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

Department of Chemical Engineering and Materials Science

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Welcome Message from MSE Graduate Advisor

I would like to welcome you to UC Irvine 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.

I would encourage you to become active in the ChEMS Graduate Student Association (GSA), as a way to get to know other students and to have a voice in aspects of graduate student life. You can contact Jesse Angle (jangle@uci.edu) for more information – or just watch for announcements at the Friday Seminars and in your e-mail.

The first year of graduate school can seem very difficult, but we have a good track record of graduating highly successful students. Most of these 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, free campus resources designed for you at the Counseling Center (949) 824-6457.

If you are in the Ph.D. program, you will be selecting an advisor by the end of the spring quarter. Use the research rotations wisely to help you decide which groups best meet your interests. We strongly encourage students to have co-advisors if their projects can benefit from the knowledge of two different advisors. It is important to balance excellence in your academic subjects with a strong performance in your research rotation, if you want to be the top candidate for research support in the group of your choice.

If you are an international student, we will expect that you will have passed the TSE/SPEAK/TOEP test with a score of 50 or higher by the end of the spring quarter 2008 (or have 26 or higher on the Speaking portion of the TOEFL iBT). You will then be eligible for TA ships and have demonstrated a good command of spoken English. The TA training will be offered next fall for all second year students, required for eligibility for a TA appointment.

Lastly, feel free to e-mail me or come to my office to meet and discuss your graduate program.

Professor Martha Mecartney
Graduate Advisor for Materials Science and Engineering
Key Personnel in Chemical Engineering and Materials Science (ChEMS)

(916 Engineering Tower)

- Grace Chau – Graduate Coordinator
  Source for all graduate paperwork, answers on rules and regulations. Exceptions require the Graduate Advisor's written approval. See Grace for keys to your labs and to the 1st year Ph.D. student office.

- Janine Le – Employment/Fellowship
  Handles all funding (TA, Grader, GSR) and fellowships
  Faculty must initiate requests for support a month in advance.

- Yi-San Chang-Yen – Department Manager

- Professor Albert Yee – Department Chair

Purchasing and Travel Reimbursement - Use School of Engineering forms for all purchases of lab supplies. There is a box to submit these forms in the faculty mailroom adjacent to 916 ET.

YOUR STUDENT MAILBOX is in room 937A Eng. Tower. 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 http://www.grad.uci.edu/forms/
COURSE SELECTION

Required Classes
You should become familiar with the Schedule of Classes on line at UC Irvine. Each quarter check our department for both CBEMS and ENGRMSE listings in the Schedule of Classes and other related disciplines to see if there are new courses that interest you.

The following MSE core courses are REQUIRED for all new students, unless you have taken the equivalent graduate course elsewhere. The Ph.D. preliminary exams and M.S. comprehensive exams are based on material covered in these required core classes.

- MSE 200 (Crystallography, Crystal Defects) FALL 2010
- MSE 265 (Phase Transformations), FALL 2010
- MSE 256A (Mechanical Properties of Materials) WINTER 2011
- MSE 205 (Materials Physics) WINTER 2011
- CBEMS 298 Departmental Seminar – every quarter (F/W/Sp)

MSE 200 assumes you have learned the material presented in a basic Introduction to Materials Science and Engineering undergraduate course (ENGR 54 at UCI). If you have not taken such a course you should review on your own the material covered in an undergraduate Introduction to Materials Science and Engineering textbook. Several different textbooks on MSE are available in the Science Library.

MSE 265 (Phase Transformations) will have a test on the first day of class to ensure that you have the appropriate undergraduate background. If you do not pass the test, you will have to take the undergraduate course in phase transformations (CBEMS 165) in the spring, and take MSE 265 the following fall quarter 2011. Please review the following topics that cover basic thermodynamics that should have been covered in undergraduate courses for this first day test:
  a. Gibbs phase rule
  b. Binary phase diagrams
  c. Ideal solution model
  d. Simple regular solution models
  e. First, second laws of thermodynamics
  f. Equilibrium conditions
If you have any questions, contact the instructor, Professor Frank Shi (fgshi@uci.edu).

MSE 256A 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 of materials.

