrMSE 256A (substituted by EngrMAE 259 Atomistic Theories in Fall 2019) requires a basic understanding of mechanical behavior of materials. You should review an undergraduate textbook if you lack an undergraduate course in strength of materials or mechanical properties.

EngrMSE 205 assumes you have a strong understanding of electromagnetics acquired in an undergraduate physics course required for all engineering and physical science majors. If you have forgotten this material you should review relevant sections of an introductory undergraduate physics textbook. This course also builds on the material taught in EngrMSE 200.

Research Units

Incoming Ph.D. students who have not been directly recruited by a research advisor who is supporting them will enroll in 1-2 units of **research rotation** (ENGRMSE 299, Independent Study) during Fall with each rotation professor. At least one research rotation must be within the department.

If you are a Ph.D. student who has been directly recruited to a research advisor who is supporting you, you will sign up for ENGRMSE 297, PhD Dissertation Research. ALL PhD STUDENTS MUST USE ENGRMSE 297 *after* they match with an advisor by the end of Fall Quarter.

If you are a M.S. student who wants to conduct M.S. thesis research, you will have an opportunity to sign up for ENGRMSE 296 after you have discussed thesis research with the faculty member and together defined a project. For the M.S. comprehensive exam (non-thesis) option, research units do not count toward your degree. M.S. students are not required to take 3 courses/quarter if they are enrolled in thesis units and/or on part-time status.

Departmental Seminar

ALL FULL TIME STUDENTS MUST ENROLL IN **ENGRMSE 298** each quarter during their first year. This is the Materials Science and Engineering Departmental Seminar, typically held once a week on Thursday afternoons. You will sign up for this class each quarter. You must attend at least 8 out of 10 seminars in order to obtain a passing grade. This will require you to be on time, and you are expected to stay for the entire seminar to receive credit. Any attempts to cheat by signing for other students or arriving late/leaving early **will result in a grade of F and possible dismissal from the graduate program.**

Units for Weekly Research Group Meeting

Your research supervisor might also want you to add a one-unit group meeting, listed as ENGRMSE 295 (Seminar in ENGR). Check with your research supervisor.

Selection of Elective Courses

Select elective courses based on the advice you receive from your research advisor if you want to be competitive to work in that group. **PhD students** (without an M.S. in MSE) **typically take 3 academic courses/quarter and the department seminar, along with research units, and must receive grades of B or better to remain in good academic standing during the first year.** You can select **elective** courses for a total of 12-16 units/quarter. Undergraduate level courses numbered 100-190 **may** count for one course **IF** this course is not required for the undergraduate MSE degree. To confirm, look at the current copy of the UCI catalogue online: <http://catalogue.uci.edu/thehenrysamuelischoolofengineering/departmentofmaterialsscienceandengineering/#graduatetext>

If you find an undergraduate level course you wish to take is NOT on the list, e-mail the MSE Graduate Advisor for verification that the course will count for the fulfillment of the degree requirements. Undergraduate courses may have prerequisites, and you should always contact the instructor of any elective course for permission to enroll and to assess whether you will be able to perform at a minimum of a B level in the course, as to not jeopardize your standing in the graduate program.

Check the Schedule of Classes for graduate level elective courses in MSE as well as in other Engineering departments and in Chemistry and Physics. Appendix III lists elective courses as of the printing of this document, but there may be more later additions each quarter.

The maximum number of units you may enroll in is 16 units. You may petition to take extra units if needed. There is an expectation that MSE PhD students with financial support from UCI take 3 academic classes/quarter the first year to finish the M.S. coursework by the end of Year I. At a minimum, 2 academic courses/quarter for those without an M.S. and all required courses must be taken in Year 1 to be in good academic standing. If you serve as a teaching assistant (TA) you will need to register for ENGR 399. Research units should be used to bring the total unit count up to 16 for each quarter.

FAQ REGARDING GRADUATE COURSEWORK

What is a passing grade in a course taken as a graduate student?

A passing grade is a B or better

How can I find if other courses are offered in winter and spring?

Classes that are offered each quarter can be found using the **Schedule of Classes** on the UCI website. Use the search function at www.uci.edu and type in "Schedule of Classes." Our department offers courses under **ENGRMSE**, but many **CBE courses are also relevant**. You may take classes outside our department only with permission of the instructor and the Graduate Advisor.

How many total units should I take?

Full time graduate students must take at least 12 units. 16 units is the norm, often with research units filling in the balance. PhD students without an M.S. in MSE must take 3 academic courses/quarter, research, and the department seminar. You can take up to 16 units or up to 18 units with petition. You will need to fill in your schedule with elective courses. All full time M.S. and M.S./Ph.D. first year graduate students are expected to take at least 3 courses each quarter in order to remain in good standing. A typical comprehensive exam **M.S.** student schedule would be 3 lecture classes/quarter and the departmental seminar. **M.S. thesis** and **M.S./Ph.D.** typically take 2-3 lecture classes/quarter and 4 units of research /quarter and the departmental seminar (~18 units).

Part time M.S. students, not continuing for the Ph.D., can enroll in fewer units up to a maximum of 8 units. Financial support is not allowed for any student with less than 12 units.

Will ESL or Physical Education classes count for my graduate degree?

English as a Second Language classes **do not** count as units for the Ph.D. or M.S. degree requirements and should be taken as extra units above the required 12 minimum units. These courses are strongly recommended for international students who want to improve their English skills. Sports or Physical Education classes help you balance your life, but also will not fulfill requirements and can only be added above the 12 minimum units.

