HAJIM SCHOOL OF ENGINEERING & APPLIED SCIENCES
UNIVERSITY of ROCHESTER

RAMP
ROCHESTER ADVANCED MATERIALS PROGRAM

Materials Science Program

Graduate Studies Handbook

2017-18

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COURSE REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY IN MATERIALS SCIENCE

A. Program Objective

Materials Science education at Rochester is intended to prepare students for careers as independent scientists and engineers in a wide variety of disciplines that has come to define the field of Materials Science in general. Courses will be offered that stress the interdisciplinary nature of Materials Science and will cover understanding the fundamental behavior of materials to integrating materials into complex systems and devices with an engineered function. Students will have the flexibility to tailor a course curriculum to meet their individual needs and educational aspirations, while also maintaining a strong base in fundamental principles that have traditionally defined Materials Science education. Students pursuing a Ph.D. will also have the opportunity to choose a research advisor from faculty residing in departments throughout the schools of Arts and Sciences, Engineering, and Medicine. This advisor will be the primary individual providing guidance and mentorship for the student as he or she pursues rigorous experimental or theoretical studies that will culminate in a thesis. The overall objective of the Materials Science Ph.D. program is to produce highly-talented individuals capable of independent and critical analytical thought to address the world's most important and challenging scientific and engineering materials problems today and in the foreseeable future.

B. Curricular Requirements

A typical program for a materials science (MSC) Ph.D. student entering with a B.S. degree consists of a minimum of 24 credit hours of MSC graduate courses, exclusive of reading courses, 8 credit hours of other related courses, and 58 credit hours of research for a total of 90 semester hours. No more than 10 credits may be transferred from non-matriculated study at the University of Rochester or from an outside institution. To request transfer credit, attach an official copy of the transcript to your Program of Study. A typical program for an MSC Ph.D. student entering with an approved M.S. degree consists of a minimum of 24 credit hours of MSC graduate courses plus 36 credit hours of research. Students must successfully complete an oral defense of their theses. It is assumed all incoming students have completed a basic undergraduate course in materials, such as our course MSC 480, Introduction to Materials Science. If not, students must complete MSC 480.

All first year graduate students are required to register for the Materials Science Program Seminar Series (MSC 496) for both semesters. The materials science program director should be indicated as the instructor for the course with zero credit hours. Grading for this course is based on attendance. The dates and times of the seminars will be announced via e-mail. Attendance of at least three seminars per semester will result in a grade of S.

All Materials Science degree programs require completion of at least one course selected from each of the two categories listed below. Other courses should be selected from the available courses in MSC and allied fields, in consultation with the student's advisor. These additional courses must include a minimum number of credits that bear the MSC designation, as described above.

1) Thermodynamics (must select a minimum of one course from this list)

MSC 405 – THERMODYNAMICS OF SOLIDS (Cross-listed as ME 460)
MSC 485 - THERMODYNAMICS &STAT MECHANICS (cross-listed as CHE 485)
MSC 455 - THERMODYNAMICS & STAT MECHANICS (cross-listed as CHM 455)
or MSC 418 - STATISTICAL MECHANICS (cross-listed as PHY 418)

2) Structure/ Property Relationships (must select a minimum of one course from this list)

MSC 408 - MICROSTRUCTURE (Cross-listed as ME 463)
MSC 409 – MECHANICAL PROPERTIES OF MATERIALS (Cross-listed as ME 481)
MSC 456 - CHEMICAL BONDS- FROM MOLECULES TO MATERIALS (CHM 456)
or MSC 541 – NANOSCALE CRYSTALLINE DFECT (Cross-listed as ME 541)

***** NOT ALL COURSES ARE OFFERED EACH ACADEMIC YEAR *****
*****PLEASE CHECK CDCS FOR MOST CURRENT COURSES OFFERED *****

Course Options and Threads

Students interested in working towards a Materials Science degree have a wide range of courses from which to draw in constructing their programs of study. The following "threads" list a few recommended courses that may be of particular interest to students focused on specific aspects of the field. A list of additional recommended courses is also given below.

These threads are intended to suggest courses that may be of particular interest to students focused in each area. However, provided other requirements are met (e.g. minimum number of credit hours with the MSC designation), students may select courses from different threads in consultation with their academic advisor. In making their selections students are strongly encouraged to consider the need for breadth, as well as depth, given the broad nature of the field.

Materials Processing and Characterization Thread: Courses introduce students to characterization and processing tools needed to understand and form materials into complex structures and integrated devices.

MSC 407 Solids and Materials Laboratory (ME 462)

MSC 463 NMR (CHM 422/423)

MSC 403 Characterization Methods in Materials Science- Diffraction (ME 451)

MSC 406 Fracture and Fatigue (ME 461)

Electronic and Optical Properties of Materials Thread: Courses establish fundamental electronic and optical properties of silicon, ceramics, and glasses to motivate advanced applications in optics, alternative energy, and medicine.

MSC 420 Introduction to Condensed Matter (PHY 420)

MSC 423 Semiconductor Devices (ECE 423)

MSC 470 Optical Properties of Materials (OPT 421)

MSC 460 Solar Cells (CHE 460)

MSC 456 Chemical Bonds (CHM 456)

MSC 437 Nanophotonic and Nanomechanical Devices (ECE 436)

Polymers and Biomaterials Thread: Courses emphasize both fundamental and applied concepts of polymer science and biomaterials.