MSE 205 assumes you have a basic understanding of electronic behavior of materials. If you lack this background you may need to review relevant sections of an introductory undergraduate textbook.
Research Units
Ph.D. students who have not selected a research advisor will enroll in at least 3 units of research (CBEMS 299). All faculty will describe their research during Welcome Week, and you will have a chance to meet with faculty and discuss your interests, and then select 2-3 research rotations for the year (one per quarter). As a placeholder, you may sign up under my name (Mecartney), until the research rotations are assigned in the first week of classes, at which time you can electronically add/drop the correct research supervisor’s name.

If you are a Ph.D. student with an M.S. who has selected an advisor, with approval of the advisor you may sign up for up to 12 units of CBEMS 297, Ph.D. Dissertation Research.

If you are an M.S. student who wants to conduct M.S. thesis research, you will have an opportunity to sign up for CBEMS 296 after the faculty describe their research. As a placeholder, you may sign up under my name (Mecartney) and change to your real research supervisor during the first week of the quarter.

Departmental Seminar
ALL FULL TIME STUDENTS MUST ENROLL IN CBEMS 298. This is the Chemical Engineering and Materials Science Departmental Seminar, typically held once a week. You will sign up for this class each quarter. You must attend 80% of the seminars in order to obtain a passing grade. This will require you to be on time. (Also, it seems silly to say this, but you are expected to stay for the entire seminar – one year we had a student who wanted to leave early each week and go to the beach….and she is no longer in our graduate program.)

Units for Weekly Research Group Meeting
Your research supervisor for CBEMS 296, 297 or 299 might also want you to add a one-unit group meeting, listed as CBEMS 295 (Seminar in ENGR). Check with your research supervisor once research rotations have been assigned.

Selection of Elective Courses
Select elective courses based on the advice you receive from rotation supervisor if you want to be competitive to work in that group. You can select elective courses for a total of 12-16 units/quarter. Courses numbered 100-190 may count for up to 8 units IF these courses are not required for the undergraduate MSE degree. To check on this, look at the current copy of the UCI catalogue on line. If you find a course you wish to take is NOT on the list, e-mail Prof. Mecartney for verification that a course will count for the fulfillment of the degree requirements. Undergraduate courses may have prerequisites, and you may need to contact the instructor for permission to enroll.

Ph.D. students take 2 units of a research rotation (CBEMS 299) each quarter in the first year, preferably from at least two different faculty members. The research rotation allows Ph.D. students to sample up to three different research laboratories. In addition, many faculty offer group meetings that they may wish to have your enroll in for 1 unit. The maximum number of units you may enroll in is 16 units.
Check the Schedule of Classes for elective courses in other Engineering departments and Chemistry and Physics. Appendix IV lists elective courses as of the printing of this document, but there may be more later additions each quarter.

FAQ REGARDING GRADUATE COURSEWORK

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 two designations: CBEMS and ENGR MSE.

How many total units should I take?
Full time students must take at least 12 units, and you may take up to 16 units. 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 3-4 courses each quarter in order to remain in good standing. A typical comprehensive exam M.S. student schedule would be 4 lecture classes/quarter and the departmental seminar. A typical M.S. thesis and a typical M.S./Ph.D. student schedule would be 3 lecture classes/quarter and one research quarter or thesis and the departmental seminar.

Part time M.S. students, not continuing for the Ph.D., can enroll for fewer units (no more than 8). Financial support is withdrawn 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. and should be taken as extra units above the 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 fill requirements so should 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 may enroll in CBEMS 399 for 3-6 units if you need additional credits to make 12 units, and take fewer regular classes or research units that quarter.

Can I take undergraduate courses for my M.S. degree?
Up to 8 units of undergraduate upper division (100-189 level) courses may count for your degree IF approved by MSE graduate advisor. Under no circumstances will courses that are required for the MSE undergraduate degree be used to fill graduate degree requirements. However, there are many elective classes that would be acceptable.

MATERIAL SCIENCE & ENGINEERING DEGREE REQUIREMENTS

There are two options, the thesis and the comprehensive exam option for the M.S.. Students who are in the M.S./Ph.D. program complete an M.S. along the way.
I. M.S. Thesis (A minimum of 36 units required and at least 8 courses)

- 21 units of Courses Numbered 200-289
  - 12 must be graduate core courses
    - (3 units) 1 Crystal Structure and Defects
    - (3 units) 1 Electrical and Optical Behavior
    - (3 units) 1 Mechanical Behavior
    - (3 units) 1 Thermodynamics and Kinetics
  - 9 additional units must be 200-289 electives (4 unit classes count as one class, same as 3 unit classes)
- 15 units of “other units”
  - Choices include:
    - 3 units of 298 (Department Seminar – required for full time students)
    - Up to 8 units of 296 (M.S. Thesis Research)
    - Additional 200-289 level electives
    - Up to 8 units of upper-division undergraduate work – NO MSE courses required for the MSE undergraduate degree will count – any undergraduate elective courses must be approved by the graduate advisor
    - All graduate elective courses from outside of MSE/CBEMS must be approved by the graduate advisor for the M.S.