Do I need to take a full load of courses if I am a Teaching Assistant?

If you are serving as a Teaching Assistant you will be expected to enroll in **ENGR 399 under Professor Schoenung** for a minimum of 1 unit; thus, you could be taking fewer regular classes and/or research units that quarter.

Can I take undergraduate courses for my M.S. degree?

One course of undergraduate upper division (100-190) courses may count for your degree **IF** approved by MSE Graduate Advisor in advance. **Under no circumstances will courses that are required for the MSE undergraduate degree be used to fulfill graduate degree requirements (see above)**. However, there are many elective classes that would be acceptable.

MATERIALS SCIENCE AND ENGINEERING DEGREE REQUIREMENTS

There are two options, the thesis option and the comprehensive exam option for the M.S. degree. Students who will not perform thesis research, and those who are in the M.S./Ph.D. program and complete a M.S. along the way, are subject to the comprehensive exam option, unless you and your research advisor decide to have you complete an M.S. thesis.

I. M.S. Thesis option: A minimum of 36 units is required

- 4 required graduate core courses (described in more detail in the following section):
 - (4 units) 1 Crystal Structure and Defects
 - (4 units) 1 Electrical and Optical Behavior
 - (4 units) 1 Mechanical Behavior
 - (4 units) 1 Thermodynamics and Kinetics
- 3 quarters of ENGRMSE 298 (Department Seminar) (6 units)
- 5 additional graduate elective courses (3 units minimum/course) numbered 200-289 (or 200-295 if offered by other departments) as approved by the Graduate Advisor.
- Up to 2 of these elective courses can be substituted by up to 8 units of ENGRMSE 296 (M.S Thesis Research), and 1 of these elective courses may be substituted by an upper-division undergraduate elective course approved by the MSE Graduate Advisor.
- M.S. Thesis is required.
- Students must file the Advancement to M.S. Candidacy **one quarter before graduation** (apply through SSoE Graduate Affairs, forms available at: <http://www.grad.uci.edu/forms/>)
- In addition to fulfilling the course requirements outlined above, it is a University requirement for the Master of Science degree that students fulfill a minimum of 36 units.

II. M.S. Comprehensive Exam Option: A minimum of 36 units is required

- 4 required graduate core courses: (described in more detail in the following section):
 - (4 units) 1 Crystal Structure and Defects
 - (4 units) 1 Electrical and Optical Behavior
 - (4 units) 1 Mechanical Behavior
 - (4 units) 1 Thermodynamics and Kinetics
- 3 quarters of ENGRMSE 298 (Department Seminar) (6 units)

- 5 additional graduate elective courses numbered (3 units minimum/course) 200-289 (or 200-295 if offered by other departments) approved by the MSE Graduate Advisor.
- One elective course may be substituted by an upper-division undergraduate elective course if the course is approved in advance by the MSE Graduate Advisor.
- The MSE comprehensive exam must be passed in Spring Quarter or at the latest in December of the following academic year. (The Ph.D. preliminary exam offered in September satisfies this requirement for students who are PhD students.)
- Students must file the Advancement to M.S. Candidacy one quarter before graduation (apply through SSoE Graduate Affairs, forms available at: <http://www.grad.uci.edu/forms/>)
- In addition to fulfilling the course requirements outlined above, it is a University requirement for the Master of Science degree that students fulfill a minimum of 36 units.

M.S. Core Courses

Crystal Structure and Crystal Defects

Course:	Check
<ul style="list-style-type: none"> • MSE 200 (Crystalline Solids: Structure, Imperfections, and Properties) 	

Electrical and Optical Properties of Materials

Course:	Check
<ul style="list-style-type: none"> • MSE205 (Materials Physics) or equivalent course 	

Mechanical Behavior

Course:	Check
<ul style="list-style-type: none"> • MSE256A (Mechanical Behavior of Engineering Materials) (substituted by MAE 259 Atomistic Theories in Fall '19) 	

Thermodynamics and Transport Phenomena

Course:	Check
<ul style="list-style-type: none"> • MSE265 (Phase Transformations) 	

It is highly recommended that Prof. Ragan's Scientific Communication (ENGRMSE 249) course be taken by PhD students. In alternate years, CBE will offer such a course.

III. Ph.D. Requirements

- Course Requirements are the same as the M.S. comprehensive exam option. Students may be permitted to use M.S. materials science and engineering degree graduate courses taken elsewhere, but you must submit documentation that they were graduate courses

equivalent in content to UCI graduate courses and this must be approved in writing by the Graduate Advisor the quarter before the required class is offered.