MSC 410 Mechanical Properties of Polymers (ME 411)

MSC 433 Polymer Science and Engineering (CHE 486)

MSC 445 Biomaterials (BME 445)

MSC 413 Engineering of Soft Matter (CHE 413)

MSC 454 Interfacial Engineering (CHE 454)

All Materials Science Courses:

MSC 452 (BME 432) Controlled Release Systems

MSC 442 (BME 442) Microbiomechanics

MSC 445 (BME 445) Biomaterials

MSC 451 (BME 451) Biomedical Ultrasound

MSC 462 (BME 462) Cell & Tissue Engineering

MSC 483 (BME 483) Biosolid Mechanics

BME 485 Cell & Membrane Mechanics (Spring 2010)

MSC 413 (CHE 413) Engineering of Soft Matter

MSC 454 (CHE 454) Interfacial Engineering

MSC 458 (CHE 458) Electrochemical Engineering and Fuel Cells

MSC 460 (CHE 460) Solar Cells

MSC 469 (CHE 469) Biotechnology and Bioengineering

MSC 482 (CHE 482) Processing Microelectronic Devices (2 credits)

MSC 433 (CHE 486) Polymer Science and Engineering

MSC 476 (CHE 476) Polymer Synthesis

MSC 472 (CHE 492) Biointerfaces

MSC 402 (CHM 402) Bio-Physical Chemistry I

MSC 404 (CHM 404) Bio-Physical Chemistry II

MSC 416 (CHM 416) X-ray Crystallography (2 credits)

MSC 463 (CHM 423) NMR (2 credits)

MSC 456 (CHM 456) Chemical Bonds

MSC 436 (CHM 458) Molecular Spectroscopy and Structures

MSC 468 (CHM 460) Chemical Kinetics

MSC 423 (ECE 423) Semiconductor Devices

MSC 484 (ECE 434) Microelectromechanical Systems

MSC 437 (ECE 436) Nanophotonic and Nanomechanical Devices

MSC 520 (ECE 520) Spin Based Electronics

MSC 580 (ECE 580) Nano-Electro-Opto-Bio

EES 448 High Temperature Geochemistry

EES 480 Material Properties of Deformed Rock

ME 405 Diffusion

ME 411 Mechanical Properties of Polymers (MSC 410)

MSC 432 (ME 432) Optomechanics

MSC 449 (ME 449) Elasticity

MSC 403 (ME 451) Characterization methods in Materials Science- Diffraction

MSC 406 (ME 461) Fracture and Adhesion

MSC 407 (ME 462) Solids and Materials Laboratory

MSC 408 (ME 463) Microstructures

MSC 466 (ME 466) Corrosion

MSC 409 (ME 481) Mechanical Properties of Materials

MSC 507 (OPT 407) SEM Practicum

MSC 470 (OPT 421) Optical Properties of Materials

MSC 464 (OPT 424) Fundamentals of Lasers

MSC 471 (OPT 443) Optical Fabrication and Testing)

MSC 474 (OPT 463) Nano-optics

MSC 465 (OPT 465) Principles of Lasers

MSC 420 (PHY 420) Introduction to Condensed Matter

C. Advising and Committees

Academic and Thesis Advisors

You will be assigned an academic advisor when you arrive at Rochester, but he or she may not be your eventual thesis advisor, whom you should identify at the end of your first year here, usually before taking the preliminary exam. (This exam is discussed below.) It is important that you find a good match between your academic interests and those of your thesis advisor, that your advisor is willing to accept you as a graduate research assistant, and that he/she is able to provide your graduate stipend and tuition. Any member of the MSC Faculty may serve as a PhD thesis advisor.

Thesis Advisory Committee

After beginning work together, a student and his/her thesis advisor must define the direction of the doctoral research and identify members of the UR faculty that will comprise the thesis advisory committee. The thesis advisory committee performs several functions. It provides advisory input during the development of the thesis research project with respect to scientific merit, techniques and methodology, relevant literature, etc. It normally serves as the Qualifying Exam Committee (see below). Finally, it, along with a representative approved by the University Dean of Graduate Studies as Chair, is the examining committee for the thesis defense.

The thesis advisory committee must consist of the research advisor, at least one other member from the MSC faculty and one faculty member who does not have to be member of the MSC faculty, but if they are, cannot be from your advisor's department. At least one member of the advisory committee is expected to have trained a graduate student through completion of a doctoral degree. Additional committee members may be included from either within or outside the University if it is considered useful or necessary. Thus, the minimum size of the committee will be three members, but four (or more) is quite

possible. In the case of co-advisors, a minimum of five members is required. Any exceptions to this procedure will have to be approved by the Associate Dean for Graduate Studies of Arts, Sciences and Engineering and the University Dean of Graduate Studies. By January of the second year, the student must submit a list of suggested committee members to the Director of Materials Science for review.

D. Ph.D. First Year Preliminary Exam

First year Ph.D. students take this exam after their second semester, usually late May or early June. **You must have a GPA > 3.0 in 400-level courses and register with the MSC Program Director's office** by the date specified to take the exam. This exam is required of all first year Ph.D. students, and successful completion of this examination by mid-June is required for formal admission into the Ph.D. program in the Materials Science Program.

To begin the exam process, each student is given a list of research papers submitted by the Materials Science faculty for review. The papers will be no more than two years old and will not be directly related to the student's chosen area of research, nor will they have been written by a member of the MSC faculty. At least three weeks before the oral presentation, each student must inform the Director's office by email or in writing which paper he/she has chosen to serve as a basis for the exam. The exam requires a committee of three Materials Science faculty members. The student's academic advisor is typically one member of the committee, as well as the faculty member who submitted the paper for review. The student can select the other member(s) of the committee or they will be chosen by the Materials Science Curriculum Committee if necessary. The student is responsible for checking the availability of the committee members and scheduling the oral exam before June 15th. The student must inform the Graduate Coordinator of the date and time so that a room can be scheduled for the exam.

At least **one week** before the exam, each student must submit to the Director's office an electronic copy of a carefully written document containing three sections of equal importance:

> *Questions Addressed by the Author(s).* The questions addressed in the article and the reasons for examining these questions should be identified.
>
> *Critical Appraisal of the Article.* The author's contribution to the solution of those questions and its significance should be discussed.
>
> *Proposal for Additional Research.* Propose in concrete terms research that might be done to extend and (if necessary) improve upon the study addressed in the article.

This document should be no longer than ten pages (12 pt double-spaced, 1 inch margins), excluding figures.