- M.S. Thesis is required.
- Students must file the Advancement to M.S. Candidacy one quarter before graduation (apply through HSSoE Graduate Affairs)
- A minimum of 8 classes are required, and and 3 and 4 unit classes each count as one class.

II. M.S. Comprehensive Exam Option (minimum of 36 units required and at least 9 courses)

- 24 units of Courses Numbered 200-289
  - 12 must be graduate core courses
    - (3 units) 1 Crystal Structure and Defects
    - (3 units) 1 Electrical and Optical Behavior
    - (3 units) 1 Mechanical Behavior
    - (3 units) 1 Thermodynamics and Kinetics
  - 12 additional units must be 200-289 electives (4 unit classes count as one class, same as 3 unit classes)
- 12 units of “other units”
  - Choices include:
    - 3 units of 298 (Department Seminar – required for full time students)
    - Up to 6 units of 299 (Research Rotations)
    - Additional 200-289 level electives
- Up to 8 units of upper-division undergraduate work– **NO MSE courses required for the MSE undergraduate degree will count** – any undergraduate elective courses must be approved by the graduate advisor.
- All graduate elective courses from outside of MSE/CBEMS must be approved by the graduate advisor for the M.S.

- It is required to pass the MSE comprehensive exam in March or December either at the M.S. level or the Ph.D. preliminary exam level.
- Students must file the Advancement to M.S. Candidacy one quarter before graduation (just apply through HSSoE Graduate Affairs, forms available at [http://www.grad.uci.edu/forms/](http://www.grad.uci.edu/forms/))
- A minimum of 9 courses are required, and 3 and 4 unit classes each count as one class.

### M.S. Core Courses

#### Crystal Structure and Crystal Defects

<table>
<thead>
<tr>
<th>Course:</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSE 200 (Crystalline Solids: Structure, Imperfections, and Properties)</td>
<td></td>
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</tbody>
</table>

#### Electrical and Optical Properties of Materials

<table>
<thead>
<tr>
<th>Course:</th>
<th>Check</th>
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<tbody>
<tr>
<td>MSE205 (Materials Physics) or equivalent course</td>
<td></td>
</tr>
</tbody>
</table>

#### Mechanical Behavior

<table>
<thead>
<tr>
<th>One course from:</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSE251 (Dislocation Theory),</td>
<td></td>
</tr>
<tr>
<td>MSE256A (Mechanical Behavior of Engineering Materials),</td>
<td></td>
</tr>
<tr>
<td>MSE256B (Fracture of Engineering Materials)</td>
<td></td>
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<tr>
<td>MSE256C (Fatigue of Engineering Materials)</td>
<td></td>
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<tr>
<td>MSE261 (High-Temperature Deformation of Engineering Materials)</td>
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</tbody>
</table>

#### Thermodynamics and Transport Phenomena

<table>
<thead>
<tr>
<th>One course from:</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSE252 (Theory of Diffusion),</td>
<td></td>
</tr>
<tr>
<td>MSE265 (Phase Transformations)</td>
<td></td>
</tr>
<tr>
<td>CBEMS240 (Thermodynamics) (for ChE B.S. students only)</td>
<td></td>
</tr>
<tr>
<td>Chemistry 230 (Thermodynamics)</td>
<td></td>
</tr>
<tr>
<td>MSE253 (Kinetic Phenomena in Materials),</td>
<td></td>
</tr>
</tbody>
</table>
III. Ph.D. Requirements

- Course Requirements are same as M.S. May be permitted to use M.S. degree graduate courses taken elsewhere, but you must submit documentation that they were graduate courses equivalent in content to UCI graduate courses.
- **Ph.D. students are required to take two classes past the M.S. degree requirements**, with these two elective courses relevant to your Ph.D. dissertation. These courses can be taken anytime prior to graduation, but are to be 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.
- Select Faculty Advisor by the End of 1st year.
- Preliminary Exam in first year, pass by December of second year at the latest.
- Ph.D. Qualifying Exam by the End of 3rd Year (advancement to candidacy).
- Written dissertation
- Oral defense of dissertation.