- PhD students are expected to complete the M.S. comprehensive exam option degree requirements by the end of the first year, unless approved by exception by the MSE Graduate Advisor.
- Match with Faculty Research Advisor by the end of the first quarter, if not recruited directly to a research group.
- Preliminary Exam taken after the first-year coursework is successfully completed, with grades of B or better, in summer/early fall, pass by December of second academic year at the latest. (Dates may vary and will be determined by the MSE faculty)
- **Ph.D. students are required to take two** graduate elective courses numbered 200-289 (or 200-295 if offered by other departments) above and beyond **the M.S. degree requirements**, with these two elective courses relevant to your Ph.D. dissertation approved by the Graduate Advisor. These courses can be taken any time prior to graduation, but are normally taken after the M.S. is completed. The two courses must be relevant to the student's Ph.D. dissertation topic and must be selected in consultation with the research advisor and approved by the MSE Graduate Advisor.
- Ph.D. Qualifying Exam with five faculty completed and passed by the End of 3rd Year (advancement to candidacy). Please visit <http://engineering.uci.edu/current/graduate/phd-qualify-defense> for SSoE policies. If not completed by this point, a timeline with milestones to pass examination must be presented to MSE Graduate Advisor in consultation with your PhD mentor. A dossier is required prior to the Qualifying Exam. See details below in Appendix II.
- Written dissertation must be completed no more than 9 quarters after passing advancement to candidacy or eligibility for financial support may be jeopardized. Must be submitted to dissertation committee four weeks prior to deadline for campus submission.
- Oral defense of dissertation and approval of PhD dissertation by dissertation committee consisting of three faculty. Please visit <http://engineering.uci.edu/current/graduate/phd-qualify-defense> for SSoE policies. The UCI library must also approve the dissertation format at time of final submission.
- All students must take a minimum of 12 units per quarter (Fall, Winter, and Spring) to be considered full time. 16 units per quarter is the norm (including research units); 18 units can be taken by petition.

IV. Good Academic Standing

- Students without good academic standing may be dismissed from graduate school and/or have all financial aid revoked, including GSR, TA, and fellowships. In order to remain in the Ph.D. or M.S. program, all students must **maintain good academic standing** including the following:
 - a. Minimum GPA requirement of 3.0 with no grades below a B.
 - b. Successful rotation/research units in the first year in M.S. thesis or Ph.D. dissertation units, with no grades of U (unsatisfactory).
 - c. M.S. Comprehensive Exam students should successfully complete the Comprehensive Exam prior to the end of the 2nd academic year. Ph.D. students

must successfully complete the Ph.D. Preliminary Exam by the end of December of the second year.

- d. Full time M.S. thesis students are expected to complete the M.S. in two years.
- e. Ph.D. students must be matched with a research advisor willing to advise and support them by the end of the Fall quarter in order to remain in good academic standing. If a student leaves a research group, the student must find another research advisor within one quarter to remain in good academic standing.
- f. Ph.D. students should successfully complete their qualifying exam prior to the end of the 3rd year, and only with written permission should schedule the exam later than the fall of the 4th year (see above).
- g. Failure to meet the above standards may result in academic probation or dismissal from the graduate program and immediate cut off of any financial support.
- h. Any student who conducts **research fraud** or **plagiarism** may also be dismissed from the graduate program, after a review of the charges and a decision as to the validity of the charges by an impartial board constituted by the SSoE Graduate Affairs Office and the SSoE Graduate Affairs Faculty Committee.

FAQ FOR DEGREE REQUIREMENTS

What are the Ph.D. Course Requirements for MSE?

- All Ph.D. students must complete the M.S. comprehensive degree requirements for MSE if they do not already have a M.S. Two additional graduate classes 200-289 (or 200-295 if offered by other departments) approved by the Graduate Advisor are required past the M.S. These courses must be selected in consultation with the student's research advisor and approved by the Graduate Advisor.

When do I need to plan my coursework for the first year?

- A Plan of Study is required for first year M.S. and Ph.D. students
- Complete the Plan of Study by the **end of the first quarter** and submit to the **Graduate Coordinator, Desiree Rios**.
- If appropriate, it will be evaluated and approved by the MSE Graduate Advisor.
- Can be modified! Most important is to list required core courses in your plan.

Where can I find additional information regarding the degree requirements for MSE M.S. and Ph.D.?

In addition to this handbook, you can find information regarding the degree requirements for the MSE M.S. and Ph.D. degrees in the UCI catalogue:

<http://catalogue.uci.edu/thehenrysamuelischoolofengineering/departments/materialsscienceandengineering/>.

What if I have a M.S. in MSE already and have completed the core requirements?

If you have a M.S. degree from another university that covers the same material as these core courses you may petition for exemption **PRIOR** to the quarter the class is offered. Ph.D. students with a M.S. in MSE are required to take **2 additional elective** graduate classes sometime before completing their Ph.D., but these classes should be selected based upon their research interest and upon consultation with their research advisor. The Ph.D. preliminary exams and

M.S. comprehensive exams are heavily based on material covered in the four required classes, so some students decide to take them again even if they have already taken similar courses to ensure adequate preparation for the preliminary exams.

How long will it take me to complete my M.S.?

M.S. thesis students should assume approximately 15-18 months to complete the degree with a research thesis. It is possible for M.S. comprehensive exam students to complete their degree in 9 months. There is rarely any financial support offered for terminal M.S. students as most of the financial support is for students who elect to continue on to the Ph.D. since it is mainly tied to long-term research funding.

What is the Ph.D. Preliminary Exam/M.S. Comprehensive Exam?

- Both exams cover basic concepts in MSE core courses and test your comprehensive knowledge of MSE.
- The preliminary exam also tests your ability to evaluate and understand scientific data and communicate this understanding. It also tests your ability to understand the technical/societal significance of scientific research.
- It is required that the preliminary exam be taken after all of the core courses have been completed with a grade of B or better.
- A panel of MSE examiners will hold all exams during a one-to-two-week period.
- The Preliminary Exam will be offered once yearly currently tentatively scheduled for the end of Summer after the first year. Retake exams held in December are scheduled only for students who did not pass the exam the first time.

