

**Intercollege Graduate Degree Program (IGDP) in
Materials Science and Engineering (MatSE) at
The Pennsylvania State University**



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General Information

The Intercollege Graduate Degree Program (IGDP) in Materials Science and Engineering (MatSE) offers comprehensive graduate education in the fundamentals of materials science and engineering (e.g., synthesis-structure-property-performance relationships). The program has strong research and educational thrusts across the entire spectrum of materials, including inorganic and structural materials, electronic and photonic materials, polymers and biomaterials, and computational materials science. Students may choose to study across the major themes of materials today, including materials in energy applications, nanotechnology, materials in medicine, materials in communications, materials for sensor applications, structural materials, etc., by using a combination of MatSE courses and a myriad of materials-related courses offered in the science and engineering departments at Penn State.

The purpose of this document is to summarize graduate degree requirements, recommendations, and policies to guide graduate students, faculty, and staff in the program. Complete statements of the Graduate School requirements are found in the GRADUATE DEGREE PROGRAMS BULLETIN <http://www.psu.edu/bulletins/whitebook/>

and the THESIS GUIDE

<http://www.gradsch.psu.edu/current/thesis.html>.

Student Advising

Advising is normally performed by a student's thesis advisor, but in circumstances where an advisor has not been identified, the chair or co-chair of the graduate program will act in this role initially. For students in the Ph.D. program, advising is also performed by a Doctoral Committee.

Course Registration

After consultation with their advisor, a student should register for courses using LionPath (lionpath.psu.edu). The majority of graduate students in the program are appointed at a half-time graduate assistantship or the equivalent.

Fall and Spring Semesters

To be considered full-time, all M.S. students and Ph.D. students who have not passed the comprehensive exam and are on half-time appointments should register for 9 to 12 credits in the Fall and Spring semesters. The Graduate Program prefers that students on assistantship are registered for 12 credits. Students typically register for a combination of course credits and research credits (MatSE 600) in order to meet the full-time requirements.

Ph.D. students who have passed the comprehensive exam and are working full-time on their thesis should register for noncredit MatSE 601. Students working part-time on their thesis should register for MatSE 611. Students may take MatSE 601 plus up to 3 additional credits of course work *for audit* by paying only the dissertation fee. Students wishing to take up to 3 additional credits of course work for credit with 601 may do so by paying the dissertation fee and an additional flat fee. Enrolling for either 3 credits for audit or credit is the maximum a student may take along with MatSE 601, without special approval by the Graduate School. Students wishing to take more than 3 additional credits of course work must register for MatSE 600 or MatSE 611 (i.e., not for 601, which is full-time thesis preparation).

Summer Semester

Registration during the summer is not required; however, if a student wants to take a course for credit or audit during the summer they should register for Summer Tuition Assistance (through the IGDP MatSE Graduate Office) if he/she has been on a fellowship or an assistantship during the previous fall and spring semesters. If a Ph.D. student is taking his/her comprehensive exam during the summer, he/she should register for summer tuition assistance and schedule a minimum of 1 credit of MatSE 600. If a Ph.D. student is defending his/her thesis during the summer he/she should apply for summer tuition assistance and register for noncredit MatSE 601.

For students who are required to take a minimum number of credits (e.g., international students), it is important to note that audited courses do not count in this total. All graduate students are expected to register for MatSE 590 (graduate seminar); those who have passed their comprehensive exam are required to attend the seminar but should register for the course as an audit, which can be done by contacting the IGDP MatSE Graduate Office. All graduate students beginning their studies in Fall 2009 or later are also required to complete an online training program in the responsible and ethical conduct of research and register for the 1-credit MatSE 582 course (Materials Science and

Engineering Professional Development) within their first year of study in order to fulfill the requirements described in the Scholarship and Research Integrity (SARI) section of this document.