IV. Good Academic Standing

- Students without good academic standing may be dismissed from graduate school. 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 research rotations in the first year and 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 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 have a research advisor willing to advise them after the 1st year. 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 the 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.
  g. Failure to meet the above standards may result in academic probation or dismissal from the graduate program.
  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 HSSoE Graduate Affairs Office and the HSSoE 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. degree requirements if they do not already have an M.S. Two additional graduate classes 200-289 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
- Fill this out by the end of the first quarter and turn into graduate coordinator.
- Will be evaluated and approved by the MSE Graduate Advisor
- Can be modified! Most important is to have required core courses included.

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, which is available on-line. Use www.uci.edu - type in “catalogue” in the search box, find the Henry Samueli School of Engineering (click), then the Department of Chemical Engineering and Materials Science (click). Or go to http://www.editor.uci.edu/catalogue/

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

If you have an 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 an 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 based on material covered in these required classes, so some international students decide to take them again even if they have already taken similar courses so that they can better prepare to 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.

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

- The exams cover basic concepts in MSE core courses and test your comprehensive knowledge of MSE.
- It is strongly recommended that the preliminary exam be taken after all of the core courses have been completed, as these are good preparation and/or review.
These exams will be oral. A panel of MSE examiners will hold all exams during a one week period.

The Preliminary Exam will be offered twice yearly, during the first few days of Spring Break in March and in December after Final Exams. The December exams are scheduled only for students who did not pass the exam in the Spring.

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.
- 4 MSE faculty, 1 faculty member not affiliated with ChEMS (outside member). Your advisor will be on your qualifying exam.
- Taken after passing Ph.D. preliminary exam. If a student expects to graduate in 4 years (entered with an 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 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.
- 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 TAship 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.
- Committee members for Ph.D. dissertation (3 including advisor) are invited as well as the entire department faculty and students. Visitors are welcome.
- The candidate presents a 45 minute presentation summarizing research
- Questions from committee (may request closed session at this point).
- Best to schedule if written dissertation has already been approved.

What is the Ph.D. Dissertation?
- This document shows your original research in MSE.
- Check out copies of past dissertations in UCI library.
- Format guidelines are available at http://www.grad.uci.edu/forms/
- 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 write the introduction.

Where can I find forms that I need? [http://www.grad.uci.edu/forms/](http://www.grad.uci.edu/forms/) and contact the graduate counselor 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 should select a research advisor by end of the 3rd quarter of the first year. A few students who are fully supported by a GSR from one faculty member do not conduct research rotation. M.S. students selecting thesis option should select advisor by end of the 1st quarter. In the fall, the first year students will select their research rotations after they meet with faculty. Terminal M.S. students do not typically conduct research rotations, but may find one advisor for research.

*Who can serve as my research advisor?*

All ChEMS faculty including joint appointments can advise. Students can have coadvisors from outside the department who are not affiliated with ChEMS as long as they have a primary advisor affiliated with ChEMS. M.S. students on comprehensive exam status do not need an advisor other than the MSE degree advisor.