The Ph.D. Preliminary Exam and M.S. Comprehensive Exam will cover these topics:

- Structure and Defects
- Thermodynamics and Kinetics
- Mechanical Behavior
- Electrical/Optical/Magnetic Properties

How can I find out more about the Preliminary/Comprehensive Exam?

- Look at **Appendix I** of this Handbook. This list is updated every year.

What is the Ph.D. Qualifying Exam?

- The Qualifying Exam covers dissertation ideas and preliminary research.
- The committee is composed of 5 members, consisting of at least 3 MSE faculty and 1 faculty member not affiliated (no joint appointment) with MSE (outside member). Two faculty must have their primary appointment in MSE. Your advisor will be on your qualifying exam committee.
- Taken after passing the Ph.D. preliminary exam. If a student expects to graduate in 4 years (entered with a M.S. in MSE), then the qualifying exam can be taken as early as the beginning of the second year. If a student expects to graduate in 5 years, then the exams should be taken no earlier than the end of the second year.
- The qualifying exam should be taken no later than the end of the 3rd year in M.S./Ph.D. program.

- This exam includes a research dossier and a 1.5 hour oral exam where you present your research plan in a 40-minute presentation. The research dossier and the PowerPoint presentation must be reviewed by your advisor prior to dissemination, with a signature by the research advisor on the front cover testifying they have read and approved the dossier.
- Students should be aware that passing this exam is “Advancement to Ph.D. Candidacy” and three years after advancement to candidacy all financial support from fellowships and TAs may end. Thus, students should take the qualifying exam NO EARLIER than 3 years before their intended graduation date, and should plan on receiving no financial support 3 years after they advance to candidacy.

How can I find out more about the Ph.D. Qualifying Exam?

- Look at **Appendix II** of this Handbook

What is the Ph.D. Oral Defense?

- Oral presentation at the end of Ph.D. dissertation is required when your PhD advisor agrees you are ready.
- Schedule when the written dissertation has already been approved.
- Committee members for Ph.D. dissertation (three, including research advisor) are required to attend. The entire department faculty, staff and students are also invited.
- The candidate presents a 45-minute presentation summarizing research results and significance.
- After the first hour, attendees other than the dissertation committee are excused. Questions from committee (closed session at this point) must be answered with an authority on the topic.

What is the Ph.D. Dissertation?

- This document shows your original research in MSE.
- Check out copies of past dissertations in UCI library.
- Formatting guidelines are available at: <http://www.grad.uci.edu/academics/degree-completion/electronic-submission.html>
- Have advisor approve first, then the two other committee members
- Writing will take at least 3 months
- Tip – use your publications as a base for chapters and use the dossier from the Ph.D. qualifying exam to help outline the introduction.
- The expectations for a qualified dissertation are listed below.

The Ph.D. dissertation is written documentation of original research that has impact on the field of study for the Ph.D. Impact in the field is measured by accepted or published peer-reviewed journal articles, peer-reviewed conference proceedings, patents, or analogous original documented adoption of innovative technology. Faculty research advisors are to provide in writing their specific expectations consistent with the above criteria.

Where can I find forms that I need?

<http://www.grad.uci.edu/forms/> and contact the Academic Coordinator if you cannot find what you need on this website.

FAQ ON ADVISING AND SUPPORT

When should I select an advisor?

Ph.D. and M.S./Ph.D. students will be matched with a research advisor by end of the 1st quarter (Fall quarter) of the first year. (Students who are fully supported by a GSR appointment from one faculty member as direct recruits do not conduct research rotations). M.S. students selecting thesis option should select advisor by the Winter Quarter. In the fall, first year PhD students will select their research rotations after the welcome week orientation and after they meet with faculty. M.S. students are discouraged from conducting research rotations, instead, M.S. students should find one advisor for research from the start.

Who can serve as my research advisor?

All Materials Science and Engineering core and joint faculty can advise your thesis research. See <http://engineering.uci.edu/dept/mse/faculty-staff/faculty> for the most current list. Students may also find co-advisors from outside the department who are not affiliated MSE with as long as they also have a primary advisor affiliated with MSE. M.S. students on comprehensive exam status do not need an advisor other than the general MSE Graduate Advisor. Core MSE faculty are in **bold**.

Diran Apelian	Solidification processing, aluminum metallurgy, plasma spray, recovery/reuse/recycling, innovations in engineering education
Shane Ardo	Solar energy conversion and electrochemistry
Plamen Atanassov	Electrocatalysis and electrocatalysts for energy conversion and energy harvesting
Will Bowman	Electrochemical materials, energy materials, oxides, transmission electron microscopy, thin films
Peter Burke	Nanotechnology; quantum electronics, quantum information science and high-speed semiconductor devices
Penghui Cao	Computational MSE for damage tolerant materials, nanocrystalline materials
Stacy Copp	Soft matter based photonic materials, polymer nanostructures, biomimetics, machine learning for materials discovery
Sarah Finkeldei	Nuclear materials chemistry, oxide ceramics, nuclear waste form stability and corrosion
James C. Earthman	Fatigue behavior and cyclic damage, automated materials testing, high-temperature fracture, biomaterials, nanocomposites
Alon Gorodetsky	Cephalopods, adaptive materials, camouflage, bioelectronics