Approximately one week after submission of the document, each student must appear before the three-member faculty committee for an oral examination defending the document. Each exam will consist of a 20-minute oral presentation by the student followed by questions from the examining committee. The entire exam will last about two hours. At the end of the exam the committee will submit a written report of the examination to the Director and the student will be notified of their status.

Students will be evaluated on the following criteria:

1) Student's ability to evaluate published research critically. (Is the student a critical thinker?)

2) Student's creativity in suggesting new lines of research. (Is the student able to develop and refine his/her own research ideas?)

3) Strength of the written document with respect to both content and style. (Is the student able to communicate complex ideas effectively?)

4) Course grades.

E. Ph.D. Qualifying Examination (Proposal)

Objective and Basis for Evaluation

The goal of the Ph.D. qualifying exam is to determine whether the Ph.D. student is prepared to conduct a high-quality dissertation in materials science. The Ph.D. qualifying exam is based primarily on a research proposal, written and defended by the student. Through written and oral presentations, and through oral discussion, the student must convince the exam committee that:

1) The proposed research addresses an unsolved, technologically important problem.
2) The proposal contains an approach that is well thought-out, appropriate for the problem addressed, and has a good chance of success.
3) That the student can successfully complete the work using the resources available to them.

The Exam Committee

The committee will consist of a minimum of three full-time faculty of professorial rank. Two must be from within the Materials Science Program and one faculty member who does not have to be member of the MSC faculty, but if they are, cannot be from your advisor's department. The exam committee normally constitutes the members of the student's thesis advisory committee.

Timing

This exam must be completed by the end of the third year of study, unless a written waiver from the program director is obtained. It must also be completed a minimum of six months before the final thesis defense can be taken, a requirement that cannot be waived. (The purpose of the Qualifying Exam is to determine whether the student is qualified and competent to continue work toward a Ph.D. in Materials Science, and the exam is typically taken much earlier but after research has begun so the thesis can be clearly outlined). Contact the Director's office as soon as you and your advisor begin planning for your proposal. There are several things you must complete before you can take this exam and the office can help guide you through this.

You must submit your written thesis proposal to your committee and your Committee Nomination form to the Dean's Office at least **10 working days (weekends and University holidays not included)** before the exam is to take place.

Your program of study must be on file with Graduate Studies office when you reach your 90 credits and, if necessary, updated.

Written Proposal

Use an Arial, Times New Roman, or Helvetica typeface and a font size of 11 points or larger. (A Symbol font may be used to insert Greek letters or special characters; the font size requirement still applies.) Type density, including characters and spaces, must be no more than 15 characters per inch. Type may be no more than six lines per inch. Use standard size (8 1/2" x 11") sheets of paper. Use at least 3/4 inch margins (top, bottom, left, and right) for all pages, including continuation pages. The document must be single-sided and single-spaced. Consecutively number pages throughout the application. Do not use suffixes (e.g., 5a, 5b). Do not include unnumbered pages. A smaller type size may be used but it must be in black ink, readily legible, and follow the font typeface requirement. Embed key figures in the document and place additional figures in appendices.

All students must consult with their advisor prior to the preparation and submission of this document. The advisor will typically provide additional guidance about the document format and preparation.

Typical Exam Format

The student will give a presentation to present an overview of the thesis research proposal for the first 20-30 minutes using blackboard, slides or overhead projector. Occasionally, this presentation is made to a larger audience in the form of a seminar with a 45 minute presentation. If so, then additional background material may be appropriate and an abstract should be given to the Director's office a week in advance for posting. The committee will then examine the student orally in a closed session. A typical examination will take between two and three hours. The candidate is judged on the significance of the research proposed, the written and oral presentation, understanding of the fundamental issues, the ability to apply the background from formal course work to problems related to the proposal, and demonstration of critical assessment of results. It is important to recognize that while the written proposal serves as a focus for the oral examination, questions about related areas can also be raised.

F. The Final Ph.D. Defense

The Ph.D. defense is the last step in your studies. Your dissertation should be in final form before you defend. When you and your advisor begin planning for the defense, be sure to contact the Director's office. There are many administrative matters you must bear in mind connected with the defense process and they can help you through them.

Thesis Preparation and Registration

A booklet entitled "The Preparation of Doctoral Thesis" is available online at http://www.rochester.edu/Theses/ThesesManual.pdf. It is the responsibility of the student to see that the style, format, margins, paper, binding, etc. are in accordance with the University regulations. The student should also be aware of deadlines for registering a thesis in conjunction with degree dates. The most updated graduate calendar is available at http://www.rochester.edu/college/gradstudies/gcalendar.html. **Registration with the office of the Associate Dean of Graduate Studies must take place 15 working days (weekends and holidays not included) before the final exam.** Refer to Preparing for a PhD Defense online at http://www.rochester.edu/college/gradstudies/phd-defense/before.html#_Selecting_a_Defense.

The Committee

The Final Exam committee must consist of a minimum of two full-time Professors from the Materials Science Program, and one full-time Professor outside the program. For specifics refer to the heading for Interdisciplinary Programs at http://www.rochester.edu/college/gradstudies/current/dissertation.html.

Exam Format

The first 45 minutes of the exam is typically a seminar open to the public. The student's presentation should last approximately 30-35 minutes and an additional 10-15 minutes should be allowed for questions from the audience. Notes, slides, charts, and visual aids for a seminar are encouraged. The student and the Examining Committee will then adjourn to a closed session where the second part of the exam will be conducted. The committee will scrutinize the student's thesis including comprehension, execution, description, and interpretation of the research described in the thesis.

After successful completion of the Final Exam, the student will be required to make any corrections in the thesis. When corrections are completed and reviewed by the thesis advisor, the submission is completed electronically to the University Dean of Graduate Studies at www.etdadmin.com/rochester. A student's stipend normally ends when the final copy of the dissertation is submitted.