- **James P. Brody**  
  Bioinformatics, micro-nanoscale systems
- **Zhongping Chen**  
  Biomedical optics, optical coherence tomography, bioMEMS, and biomedical devices
- **William Cooper**  
  Water resources, remediation
- **Nancy A. Da Silva**  
  Molecular biotechnology, metabolic engineering, environment biotechnology.
- **James C. Earthman**  
  Fatigue behavior and cyclic damage, automated materials testing, high-temperature fracture, biomaterials, cellular networks.
- **Steven George**  
  Tissue Engineering, Chair of Biomedical Engineering
- **Stanley B. Grant**  
  Environmental engineering, coastal water quality, coagulation and filtration of colloidal contaminants, environmental microbiology.
- **Zhibin Guan**  
  Organic, Biological, and Macromolecular Materials Chemistry
- **G.W. Hatfield**  
  Microbiology and Molecular Genetics
- **Michelle Khine**  
  Biomedical Engineering
- **Young-Jik Kwon**  
  Drug delivery, biomaterials, pharmaceutical sciences
- **Matt Law**  
  Nanoscale materials and devices, solar energy conversion
- **Guann Pyng Li**  
  High-speed semiconductor technology, optoelectronic devices, integrated circuit fabrication and testing.
<table>
<thead>
<tr>
<th>Name</th>
<th>Research Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Lowengrub</td>
<td>Mathematical modeling of materials</td>
</tr>
<tr>
<td>Marc Madaou</td>
<td>Miniaturization science (MEMS and NEMS), polymer actuators (for drug delivery), C-MEMS and CD based fluidics.</td>
</tr>
<tr>
<td>Martha L. Mecartney</td>
<td>Superplasticity, grain boundary engineering of ceramics, solid oxide fuel cell materials, ceramics for nuclear waste.</td>
</tr>
<tr>
<td>Farghalli Mohamed</td>
<td>Mechanical properties (creep, superplasticity) and correlation with microstructure, mechanical behavior at the nanoscale.</td>
</tr>
<tr>
<td>Ali Mohraz</td>
<td>Guided and self assembly of colloids, soft matter physics, microstructured materials synthesis for energy and biomimetic application, colloids for environmental remediation.</td>
</tr>
<tr>
<td>Ayman Mosallam</td>
<td>Advanced composites and hybrid systems, seismic repair and rehabilitation of structures, blast mitigation and diagnostic/prognostic techniques for infrastructure security</td>
</tr>
<tr>
<td>Daniel R. Mumm</td>
<td>Thermo-mechanical behavior of materials, interfaces and microstructure, materials for power and propulsion, cellular materials, morphing structures, micro/nano-mechanics.</td>
</tr>
<tr>
<td>Hung Nguyen</td>
<td>Biocomputation and modeling of biochemical processes</td>
</tr>
<tr>
<td>Mikael Nilsson</td>
<td>Nuclear waste separations</td>
</tr>
<tr>
<td>Regina Ragan</td>
<td>Scanning tunneling microscopy and nanostructures for sensor applications.</td>
</tr>
<tr>
<td>Peter Rentzepis</td>
<td>Optical chemical and spectroscopic properties of photochromic molecules</td>
</tr>
<tr>
<td>Diego Rosso</td>
<td>Water pollution, wastewater treatment</td>
</tr>
<tr>
<td>Kenneth Shea</td>
<td>Polymeric materials development, hybrid materials, sol-gel science</td>
</tr>
<tr>
<td>Frank G. Shi</td>
<td>Optoelectronics packaging, packaging materials, photonic glass and nanocomposites.</td>
</tr>
<tr>
<td>Lizhi Sun</td>
<td>Computational and analytical modeling of materials behavior from dislocations to macroscopic physical behavior</td>
</tr>
<tr>
<td>Lorenzo Valdevit</td>
<td>Mechanics of composite materials and lightweight structures</td>
</tr>
<tr>
<td>Szu-Wen Wang</td>
<td>Biomolecular engineering, interfacial engineering, biomaterials, drug delivery.</td>
</tr>
<tr>
<td>Kumar Wickramasinghe</td>
<td>Nanotechnology, development of novel atomic force microscopies</td>
</tr>
<tr>
<td>Albert Yee</td>
<td>Nanofabrication of soft materials, physics of polymer thin films, nanomechanical properties of polymers, ultra-low-k dielectrics, fracture and toughening of polymer nanocomposites</td>
</tr>
</tbody>
</table>

**How are continuing graduate student supported?**

- All support is given competitively, and based on continuing good standing.
- Teaching Assistantships
- Fellowships (usually to new students for recruitment)
- GSR – Research Assistantships funded from faculty research
- Hours worked are in ADDITION to units earned for research credit
U.S. students must fill out the FAFSA each year, due March 2, 2008
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 Graders Do?
- TAs grade homework and tests, run demonstrations, hold office hours, lead discussions,
maintain class websites, maintain records of grades, run labs
- Readers grade homework and tests, also can hold office hours.
- Students are selected based on faculty nominations, match with course material,
GAANN/CAREER grant priority, past experience
- All students who want to be a TA or grader must have completed the IRC September TA
training.