Zhibin Guan	Organic, Biological, and Macromolecular Materials Chemistry
Horst Hahn	Defects and diffusion in metals and ceramics, nanostructured materials
Jered Haun	Targeted drug delivery, clinical cancer detection, nanotechnology, molecular engineering, computational simulations
Allon Hochbaum	Nanoscale materials and hybrid bio-inorganic devices for applications in clean energy
Michelle Khine	Development of nano- and micro-fabrication technologies
Enrique Lavernia	Nanostructured materials, additive manufacturing, powder metallurgy, mechanical behavior
Matt Law	Nanoscale materials and devices, solar energy conversion
Mo Li	Responsive materials, multifunctional materials and structures, fracture mechanics, cement chemistry, industrial ecology, materials-structure-environment interaction
Ray Luo	Computational analysis of biomolecular sequence, structure, dynamics, and function
Martha Mecartney	Grain boundary engineering of ceramics, solid oxide fuel cell electrolytes, ceramics for nuclear waste and nuclear fuels, superplastic ceramics.
Ali Mohraz	Soft materials, guided and self-assembly of colloidal structures, nanostructured materials for energy and biotechnology applications
Daniel Mumm	Materials for energy and propulsion, degradation in extreme environments, materials for electrochemical applications, interfacial structure/property relationships, thermo-mechanical behavior
Mikael Nilsson	Fundamentals and applications in chemical separation processes for used nuclear fuel; radiation chemistry: radioisotopes for medicine
Xiaoqing Pan	Atomic-scale structure, properties and dynamic behaviors of advanced materials including thin films and nanostructures for memories, catalysts, and energy conversion and storage devices
Joe Patterson	Polymer chemistry, nanoscience, TEM

Regina Ragan	Self-assembly, optical characterization of plasmonic and metamaterials, scanning probe microscopy of catalytic and electrochemical systems for sensor and energy applications
Timothy Rupert	Nanoscale mechanics and materials
Julie Schoenung	Materials selection, green engineering, materials processing and characterization, nanostructured materials, structure-property relationships
Frank G. Shi	Optoelectronic device (LED, solar cells, etc.) packaging technologies; Optically transparent device encapsulation materials; Transparent functional coating materials
Lorenzo Valdevit	Additive manufacturing, mechanics of composite materials and lightweight structures
Vasan Venugopalan	Application of laser radiation for medical diagnostics therapeutics and biotechnology; laser-induced thermal, mechanical, and radiative transport processes
Huolin Xin	Condensed matter physics, TEM
Yoonjin Won	Multi-scale structures for thermal and energy applications, in particular fabrication, characterization, and integration of structured materials
Iryna Zenyuk	Renewable energy, fuel cells, electrolyzers, batteries, X-ray imaging techniques, multi-scale modeling, transport phenomena
Weian Zhao	Development of novel molecular, nano- and micro-engineered tools for stem cell therapy and regenerative medicine, diagnosis and in vivo imaging, and elucidating stem cell and cancer biology

How are continuing graduate students supported?

- All support is given competitively, and based on **continuing good standing**.
- Teaching Assistantships
- Internal Fellowships (usually to new students for recruitment) and External Fellowships
- GSR – Research Assistantships funded from faculty research. In Engineering in 2019, the GSR Steps are as follows:
 - Step IV = B.S. only
 - Step V = B.S. + M.S. completed
 - Step VI = Ph.D. candidate who has passed the Ph.D. Qualifying Exam
 - The Step levels change the quarter after these milestones are met.
- Hours worked are in ADDITION to units earned for research credit.

- Students who are U.S. citizens or Permanent Residents must fill out the FAFSA each year, due March 1 at <http://www.fafsa.ed.gov/> in order to be eligible for certain financial awards such as GAANN Fellowships and Work Study awards.

What do Teaching Assistants and Readers Do?

- TAs grade homework and tests, run demonstrations, hold office hours, lead discussions, maintain class websites, maintain records of grades, and/or run laboratories.
- Readers grade homework and tests; they also can hold office hours.
- Students are selected based on faculty nominations, match of knowledge with course material, GAANN/CAREER grant priority, and past experience.
- All students who want to be a TA or Reader must have completed the TAPDP September TA training.

What are the requirements for spoken English for international students who want to TA?

- To be a TA, international students must pass TOEP (with a score of 5), TSE or SPEAK test (with a score of 50) or TOEFL iBT score of 26 or higher on the Speaking component.
- TOEP is given at UCI only to students who have taken TSE or SPEAK and obtained a non-passing score of 4, refer to: https://www.humanities.uci.edu/esl/toep/Speak_TOEP_2019-2020_Dates.pdf. Classes offered through ESL can prepare graduate students for these exams and improve communication skills.
- Humanities 21A, 21B, 29 are for graduate students who are not native English speakers. Please meet with the Academic English Coordinator, Dr. Susan Earle-Carlin before enrolling in any of these classes. She will meet with you and evaluate your English to see what class level you need to enroll in.

What should I do if I want to change research advisors?

- Let the MSE Graduate Advisor know immediately.
- Talk with your research advisor – if unable to do so, ask MSE Graduate Advisor to talk to your advisor.
- Talk with other faculty in the department about research projects and find a new advisor within one quarter.
- If you have been fully supported financially by your advisor on a GSR, you can be required to finish up a project component (requiring no more than one extra quarter), before you can switch advisors. During this extra quarter you should be given financial support (GSR/TA/Reader/fellowship) equal to a 49% GSR.

Can I switch to another degree program at UCI if I find my interests are better matched by another degree program?

Although you cannot simply switch or transfer to other programs, you can apply to other degree programs at UCI, which means being part of the applicant pool for the next cycle. If you decide to change your degree program, you **cannot** apply for readmission to the MSE program after the start of the next academic quarter in your new degree program. All financial support from the department will be terminated if you change degree programs.