H. Key Milestones

At the end of the first academic year
Choose a research advisor
Complete preliminary examination
Begin Ph.D. thesis research

Second Year
No later than January, submit the names of the thesis advisory committee to the Materials Science Program Office
Complete most remaining course work
Organize thesis proposal

Third Year
Submit final copy of research proposal to Program Office and Advisory Committee Members (two weeks before exam).
Complete qualifying examination (proposal defense) by year-end.

Subsequent Years

Continue research and writing of the thesis under the direction of the thesis advisor and thesis advisory committee. *Note:* the expectation of the program is that students should not take more than five years to successfully complete the Ph.D. University Regulations require that students exceeding a 7 year stay receive approval for an extension both from the program (Curriculum Committee) and the Associate Dean of Graduate Studies.

REQUIREMENTS FOR THE MASTER OF SCIENCE IN MATERIALS SCIENCE

A. Program Objective

Materials Science graduate education at Rochester is intended to prepare students for careers as independent scientists and engineers in a wide variety of disciplines that has come to define the field of Materials Science in general. Courses will be offered that stress the interdisciplinary nature of Materials Science and will cover understanding the fundamental behavior of materials to integrating materials into complex systems and devices with an engineered function. Students will have the flexibility to tailor a course curriculum to meet their individual needs and educational aspirations, while also maintaining a strong base in fundamental principles that have traditionally defined Materials Science education. Students can choose between a M.S. Degree with or without a major research component. Should students choose the thesis option for their M.S. program, they will also have the opportunity to choose a research advisor from faculty residing in departments throughout the schools of Arts and Sciences, Engineering, and Medicine. This advisor will be the primary individual providing guidance and mentorship for the student as he or she pursues rigorous experimental or theoretical studies that will culminate in a thesis. The overall objective of the M.S. Program in Materials Science is to provide students the ability to build on their university education, preparing them for a career in a materials-related industrial field, or providing a foundation of coursework for furthering their graduate education.

B. Curricular Requirements

The M.S. degree in materials science requires a minimum of 30 credit hours of graduate courses. There are two paths to obtaining an M.S.: Plan A, with thesis, and Plan B, without thesis. Plan B is the normal, default, option for entering students. If a student wishes to pursue a Plan A path instead, it is the student's responsibility to make arrangements with a faculty thesis advisor to supervise his/her work and to inform the MSC program office of this.

For students electing to obtain the M.S. degree with thesis (Plan A), the following requirements apply: The 30 credit hours must include a minimum of 20 credit hours of MSC graduate courses plus 10 credit hours for research, and the student must successfully complete an oral defense of his/her thesis, after all other degree requirements have been completed.

For students electing to obtain the M.S. degree without a thesis (Plan B), the following requirements apply: The 30 credit hours must include a minimum of 24 credit hours of MSC graduate courses plus 6 credit hours of other related courses. The maximum number of research credits for a Plan B M.S. degree is 6 credit hours. A student in Plan B must pass a comprehensive oral examination to obtain the degree.

It is assumed all incoming students have completed a basic undergraduate course in materials, such as our course MSC 202, Introduction to Materials Science. If not, students must complete MSC 202, which is a three credit hour course for graduate students.

All first year graduate students are required to register for the Materials Science Program Seminar Series (MSC 496). The materials science program director should be indicated as the instructor for the course with zero credit hours. Grading for this course is based on attendance. The dates and times of the

seminars will be posted on the program web page and announced via e-mail. Attendance of at least three seminars per semester will result in a grade of S.

All Materials Science degree programs require completion of at least one course selected from each of the two categories listed below. Other courses should be selected from the available courses in MSC and allied fields, in consultation with the student's advisor. These additional courses must include a minimum number of credits that bear the MSC designation, as described above.

1) Thermodynamics (must select a minimum of one course from this list)

MSC 405 – THERMODYNAMICS OF SOLIDS (Cross-listed as ME 460)
MSC 485 - THERMODYNAMICS &STAT MECHANICS (cross-listed as CHE 485)
MSC 455 - THERMODYNAMICS & STAT MECHANICS (cross-listed as CHM 455)
or MSC 418 - STATISTICAL MECHANICS (cross-listed as PHY 418)

2) Structure/ Property Relationships (must select a minimum of one course from this list)

MSC 408 - MICROSTRUCTURE (Cross-listed as ME 463)
MSC 409 - MECHANICAL PROPERTIES OF MATERIALS (Cross-listed as ME 481)
MSC 456 - CHEMICAL BONDS- FROM MOLECULES TO MATERIALS (CHM 456)
or MSC 541 – NANOSCALE CRYSTALLINE DFECT (Cross-listed as ME 541)

***** NOT ALL COURSES ARE OFFERED EACH ACADEMIC YEAR *****
*****PLEASE CHECK CDCS FOR MOST CURRENT COURSES OFFERED *****

Lists of courses satisfying the master's degree curricular requirements are specified in Section I-B of the Ph.D. curricular requirements.

C. Continuity

All master's degree students, including part-time students, must maintain continuous enrollment. If students fail to enroll for any term, the Arts, Science and Engineering Graduate Studies Office may terminate a student's status with the university, or students must pay the appropriate fees for unregistered semesters in order to complete the degree. To maintain continuity, full-time Plan A and Plan B M.S. degree students who are not enrolled in full-time coursework but are working full time on their degree requirements (e.g. dissertation, theses, research, M.S. degree oral exam etc.) may register for MSC 897 or MSC 899 for zero credit hours. Both of these categories are considered full-time enrollment for all reporting purposes and satisfy government requirements for F-1 and J-1 international students. MSC 897 can only be used one time, and does not include a fee. You must have all credits that you have taken graded and your program of study on file with Graduate Studies Office. MSC 899 can be used for more than one semester, and does include a fee, as well as other fees associated with full-time enrollment. For more details about maintaining continuous enrollment, please see the Official Bulletin Graduate Studies at http://www.rochester.edu/gradstudies/publications.html.