What are the requirements for spoken English for international students who want to TA?
- To be a TA, the international student must pass TOEP, TSE or SPEAK test with a score
of 50 or a TOEFL iBT score of 26 or higher on the Speaking component.
- TOEP given at UCI students who have taken TSE or SPEAK and obtained a score of 40,
refer to: http://e3.uci.edu/programs/esl/toep.html
- 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 (Professor Mecartney)
- Talk with your advisor – if unable to do so, ask MSE graduate advisor to talk to advisor
- Talk with other faculty in the department about research projects

- 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/grader/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?
Yes, you can apply to other degree programs at UCI. However, if you are accepted and
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. A “C” grade is considered failing and will not count for any course requirements.
Only one grade of B- can be counted by petition for the M.S. 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 – 12 units – expect up to 24 hours of homework and studying
- Research – expect 20-40 hours a week, depending on how many courses your are taking
- Fellowships expect that a student is working FULL TIME on research and coursework (at least 40 hours a week).
Quarterly Research Rotation Reports

1. Reports, both an electronic and paper copy, are due each quarter to the research supervisor before grades are due. Specific deadlines will be set by the research supervisor. Supervisors may ask for advance drafts and require revisions prior to assigning a grade for the research rotation.

2. Students are also expected to provide electronic copies of all data to the research supervisor, and copies of lab notes at the same time the report is submitted.

3. Students must provide a paper copy of each quarterly report to the MSE or CBE graduate advisor in the 916 ET mailboxes. These research reports/papers will be part of the assessment process for first year students by the MSE or CBE graduate committees, which is why the respective CBE or MSE graduate advisors will be collecting a copy.

4. Reports should be at least 5 pages in length, excluding the title page, references and appendix and should have the following sections formally indicated.

   a. Title Page: Title of project, name, date, research supervisor’s name.
   b. Abstract: 100-300 words.
   c. Introduction: Literature review of articles read regarding the research project, context for the research, hypothesis or main problem to be addressed, and approach to solve the problem.
   d. Experimental Approach: Experimental or computational techniques, and descriptions of experimental/computational process.
   e. Results: Relevant results with tables, micrographs, and graphs as appropriate, briefly described.
   f. Discussion: Discussion of the implications of these results, comparisons with prior published research and suggestions for future work.
   g. Conclusions: Short (one paragraph) description of major findings.
   h. References: Provide references at the end with footnoted in the text for all literature cited in the Introduction or Discussion and for any facts that need references. References must include the following information – full list of authors, full article title, journal title, volume, issue, pages, and year. Websites are generally not appropriate references and Wikipedia and popular science magazines are never accepted as primary references. Peer reviewed archival journals (can be found on Web of Science, SciFinder and other library databases) are the gold standard. Occasionally reference books are cited also.
   i. Appendix: Extra figures and extended tables of raw data may be included.
Appendix II

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

The exams for MSE will be held at the end of Finals Week or the beginning of the following week in December 2009 and March 2010. All Ph.D. students who entered in the Fall of 2009 or earlier are required to take the prelim exam in March 2010. Attached is a list of exam topics. The role of examiner rotates among faculty affiliated with the department with MSE expertise and are determined by the MSE Committee.

The preliminary exams are oral, with 2 department faculty members quizzing students at one time. You will have two oral exam sessions that will cover two topics each. Each exam team will have one hour. Each student will have no more than one exam/day (two topics a day).

Many of the topics can be initially reviewed using an Introduction to Materials Science and Engineering textbook as a start. You are encouraged to form study groups and quiz each other on the topics. An updated list of topics will be given to you by the beginning of winter quarter, however the content is not expected to change significantly.

M.S. students taking the comprehensive exam option may take the same exams as the Ph.D. preliminary exam students. However, the standards for passing a M.S. comprehensive exam are not as high as for the Ph.D. preliminary exam. M.S. students must take this exam either in December or in March. The exam is not offered other quarters.

Preliminary Exam Topics

1. Structure of Materials
   - Types of Bonding (Relation to Melting Points, Elastic Modulus, Dislocation Movement)
   - Unit Cells
   - Miller Indices/Directions
   - Crystal Systems
   - Bravais Lattices
   - Common Metallic Crystal Structures
   - Ionic Crystal Structures/Pauling's Rules
   - Common Semiconductor Crystal Structures
   - Chemistry and Structure of Common Polymers
   - Relationship of Properties to Structure of Polymers
   - Amorphous Structure
   - Point Group and Space Group Symmetry
   - X-ray Diffraction
   - Structure Factor Calculations
   - Point defects in Metals and Ionic Solids, Calculations of Defect Concentrations
   - Kroger-Vink Notation and Defect Compensation in Ionic Solids
   - Line Defects, Plane Defects, Volume Defects
• Grain Boundaries and Interfacial Energy
• Microscopy techniques
• Relationship of Electrical Properties to Bonding and Crystal Structure
• Bonding Based on Location in the Periodic Table
• Epitaxial Films
• Films with Preferred Orientation