What grades do I need to have to maintain good standing?

Students must have a 3.0 GPA minimum with no grades below a B to remain in good standing. You need to have a GPA higher than a 3.2 for certain types of fellowships, a GPA higher than 3.7 or 3.8 for campus wide competitive fellowships, and a GPA higher than 3.1 for any TA positions. In addition, see the non-grade requirements to remain in good standing in section IV on Page 8 of this handbook.

How Hard Should I Work at UCI?

- Coursework at the level of 12 units requires up to 24-30 hours of homework and studying to pass classes.
- Research should be performed about 20 hours a week, if taking a full load of classes and a minimum of 40 hours a week if not taking a full load of courses.
- Fellowships expect that a student is working FULL TIME on research and coursework (at least 40 hours a week).
- **NO OUTSIDE EMPLOYMENT IS PERMITTED** WITHOUT PERMISSION OF THE GRADUATE ADVISOR AND YOUR RESEARCH ADVISOR. Any outside employment may reduce your financial support.

APPENDIX I

MSE Ph.D. Preliminary Exam and M.S. Comprehensive Exam

The exams for MSE first year PhD students will be held in Summer or early Fall 2020. All Ph.D. students who entered in the Fall of 2019 are required to take the prelim exams then. Attached is a list of exam topics. Examiners are faculty affiliated with the department with MSE expertise and are determined by the MSE Graduate Advisor.

The preliminary exams are oral, with a minimum of 2 program faculty members quizzing students. Only students who have successfully completed the four MSE core classes with a grade of B or better and are in academic good standing are eligible to take this exam.

Preliminary Exam Guidelines

A peer-reviewed scientific publication will be assigned for critical analysis.

Critical and Scientific Analysis of Publication: 60% of grade

There should be no more than 12-15 slides with 20 point font Arial for text. Make sure figures are legible. The slides are only outlines to the above points and discussion on the above points will be guided by examiners.

The remaining 40% of grade is related to answers to questions based on coursework. These questions are related to research paper and core courses.

Thus, you need to put some thought into how the content of the paper intersects with courses that you have taken, especially the core courses (see topics for MS Comprehensive Exam for guidelines).

Many of the course work topics (see below) can be initially reviewed using an Introduction to Materials Science and Engineering textbook and your core course syllabi as a start. You are encouraged to form study groups and orally quiz each other on the topics in a mock exam format prior to the actual exams. An updated list of topics may be given to you by the beginning of winter quarter if changes are introduced, however the content is not expected to change significantly if at all.

M.S. students taking the comprehensive exam option may only take the same exams as the Ph.D. preliminary exam students with approval of the Graduate Advisor and with a strong letter of recommendation from a faculty that has supervised the student's research abilities. However, the standards for passing a M.S. comprehensive exam are not as high as for the Ph.D. preliminary exam. M.S. students entering Fall 2019 must take the comprehensive exam in Spring 2020. The exam is not offered in Winter Quarter or Summer.

Preliminary and MS Comprehensive Exam Topics

1. Structure of Materials

- Atomic structure and hydrogenic electron orbitals
- Chemical and non-chemical types of Bonding
- Bonding Based on Location in the Periodic Table
- Crystal lattice and basis
- Unit Cells
- Miller Indices/Directions
- Crystal Systems
- Bravais Lattices
- Reciprocal lattice space
- Close-packed Structures
- Interstitial filling of close-packed structures
- Eutectic structures
- Common Metallic and Semiconductor Crystal Structures
- Surface Bonding and Energies
- Ionic Crystal Structures/Pauling's Rules
- Point Group and Space Group Symmetry
- X-ray Diffraction and Ewald Sphere
- Structure Factor Calculations
- Microscopy Techniques
- Point defects in Metals and Ionic Solids, Calculations of Defect Concentrations
- Line Defects, Plane Defects, Volume Defects

2. Thermodynamics and Kinetics

- Calculation of Vacancy Concentrations as a function of Temperature
- Kroger-Vink Notation and Defect Compensation in Ionic Solids
- Diffusion Mechanisms
- Diffusion Coefficient
- Steady State Diffusion
- Homogeneous Nucleation and Growth
- Surface Energy, Volume Free Energy, Critical Radii for Growth
- Gibbs Phase Rule
- Gibbs Free Energy, Entropy, Enthalpy
- Heterogeneous Nucleation
- Epitaxial and Textured Films
- Growth Rate
- Precipitation
- Crystallization
- Glass Transition Temperature, Specific Volume
- Liquid/Solid/Vapor phase equilibria and wetting angles
- Grain Growth
- Grain Boundaries and Interfacial Energy

- Phase Equilibria and Interpretation of Phase Diagrams
- Solid Solubility

3. Mechanical Behavior

- Stress, Strain Definitions, Stress-Strain Curves
- Elastic Deformation
- Elastic Modulus, Poisson's Ratio
- Plastic Deformation
- Slip Planes and Slip Directions
- Definition of Dislocations
- Role of Dislocations in Deformation of Crystalline Solids
- Interaction of Dislocations
- Impeding the Movement of Dislocations
- Orowan Stress
- Methods to Detect Dislocations
- Effect of grain size on mechanical properties of metals and ceramics (including properties of nanocrystalline materials)
- Mechanical Behavior of Polymeric Materials
- Methods to Measure Mechanical Behavior
- Relative Values of E, H for metals, ceramics, polymers
- Resilience, Toughness
- Viscoelastic Behavior of Polymers
- Fracture Mechanics
- Stress Intensity Factor
- Fracture Toughness
- Low Temperature Behavior of Materials (Ductile to Brittle Transition)
- High Temperature Behavior of Materials (Creep)
- Fatigue
- Thermally Induced Stresses