D. Duration

A full-time student should not take more than two years to complete all the Plan B M.S.

requirements, including the oral examination. In the first year of study, a student in Plan A should satisfy most course requirements, become fully trained in the laboratory, and make substantial progress on their thesis project. Typically, all efforts beyond the first year are devoted to the completion of the research thesis. The University has a five-year limit on the time taken to complete any M.S. degree (Plan A, Plan B, full-time or part-time).

E. Advising

Plan A students should identify a thesis advisor before beginning their first term and the thesis advisor will serve as the student's academic advisor. The advisor will help the student construct a program of study appropriate to the student's interest, abilities, and the demands of the research project. Any member of the Materials Science Faculty may serve as a M.S. thesis advisor. Plan A students are also required to form a thesis advisory committee. This committee must consist of 1) the thesis advisor, 2) one faculty member who is part of the Materials Science Program Faculty, and 3) one faculty member from outside the program.

Plan B students will be assigned an academic advisor before beginning their first term of study. This advisor will help the student construct a program of study.

F. Thesis and Exit Exams

M.S. Plan A

Plan A students are required to prepare a written thesis under the supervision of his/her advisor following the format specified for the Ph.D. degree (see above).

Arranging for the defense: When you or your advisor begin thinking about defending, remember to contact the Graduate Coordinator. He/she will guide you through the process and the administrative requirements, including the specific deadlines for the defense and dissertation submission for each degree conferral date, *i.e.* May, October, March. You must be registered for the semester in which you defend.

Scheduling and required paperwork: Check with the Graduate Coordinator for allowable defense dates. The thesis document must be registered with the Associate Dean for Graduate Studies, and bound copies must be delivered to the members of the examining committee at least two weeks (10 working days) prior to the oral exam. You must also submit an updated Program of Study and a Nomination of Committee form. When your committee has been selected and a defense date is chosen, the Graduate Coordinator will reserve a conference room for your defense.

The examining committee: You will defend your dissertation before a committee of two full-time professors from the Materials Science program and one full-time professor from outside the department of your advisor's primary appointment. The committee members are selected by your advisor, with input from you, and then it is your responsibility to contact the faculty. For specifics refer to the heading for Interdisciplinary Programs at http://www.rochester.edu/college/gradstudies/current/dissertation.html.

The thesis work must be presented in a public seminar and followed by a closed session oral examination. The written document, the prepared presentation, and the oral exam will be used in evaluating the following criteria:

A) Is the student clearly capable of executing an original study over a prolonged period?
B) Is the student capable of presenting the rationale and results of new study in a clear manner?
C) Did the student become thoroughly acquainted with the literature in his thesis area?

Final copies of the dissertation: You must turn in two corrected unbound copies of your dissertation after successful completion of the defense. These copies will go to the Dean's office. Also, give the Graduate Coordinator a third bound copy for your folder. It is also customary to provide bound copies to your exam committee.

M.S. Plan B

A student in Plan B must pass a comprehensive oral examination. Degrees are conferred in October, March, and May. See the Graduate Coordinator for deadlines for the appropriate conferral date to ensure that all requirements are met.

All students in Plan B must pass a thirty minute oral exit exam before a committee comprised of at least four Materials Science faculty members. Two weeks prior to the exam, the M.S. candidate will be provided three recently published papers, one of which he or she must choose to evaluate. Students are not allowed to discuss their chosen manuscript with other students or faculty. The exam begins with the candidate presenting a ten-minute oral summary and critique of the chosen manuscript. A written paper will not be required. The examination committee members will then ask questions for approximately twenty minutes to evaluate (i) the student's ability to identify and clearly explain the physical principles upon which the paper is based, (ii) the scientific basis and appropriateness of the student's critique, and (iii) student competency in materials science subjects, particularly those related to completed M.S. coursework.

It is considered important that the total exam time (30 minutes for each student) be rigorously maintained. As a result, students are reminded that it is very important for them to use their time well during both the presentation and question portions of the exam.

Following the exam the committee will recommend that the student pass, pass with a contingency, or fail to the Materials Science Program Director.

Possible Outcomes:

- pass
- contingent pass: either take additional course(s) or write a follow-up document to be reviewed and voted on by the committee
- failure: termination from the program

The oral exams will normally be held once a year, in the late spring or early summer. Exams will normally be held in a single block, with students following each other at half hour intervals.

Faculty	Email	Department
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Ph.D. Student Expectations and Responsibilities

Goal of Graduate Education

The primary goal of graduate education at the University of Rochester is to prepare promising students for outstanding scholarly and professional achievement, by educating them in the skills of a discipline and in the intellectual and ethical foundations of research, instilling in each student the capacity for independent critical judgment, and inspiring students to use their knowledge and training for the betterment of society.

Graduate Student Policies and Procedures

Policies and procedures governing graduate students at the University of Rochester can be found in the Graduate Bulletin (http://www.rochester.edu/GradBulletin). Additional policies for graduate students in Arts, Sciences and Engineering (AS&E) can be found on the AS&E Graduate Studies website (http://www.rochester.edu/college/gradstudies/policies/). Students should discuss departmental or program-specific policies with the program Director. Students should be aware of and comply with all university, AS&E and departmental policies governing their program.

Ph.D. Student Expectations

As with most worthwhile endeavors, success in graduate study cannot be guaranteed and often depends on the mutual efforts of faculty and student to work diligently and form a productive professional relationship. Graduate students may reasonably expect the following, related to their research, their teaching and their general program support. The exact way in which these goals may be met can vary, depending on the program and the department.