2. Thermodynamics and Kinetics
• Calculation of Vacancy Concentration
• Diffusion Mechanisms
• Diffusion Coefficient
• Steady State Diffusion
• Non-steady State Diffusion
• Calculation of Diffusion Flux and Diffusion Profiles
• Kinetic Rate Equations
• Homogeneous Nucleation and Growth
• Surface Energy, Volume Free Energy, Critical Radii for Growth
• Gibbs Phase Rule
• Gibbs Free Energy, Entropy, Enthalpy
• Heterogeneous Nucleation
• Growth Rate
• Spinodal Decomposition
• Precipitation
• Crystallization
• Glass Transition Temperature, Specific Volume
• Liquid/Solid/Vapor phase equilibria and wetting angles
• Grain Growth
• Phase Equilibria
• Solid Solubility
• Microstructural Evolution During Cooling from a Melt

3. Mechanical Behavior
• Stress, Strain Definitions, Stress-Strain Curves
• Elastic Deformation
• Elastic Modulus, Poisson's Ratio
• Plastic Deformation and Eqn.
• Slip Planes and Slip Directions
• Definition of Dislocations
• Interaction of Dislocations
• Impeding the Movement of Dislocations
• Movement of Dislocations
• Methods to Detect Dislocations
• Role of Dislocations in Deformation of Crystalline Solids
• 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, plastics
• Resilience, Toughness
• Viscoelastic Behavior of Polymers
• Fracture Mechanics
• Griffith-Orowan
• Stress Intensity Factor
• Fracture Toughness
• Mechanical Behavior of metals, ceramics, polymers
• Low Temperature Behavior of Materials (Ductile to Brittle Transition)
• High Temperature Behavior of Materials (Creep)
• Fatigue
• Thermal Expansion Stress

4. Electronic/Optical/Magnetic Properties
• Diffraction from Crystals
• Reciprocal Lattice
• Electrical Conductivity, Mobility
• Hall Effect
• Pauli Exclusion Principle
• Fermi Level/Fermi distribution Function
• Density of States
• Electron Fermi Gas - Heat Capacity, transport
• Electron Band Structures in Solids
• Thermionic Emission
• Seebeck Effect
• Intrinsic/Extrinsic Semiconductors
• Temperature Dependence of Conductivity
• Diffusion, Conduction, and Continuity equations
• Semiconductor Devices (Schottky junction, pn junction, LED, solar cell, MOSFET)
• Optical Absorption
• Dielectric Behavior
• Piezoelectricity and Ferroelectricity
• Superconductivity
• Superconductor Quantum Interference Device
• Optical Properties of Materials (Index of Refraction, dispersion)
• Fresnel's Formula
• Transparency, Translucency, Opacity
• Luminescence
• Ferromagnetism, ferrimagnetism, paramagnetism, diamagnetism
Appendix III

MSE Ph.D. Qualifying Examination

The purpose of the qualifying examination is to demonstrate that the student is capable of conducting Ph.D. research and has a viable research plan for the Ph.D. dissertation. 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 interest, insofar as that is possible. Grace Chau has the forms for the selection of the Qualifying Exam Committee.

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 Dean’s office.

a) Current guidelines require at least three faculty from ChEMS
b) One outside member who is not a member of the ChEMS nor in the Materials and Manufacture Technology concentration.
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/

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 2nd year and the beginning of the 3rd year. If the qualifying examination is not taken by the end of the 3rd 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. At the time of scheduling the oral examination, a copy of the dossier must be provided by the student to the graduate office with the signature of the advisor.
I. Written Research Summary (Dossier)

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

1 page 1) Title Page – Title, Name of Student, Degree Program, Date, Advisor and Advisor’s Signature

1 page 2) Abstract Page – 100 word summary – include the new information/ new understanding/ major contribution that the dissertation will provide

1 page 3) Introduction – rationale for this research, engineering context, why important, what key questions will be answered

2-3 pages 4) Background – Summaries of prior published research key and relevant paper should be discussed to demonstrate a knowledge of the current state of the field

3-5 pages 5) Preliminary Experiments – a summary work to date, including interpretation of data obtained by the P.D. candidate. Include figures, graphs, and tables and the development of any models

2-4 pages 6) Future Research Plan – a thorough discussion of the experiments the students plans to complete and how the experiments will provide critical information for the dissertation and modeling a significant contribution to the research field

1 page 7) Timeline – Provide an estimated timeline of when you will complete different experimental tasks

1 page 8) Summary of the fundamental research contributions that are expected from this research

9) Reference – Author name, 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 the document the general expectations for the Ph.D.