4. Electronic and Optical Properties

- Reciprocal Lattice
- Electrical Conductivity, Mobility
- Hall Effect
- Pauli Exclusion Principle
- Fermi Energy
- Fermi-Dirac and Maxwell Boltzmann distribution Function
- Density of States
- Electron Fermi Gas - Heat Capacity, thermal conductivity
- Electronic Band Structures in Solids
- Thermionic Emission
- Intrinsic/Extrinsic Semiconductors
- Temperature Dependence of Conductivity of metals and semiconductors

- Thermal transport in metals and insulators, role of defects
- Diffusion, Conduction, and Continuity equations
- Semiconductor Devices (Schottky junction, pn junction, LED, solar cell, MOSFET)
- Optical Absorption
- Dielectric Response to Electromagnetic Waves
- Optical Properties of Materials (Index of Refraction, dispersion)
- Transparency, Translucency, Opacity
- Luminescence and Fluorescence

Appendix II

MSE Ph.D. Qualifying Examination

The purpose of the qualifying examination is to demonstrate that the student is capable of conducting independent Ph.D. research and has a viable research plan for the Ph.D. dissertation. PhD faculty advisors provide guidance but do not dictate every step of research and students need to exhibit an ability for independent thinking to pass this exam. Feedback from the qualifying examination committee is very helpful in developing a viable dissertation topic and appropriate experiments.

The MSE Ph.D. qualifying exam committees follow the rules set by the Graduate Council. The student and the research advisor select the qualifying exam committee, with approval of the MSE Graduate Advisor. The committee should primarily be composed of faculty familiar with your area of research interest, insofar as that is possible, and two must have their primary appointment in MSE. Nomination form can be found at: http://engineering.uci.edu/files/qualifying-exam-nomination-form_0.pdf

Requests for the Qualifying Exam Committee must be submitted two weeks in advance of the date scheduled for the exam, and this form requires multiple signatures, including the Associate Dean's.

- a) Current guidelines require at least three faculty from MSE, where at least two examiners have their primary appointment in MSE.
- b) One outside member who is not a member or joint appointee of the MSE department.
- c) A fifth member is required who can come from the department or any outside department.

For more information, check the Office of Graduate Studies website for the most current information. <http://www.grad.uci.edu/forms/>

Normally, three members of the Qualifying Exam Committee will form your dissertation committee.

The Ph.D. Qualifying Examination should be scheduled between the beginning of the 3rd year and the beginning of the 4th year. If not completed by the end of the 3rd year, the student in conjunction with their faculty advisor must submit a plan with milestones for completing this exam in a timely manner. If the qualifying examination is not taken by the end of Winter quarter of the 4th year, the student is no longer in good academic standing and may not be eligible for financial support. After completion of this exam, the student is considered Advanced to Candidacy for the Ph.D.

There are two required parts of the qualifying examination:

- I. Written Dossier
- II. Oral Presentation (30-35 minutes)

The written dossier must be approved and signed off on the title page by the advisor before the dossier is distributed to the committee members and before the qualifying examination can be scheduled. You can schedule the exam before the dossier is complete, but it should be distributed to the other 4 committee members a week in advance of the exam (and must have advisor signature on front, indicating approval for distribution).

I. **Written Research Summary (Dossier)**

Use Times New Roman 12 font, 1.5 line spacing or equivalent. Pages are approximations.

- | | |
|-----------|---|
| 1 page | 1) <u>Title Page</u> – Title, Name of Student, Degree Program, Date, Advisor and Advisor’s Signature |
| 1 page | 2) <u>Abstract Page</u> – 100-word summary – include the <u>new</u> information obtained from experiments and/or theory/ <u>new</u> understanding provided to the research field/ major contribution that the dissertation will provide to the research community. |
| 1 page | 3) <u>Introduction</u> – brief discussion of current state of knowledge in the research field, rationale for research and how it adds to current knowledge, scientific content impact of research in technology and society, what <u>key</u> questions will be answered. |
| 2-3 pages | 4) <u>Background</u> – Extensive discussion of prior research relevant to your research should be discussed to demonstrate a knowledge of the current state of the field and the rationale for challenges addressed by your research. |
| 3-5 pages | 5) <u>Preliminary Experiments</u> – a summary of your work to date, including research methods and interpretation of data obtained by the P.D. candidate. Include figures, graphs, and tables and the development of any models. Explain the science and technology associated with the data. |
| 2-4 pages | 6) <u>Future Research Plan</u> – a thorough discussion of the experiments the student plans to complete for his/her thesis. Explain how the experiments will provide critical information for the dissertation and define significant contributions to the research field. |
| 1 page | 7) <u>Timeline</u> – Provide an estimated timeline of when you will complete experiments, analysis, paper writing, and thesis document. |

- 1 page
- 8) Summary of the new fundamental and technological research contributions that are expected from this proposed research
 - 9) References – Author name/s, full title, journal, volume, page, year

The dossier, *excluding* References but including Figures and Tables will probably be about 15 – 25 pages. It is appropriate to change the research plan as experiments evolve, but the research plan presented in the qualifying examination serves to document the general expectations for the Ph.D.