Research, Teaching and Training

- **Resources:** to receive appropriate resources, including reasonable access to faculty, appropriate course offerings to meet the student's approved program of study, and facilities to allow the student to complete the program.
- **Guidance:** to receive advice and direction regarding the student's academic program as well as thesis research.
- **Training:** to receive training on the current best practices in research and teaching, including appropriate techniques, tools, methods and equipment needed to successfully carry out the student's research or teaching duties.
- **Appropriateness:** to have projects and tasks that are assigned to the student be appropriate for the student's program of study and designed to help the student make continued progress towards completion of the degree.
- **Expectations:** to be informed of the expectations, including timelines, for the successful completion of any duties, such as research projects, teaching assignments, and thesis work.
- **Evaluation:** to receive timely and fair assessment of the student's work, including course work, program exams, research and teaching.
- **Support services:** to be provided with professional and personal development support services if requested, such as those offered by the Career Center, Disability Services, Learning Assistance Services and access to English as a Second Language instruction (for a fee), that enhance the student's professional and academic experience.
- **Professional development:** to be provided in appropriate cases with opportunities to publish the student's research, present the student's work, apply for patents and copyrights for the student's

work, and attend colloquia, seminars, and workshops to support the student's professional development.

Community and Administrative

- **Non-discrimination and non-harassment:** to be treated in a fair, impartial, and professional manner in all dealings in accordance with university policies governing discrimination and harassment (as per the University of Rochester Policy Against Discrimination and Harassment http://www.rochester.edu/working/hr/policies/pdfpolicies/106.pdf).
- **Collegiality:** to have a collegial, welcoming environment in which to pursue the student's research, teaching and professional activities, where students are respected as valuable members of the community.
- **Fair treatment:** to be given appropriate credit for the student's work and provided clear guidelines on authorship, data ownership and research practices when engaged in joint research projects.
- **Conflict of interest:** to receive appropriate instruction about conflicts of interest so the student can avoid being placed in a situation that creates a conflict of interest (see the UR Guidelines on Research Integrity and Conflict of Interest for Graduate Students Policy http://www.rochester.edu/provost/COI_Guidelines_Grad_Students_and_Postdocs_Final_5-28-09.pdf).
- **Policies:** to receive guidelines on academic policies and procedures, as found in the Graduate Bulletin (http://www.rochester.edu/GradBulletin), on the AS&E Graduate Studies website (http://www.rochester.edu/college/gradstudies/policies) and provided by the student's program.
- **Feedback:** to be provided feedback on performance and given clear guidelines on the required areas of improvement when performance is deemed poor and the student is in jeopardy of being removed from the program.
- **Appeal:** in ways prescribed by University policies, to have the opportunity to petition for an exemption to an existing policy, to appeal decisions related to policies and procedures, and to issue a complaint when standards of fairness may have been violated.

Ph.D. Student Responsibilities

Ph.D. students are responsible for working towards completion of their degree programs in a timely manner. In addition to gaining expertise in a particular field of study, Ph.D. students are expected to expand the knowledge of that disciplinary field by discovering and pursuing a unique topic of scholarly research, resulting in the Ph.D. dissertation. It is the student's responsibility to ensure continued progress of his or her academic program and thesis research. Students have a responsibility for the following aspects of their program.

Research, Teaching and Training

- **Timeframes:** to work effectively towards completion of the degree in a timely manner.
- **Academics:** to learn the existing theories, practices and research methods of the discipline and to apply these in the student's research and teaching.
- **Thesis:** to discover and pursue a unique topic of research in order to construct new knowledge and to apply this knowledge to existing problems and issues.

- **Communication:** to communicate regularly with faculty advisors and thesis exam committee members, providing these faculty with updates on the student's progress within the program and updates on results of research activities.
- **Integrity and ethics:** to assume the highest integrity and maintain ethical standards in all aspects of the student's work, especially in the tasks of collecting, analyzing, and presenting research data. Special care should be taken to follow guidelines established by the University's independent review boards for research, such as the Research Subjects Review Board (RSRB)(http://www.rochester.edu/rsrb).
- **Laboratory notebooks:** where applicable, to maintain detailed, organized and accurate laboratory notebooks and records. When a student leaves the lab, the notebook and all research data remain the property of the laboratory.
- **Teaching:** to take teaching duties seriously and to use all teaching experiences to enhance the student's effectiveness as an instructor.
- **Professionalization:** to contribute, wherever possible, to the scholarly discourse of the discipline through presentations and publications. The student should attend and participate in appropriate meetings, colloquia, seminars and group discussions that are part of the educational program, and the student should submit all relevant research results that are ready for publication in a timely manner.
- **Work environment:** to help maintain a clean and safe work environment, including, but not limited to, office space, laboratory spaces and common spaces.
- **Mentors:** to seek out a range of faculty, professional and peer mentors who can help the student prepare for a variety of professional and career roles and responsibilities, and to serve as a mentor to others when appropriate.

Community and Administrative

- **Collegiality:** to promote collegiality and a welcoming environment in the student's classrooms and laboratories and in all aspects of the student's program, ensuring that all students, faculty and staff are treated with respect.
- **Familiarity with policies:** to take responsibility for keeping informed of and complying with regulations and policies and to complete all required paperwork and other degree obligations in a timely fashion (http://www.rochester.edu/college/gradstudies/current). Note that individual programs may have additional policies, and it is the student's responsibility to understand and comply with these policies as well.
- **Effort:** to devote full time and effort towards completing degree requirements (for full-time students). Students are expected to be on campus and completing degree requirements during the academic semester. Students must check with the program Director for program-specific limits on vacation time and must receive approval for all vacation time from their advisor and/or the program director. Students away from campus for an extended period during any academic semester (e.g., for field research) must register in Absentia for the semester.
- **Employment:** not to simultaneously be employed full-time while maintaining full-time student status, unless it is an internship related to the student's academic program and supported by the student's advisor, the program Director and the Dean of Graduate Studies. Part-time employment for full-time students is limited by individual programs—any part-time employment must be approved by the student's advisor and the program Director. International students must discuss with the International Services Office (ISO) any special rules and regulations for internships and part-time employment. Any part-time employment must be approved by the student's advisor and the program Director of. International students must discuss with the International Services Office (ISO) any special rules and regulations for internships and part-time employment.