This document can serve as a basis for the introductory chapters of the Ph.D. This document will serve as a basis for the Ph.D. dissertation, and will save time later when writing the dissertation.
The introduction and background should become the first chapter of the dissertation, and the preliminary experiments should be a draft chapter for the dissertation.

II. Oral Examination
During the oral examination the student should summarize the written document with less emphasis on published researched by others than on the preliminary and future work of the student. This will be a PowerPoint presentation about 30-40 minutes in length. The five faculty members will question the student and offer suggestions for the Ph.D. dissertation. At least 1.5 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.
APPENDIX IV
Courses for 2010-2011

FALL 2010
Chemical Engineering and Materials Science Department
CBEMS 259 Transmission Electron Microscopy (Mecartney) (need to concurrently enroll in MSE 200 or have taken equivalent, most useful for students who have a research advisor)
CBEMS 221 Drug Delivery (Wang) (highly recommended for students interested in biomaterials)
CBEMS 254 Polymer Science and Engineering (Yee) (highly recommended for students interested in polymeric materials, especially if you have not taken such a class at U.S. university)

Electives offered in other departments
Chemistry
CHEM 251 Conduct of Research (Vanderwal)
CHEM 229A Computational Methods (Taborek)
Physics
Physics 220 Electronics
Physics 238A Condensed Matter Physics (Fisk)
Mechanical and Aerospace
ENGRMAE 254 Mechanics of Solids (Atluri)
Civil and Environmental
ENGRCEE 250 Finite Element Methods for Engineering (Sun)
Biomedical Engineering
BME 210 Cell and Tissue Engineering
Electrical Engineering and Computer Science
EECS 179 MEMS (Bachman)
EECS 277A Advanced Semiconductor Devices I (Burke)
Information and Computer Science
ICS 65 C++ Programming (Thornton)

Up to 2 classes from the 100-190 level may be used for graduate coursework, with approval of the graduate advisor. All courses listed above are approved. There are additional graduate electives offered in each department, but 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
MSE 200
MSE 265
CBEMS 298
XXX and YYY – 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)
MSE 200
MSE 265
CBEMS 298
XXX – one (1) more graduate class
CBEMS 296 – 3 units of thesis research (may substitute in CBEMS 299 with graduate advisor’s permission)

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

MSE 200
MSE 265
CBEMS 298
XXX – one (1) more graduate class
CBEMS 299 – 3 units

**Ph.D. Students with an M.S. in Materials**

CBEMS 298
XXX – one (1) graduate class (not required to take in fall if none interest you)
CBEMS 299 – 9-11 units if research advisor is not yet selected
CBEMS 297 – 9-11 units if research advisor is selected

**WINTER 2011 (tentative – see schedule of classes for other departments)**

MSE 256 A Mechanical Properties – REQUIRED
MSE 205 Material Physics – REQUIRED
CBEMS 249 Nuclear Chemistry (Nilsson)
CBEMS 195 Numerical Methods (Mohraz)
CBEMS 249 Molecular Simulations (Nguyen)
ENGR CEE Advanced Strength of Materials (Yang)
ENGR MAE Fundamentals of Microfabrication (Madou)
ENGR MAE Biomems (Madou)
See also Chemistry, Physics, etc.

**SPRING 2011 (tentative – see schedule of classes for other departments)**

CBEMS 249 Electrochemistry and Solid State Chemistry (Mumm)
CBEMS 174 Semiconductor Device Packaging (Shi)
ENGR MSE 263 Computer Techniques in Experimental Materials Science
EECS Electronic Systems (Shapiro)
EECS Nanotechnology (Burke)
EECS Nano Imaging - Atomic Force and Scanning Probe Microscopy (Wickramasinghe)
ENGR MAE Fuel Cell Fundamentals (Brower) – caution, low grades for MSE students
ENGR MAE Sustainable Energy Systems (Seeker)
ENGR MAE Microsensors and Actuators (Trusov)
ENGR MAE Composite Materials (Valdevit)
See also Chemistry, Physics, etc.