This document can serve as a draft for the introductory chapters of the Ph.D. This document will serve as an outline for the Ph.D. dissertation, and you will save time later when writing the dissertation if you complete this properly. The introduction and background provide a good draft for the first chapter of the dissertation (with an update of the research field a few years later), and the preliminary experiments should be a draft of one chapter for the dissertation.

II. **Oral Examination**

During the oral examination the student should summarize the written document with less emphasis on published research by others than on the preliminary and future work of the examinee. This will be a PowerPoint presentation about 30-40 minutes in length. The five faculty members on the committee will question the student and offer suggestions for the Ph.D. dissertation. At least two hours should be scheduled in order to allow time for questions.

At this exam, examiners may return the Research Dossier with written suggestions in the text. The purpose of the oral exam is to evaluate the student's understanding of the proposed research and his/her ability to conduct original, independent research.

APPENDIX III Courses for 2019-2020

FALL 2019

The following are approved electives in ENGRMSE and CBE for the Fall 2019.

ENGRMSE 241 Nanomaterials

ENGRMSE 249 Scientific Communications Part 1, 2 units (Part II will be offered in Spring)

ENGRMSE 259 Transmission Electron Microscopy (ENGRMSE 200 is a prerequisite, so only students with an M.S. in MSE should take this)

ENGRMSE 158 Ceramic Materials (this would count as the one UG elective allowed, only if not already taken for B.S. MSE degree requirements)

CBE 187 Semiconductor Device Packaging (this would count as the one UG elective allowed)

CBE 276 Nuclear and Radiochemistry

ENGRMAE 256 Nanomechanics

ENGRMAE 195 Additive Manufacturing and 3-D Printing (this would count as the one UG course allowed)

ENGRMAE 220 Conductive Heat Transfer

ENGRMAE 253 Advanced Biomems

ENGRMAE 254 Mechanics of Solids

EECS 285C Nanoimaging (AFM)

ENGRCEE 250 Finite Element Methods for Engineering

Physics 215A Quantum Mechanics

Physics 238A Condensed Matter Physics

Physics/Chemistry 229A Computational Methods

Physics/Chemistry 206 Laboratory Skills - only if completed summer 2019 as part of CHaMP

You can also check Chemistry for more electives that you may be eligible to take.

You must check with the course instructor in advance to confirm you have the prerequisites to take the above courses in other departments. Please forward instructor approval via email to the Graduate Advisor.

One class from the 100-190 level may be used for graduate coursework, with approval of the graduate MSE advisor. There are additional graduate electives offered in each department, but again check with the instructor to ensure that you have the correct background to take the course, and then e-mail the MSE Graduate Advisor for approval.

Summary of Fall Required Course Enrollment for MSE First Year Graduate Students

First year M.S. Students NOT Conducting Research

ENGRMSE 200

ENGRMSE 256A (substituted by ENGRMAE 259 in Fall '19)

ENGRMSE 298

XXX and YYY – one (1) or two (2) more graduate classes

First year M.S. Students Conducting Thesis Research (any student interested in continuing for the Ph.D. should take this route)

ENGRMSE 200

ENGRMSE 256A (substituted by ENGRMAE 259 in Fall '19)

ENGRMSE 298

XXX – one (1) more graduate class

ENGRMSE 296 – 3 units of thesis research (may be substituted with ENGRMSE 299 with Graduate Advisor's permission)

First year M.S./Ph.D. Students

ENGRMSE 200

ENGRMSE 256A (substituted by ENGRMAE 259 in Fall '19)

ENGRMSE 298

XXX – one (1) more graduate class

Highly recommended – ENGRMSE 249 Scientific Communications Part I

ENGRMSE 299 – 2 or more units

Ph.D. Students with a M.S. in Materials

ENGRMSE 298

XXX – one (1) graduate class (not required to take in fall if none interest you)

ENGRMSE 297 – 9-14 units

Appendix IV

Graduate Program Learning Outcomes

(MS in Materials Science and Engineering)

I. Program Learning Outcomes

Core Knowledge. Students will be able to:

- Demonstrate general knowledge of core topics and theory in Materials Science and Engineering necessary for professional practice or PhD studies.

Research Methods and Analysis. Students will be able to:

- Understand the qualitative and quantitative methodologies typically used in Materials Science and Engineering practice and research.
- Demonstrate the ability to critically analyze research literature.

Professionalism. Students will:

- Participate in seminar series presented by professionals and academicians in Materials Science and Engineering.

II. Action Plan Timeline

PLOs are assessed at the time graduation for each student. Data are compiled annually and used for continuous improvement of the graduate program.

(PhD in Materials Science and Engineering)

I. Program Learning Outcomes

Core Knowledge. Students will be able to:

- Demonstrate general knowledge of core topics and theory in Materials Science and Engineering necessary for professional practice and/or academic research.

Pedagogy. Students will be able to:

- Communicate effectively to large and small groups in pedagogical settings in lecture and/or discussion formats.

Scholarly Communication. Students will be able to:

- Structure a coherent academic argument that rigorously presents and evaluates research data.

- Make clear and cogent presentations, and professional documents that summarize their research and its significance.

Independent Research. Students will be able to:

- Develop and carry out independent research projects with theoretical and methodological rigor.

Broader Impacts. Students will be able to:

- Understand the technological and societal impacts of their research.

II. **Action Plan Timeline**

PLOs are assessed at the time of graduation for each student. Data are compiled annually and used for continuous improvement of the graduate program.