RESPONSIBILITIES OF TEACHING ASSISTANTS

SUPERVISED COLLEGE TEACHING

Most Ph.D. students admitted to the program are offered graduate fellowships that provide a competitive stipend and cover the costs of tuition and some other fees. As part of their educational experience, all Materials Science Ph.D. students are expected to provide teaching assistance for at least two semesters unless they are granted a waiver that must be approved by the Director's office.

Expectations and Responsibilities of TAs:

1. TAs should be polite, courteous, and respectful to all students.
2. TAs should have 2 hours/week of office hours, at a time that is convenient for the students in the course.
3. TAs are *not* expected to be available to answer students' questions outside of office hours.
4. Students in courses are expected to observe the above restrictions on office hours.
5. TAs should be prepared to answer questions on the material being presented in class.
6. TAs share in the grading of homework and examinations.
7. TAs should grade and return homework assignments in a timely manner.
8. The department, if requested, will provide each graduate student with the opportunity to make classroom presentations.

Master's Student Expectations and Responsibilities

Graduate Student Policies and Procedures

Policies and procedures governing graduate students at the University of Rochester can be found in the Graduate Bulletin (http://www.rochester.edu/GradBulletin). Additional policies for graduate students in Arts, Sciences and Engineering (AS&E) can be found on the AS&E Graduate Studies website (http://www.rochester.edu/college/gradstudies/policies). Students should discuss departmental or program-specific policies with their program Director. Students should be aware of and comply with all university, AS&E and departmental policies governing their program.

Master's Student Expectations

As with most worthwhile endeavors, success in graduate study cannot be guaranteed and often depends on the mutual efforts of faculty and student. Master's students may reasonably expect the following support in their program. The exact way in which these goals may be met can vary, depending on the program and the department.

- **Resources:** to receive appropriate resources, including reasonable access to appropriate course offerings to meet the student's approved program of study and facilities to allow the student to complete the program.
- **Guidance:** to receive advice and direction regarding the student's academic program.
- **Expectations:** to be informed of the expectations, including timelines, for the successful completion of any potential non-course duties, such as research projects, teaching assignments, and thesis work.
- **Evaluation:** to receive timely and fair assessment of the student's work, including course work, program exams and (potentially) research and teaching assignments.
- **Support services:** to be provided with professional and personal development support services if requested, such as those offered by the Career Center, Disability Services, Learning Assistance Services and access to English as a Second Language Instruction (for a fee), that enhance the student's professional and academic experience.
- **Professional development:** to be provided with opportunities to attend colloquia and seminars and, in appropriate cases, to publish the student's research.
- **Non-discrimination and non-harassment:** to be treated in a fair, impartial, and professional manner in all dealings in accordance with university policies governing discrimination and harassment (as per the University of Rochester Policy Against Discrimination and Harassment: http://www.rochester.edu/working/hr/policies/pdfpolicies/106.pdf).
- **Collegiality:** to have a collegial, welcoming environment in which to pursue the student's graduate studies, where students are respected as valuable members of the community.
- **Fair treatment:** to be given appropriate credit for the student's work and provided clear guidelines on authorship, data ownership and research practices when engaged in joint research projects.
- **Conflict of interest:** to receive appropriate instruction about conflicts of interest so the student can avoid being placed in a situation that creates a conflict of interest (see the UR Guidelines on Research Integrity and Conflict of Interest for Graduate Students Policy: http://www.rochester.edu/provost/COI_Guidelines_Grad_Students_and_Postdocs_Final_5-28-09.pdf).

- **Policies:** to receive guidelines on academic policies and procedures, as found in the Graduate Bulletin (http://www.rochester.edu/GradBulletin), on the AS&E Graduate Studies website (http://www.rochester.edu/college/gradstudies/policies) and provided by the student's program.
- **Feedback:** to be provided feedback on performance and given clear guidelines on the required areas of improvement when performance is deemed poor and the student is in jeopardy of being removed from the program.
- **Appeal:** in ways prescribed by University policies, to have the opportunity to petition for an exemption to an existing policy, to appeal decisions related to policies and procedures, and to issue a complaint when standards of fairness may have been violated.

Master's Student Responsibilities

Master's students are responsible for working towards completion of their degree programs in a timely manner. It is the student's responsibility to ensure continued progress of his or her academic program. Students have a responsibility for the following aspects of their program.

- **Timeframes:** to work effectively towards completion of the degree in a timely manner.
- **Academics:** to successfully complete a program of study consisting of either 30 or 32 credit hours, as specified by the departmental requirements.
- **Thesis (for Plan A students only):** to discover and pursue a unique topic of research in order to construct new knowledge.
- **Integrity and ethics:** to assume the highest integrity and maintain ethical standards in all aspects of the student's work, including course work and research, especially in the tasks of collecting, analyzing, and presenting research data and in writing reports or essays. Special care should be taken to follow guidelines established by the University's independent review boards for research, such as the Research Subjects Review Board (RSRB) (http://www.rochester.edu/rsrb/).
- **Laboratory notebooks:** where applicable, to maintain detailed, organized and accurate laboratory notebooks and records. When a student leaves the lab, the notebook and all research data remain the property of the laboratory.
- **Teaching:** where applicable, to take teaching duties seriously and to use all teaching experiences to enhance the student's effectiveness as an instructor.
- **Work environment:** to help maintain a clean and safe work environment, including, but not limited to classroom spaces, laboratory spaces and common spaces.
- **Collegiality:** to promote collegiality and a welcoming environment in all aspects of the student's program, ensuring that all students, faculty and staff are treated with respect.
- **Familiarity with policies:** to take responsibility for keeping informed of and complying with regulations and policies and to complete all required paperwork and other degree obligations in a timely fashion (Note that individual programs may have additional policies, and it is the student's responsibility to understand and comply with these policies as well.)
- **Effort:** to devote full time and effort towards completing degree requirements (for full-time students). Students are expected to be on campus and completing degree requirements during the academic semester. Students away from campus for an extended period during any academic semester (e.g., for field research) must register in Absentia for the semester**.**
- **Employment:** not to simultaneously be employed full-time while maintaining full-time student status, unless it is an internship related to the student's academic program and supported by the student's advisor, the program Director of Graduate Studies and the Dean of Graduate Studies. International students must discuss with the International Services Office (ISO) any special rules and regulations for internships and part-time employment.

GRADUATE STUDENT RESIDENCY, VACATIONS, AND LEAVE OF ABSENCE

General Guidelines and Principles

Graduate students are expected to be in residence the entire calendar year. Students must recognize that the periods when classes are not in session are the ideal times to devote to research and should plan to spend as much of that time as possible in productive research.

The need to take reasonable time off for vacation and time away from the academic program is recognized. However, graduate students should expect to take off no more than 10 working days per year. Such periods should be carefully arranged far in advance with the research advisor, a full semester or six months in advance is not too early. Graduate students need to be cognizant of all possible deadlines for manuscripts, abstracts, proposals, grant reports, and academic requirements such at TA assignments and the qualifying exam so that any vacation time does not adversely affect fulfilling these obligations.

If it becomes absolutely necessary for students to take leaves of absence for any time longer than a normal vacation period, they should not expect their stipends to continue while they are away. Such leaves must be approved, far in advance, by the student's research advisor and should be considered a special privilege that is not generally available.

This policy is not intended to change the academic environment that we have into a workplace. Students and faculty alike should spend as much time as they can on their academic pursuits because it is enjoyable, not because they are compelled to do so. In keeping with the academic environment, necessary flexibility in this policy may be exercised, consistent with meeting the deadlines of assignments and research results. Each faculty member may choose to enforce this policy in his research group in a way that works best for him and his students. Any variations are at the option of the faculty advisor, and students should not expect that all variations will be generally available.

Vacation Approval Form

The research advisor and the department chair make final decisions regarding when and how long students may take time off from their research. Many factors affect such decisions. The research calendar has many deadlines that must be met: proposal submissions, abstracts for presentations at technical meetings, final reports to funding agencies, etc. All these activities are the joint responsibility of the research advisor and the students in the research lab. In addition, the academic calendar imposes special constraints. For example, graduate students in their first year of residency (and in some cases beyond the first year) have an obligation to support the teaching function of the department through service as a teaching assistant. Thus, every graduate student in this situation must schedule time off when it will not conflict with these TA responsibilities.

UNIVERSITY OF ROCHESTER

Materials Science Program

APPLICATION FOR EXTENDED VACATION

Full-time graduate students are expected to discuss any vacation plans with their research supervisor. In addition, vacation days cannot be taken when they will conflict with a student's responsibilities as a teaching and research assistant.

Full-time graduate students who plan to be away from the department for five or more consecutive days must fill out this form and obtain approvals *in advance*, in accordance with the schedule presented below.

For vacation periods of *five to nine days* (excluding weekends but including holidays), this application form must be completed at least *one month* in advance of departure.

For vacation periods of *ten or more days*, this application must be completed at least *two months* in advance of departure.

Failure to comply with these deadlines may result in the loss of vacation privileges as well as the loss of stipend for the period of absence.

Student Name: _____

Vacation period: _____

Date of return to assume full time responsibility: _____

Thesis Advisor: _____ Date: _____

Program Director: _____ Date: _____

Environmental Health & Safety
Occupational Safety Unit
Safety Training for Research Laboratory Personnel

OSHA Required Training

To assure compliance with federal and state regulations, those working in labs or supervising lab personnel must complete EH&S laboratory safety training annually. Is your lab safety training current? You can now check your individual training history through the HRMS PeopleSoft site - HRMS Sign-in. Once you log in using your netid and password, select the "Self Service" option from the main menu, then select "Learning and Development" and "Training Summary". You'll see a list of the various training courses you have completed at the University.

EH&S Lab Safety Training sessions include topics to comply with the following regulations:

- OSHA (Occupational Safety and Health Administration) compliance training for the standards:
  - Bloodborne Pathogens
  - Fire Safety
  - Formaldehyde Standard
  - Gas Cylinder Safety
  - Laboratory Standard
  - Personal Protective Equipment
- EPA (Environmental Protection Agency) issues for minimizing waste and disposal of regulated medical waste and hazardous waste
- General biosafety information including CDC (Centers for Disease Control and Prevention), New York State Department or Health, and Department of Environmental Conservation issues

Departments can schedule a live 3-hour session for their department provided a minimum of 20 people are scheduled for attendance. This can be scheduled by calling EH&S at x5-3241.

Computer-based Laboratory Safety Training, through the Blackboard system, is available for staff who are unable to attend a "live" session. Non-UR employees, non-UR students and volunteers may complete their lab safety training using the same Blackboard system, but must register for a "basic account" first. (Go to https://www.urmc.rochester.edu/libraries/miner/teaching_and_learning/blackboard/forms/create_user.cfm.)

Instructions on how to self-enroll in the course are available - Self-enroll in Lab Safety Training. The safety training has been customized for the various University lab staff:

- **Clinical Lab Personnel** - training program designed only for those who process human specimens.
- **Phlebotomists and Clinical Study Coordinators** - training program designed only for those who draw blood or coordinate clinical studies
- **Research Lab Personnel** - Laboratory Safety Training is now available through Blackboard. All individuals within a particular lab must complete the same training program. Select the program based on the activities in the lab - **You need to complete only one of the four options below. If you are not sure which one to take, the Biologicals/Chemicals/Animals covers the most information.**
  - **Biologicals/Chemicals/Animals -** training program designed for those staff working with chemicals, recombinant DNA, human specimens, or infectious agents
  - **Biologicals/Chemicals -** training program designed for those for those staff working with chemicals and recombinant DNA, human specimens or infectious agents but **NO** animals
  - **Chemical/Animals -** training program designed for those staff working with chemicals and animals
  - **Chemicals -** training program designed for those staff working with chemicals only and miscellaneous physical hazards are present

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QUESTIONS or COMMENTS?

Contact EH&S at (585) 275-3241 or e-mail EH&S Questions.

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