Graduate Degree Requirements

Master of Science Degree: Thesis-Based Program

The program for the M.S. degree must include a total of at least 30 credits. Subject to the approval by the graduate program chair or co-chair and the graduate school, a maximum of 10 credits of high-quality graduate work conducted at an accredited U.S. institution may be applied toward the requirements for the master's degree, provided that those credits had not already been applied toward a previous degree. A minimum of six research credits (MatSE 600) is required. The *minimum* number of formal course credits required is 18 [*excluding* MatSE 590 and 600], with a minimum of 12 credits at the 500-level [*excluding* MatSE 590 and MatSE 582 Professional Development]. Effective Fall 2011, the instructional program includes three required graduate core courses in materials including Thermodynamics of Materials (MATSE 501), Kinetics of Materials Processes (MATSE 503) and Principles of Crystal Chemistry (MATSE 512). Any substitution of courses must be approved by the graduate program chair or co-chair. All candidates for advanced degrees are also expected to attend the MatSE 590 colloquium unless they have a schedule conflict with a course in which they are enrolled.

The Graduate School requires that all candidates for advanced degrees complete training in Scholarship and Research Integrity (SARI). The SARI requirements for the IGDP MatSE program include completion of an online Responsible Conduct of Research training program and a 1-credit Professional Development course (MATSE 582). Students should complete the SARI requirements by the end of their first year of study.

A thesis describing independent research performed by the student shall be written and defended in an oral examination. Bound copies will be made available for the University Library and the thesis advisor. A thesis committee will administer the final oral examination of the thesis. The M.S. committee will consist of a minimum of three (3) graduate faculty members. At least two (2) of these must be members of the IGDP MatSE graduate faculty. The student (in conjunction with his/her advisor) will recommend appropriate members for the committee. *Students intending to*

graduate in a particular semester must activate their intent to graduate, submit the thesis for format review, and submit a final version of the thesis to the graduate school by the specific dates listed on the graduate school website.

Table 1 below summarizes the M.S. degree requirements.

Table 1. Summary of M.S. Requirements

	Requirements
Minimum total credits	30
Minimum research credits	6
Minimum formal course credits	18
Minimum 500-level credits (excluding MATSE 582 and 590)	12
Core Graduate Course credits (students beginning Fall 2011 or later)	9
Seminar	2 credits/year
Scholarship and Research Integrity (students beginning Fall 2009 or later)	On-line training and 1 credit MatSE 582 “Materials Science and Engineering Professional Development”
Minimum GPA for graduation	3.0
Thesis requirement	A written thesis and an oral defense administered by a committee of 3 faculty members with at least 2 from the IGDP MatSE graduate program

Doctoral Degree Requirements

General requirements are based upon completing the required course work, passing the qualifying examination, a period of residence, passing the comprehensive examination, the writing of a satisfactory thesis (and its acceptance by the doctoral committee and the Graduate School). A doctoral program consists of a combination of courses and research that fulfills the requirements of the Graduate School, and is approved by the student's doctoral committee. A master's degree is not a prerequisite for the doctorate. However, the first year of graduate study leading to the Ph.D. may be the same as that for the M.S. degree. Acceptance into the Ph.D. program is based on the student's performance on the Ph.D. qualifying exam, which is administered by a graduate qualifying exam committee. Although there is no specified graduate school requirement for the number of course credits required for a Ph.D. degree, the IGDP MatSE program requires a *minimum* of 18 credits of 500-level courses [*excluding* MatSE 590 and MatSE 582 Professional Development] for completing a doctoral degree. The instructional program includes three required graduate core courses in materials: Thermodynamics of Materials (MATSE 501), Kinetics of Materials Processes (MATSE 503), and Principles of Crystal Chemistry (MATSE 512). Any course substitution must be approved by the graduate program chair. Additional courses are determined by the student and the advisor, in consultation with the student's doctoral committee. A student with the M.S. degree from Penn State can use the 500-level credits earned during his or her M.S. study to (partially) fulfill the course requirement.

The Graduate School requires that all candidates for advanced degrees complete training in Scholarship and Research Integrity (SARI). The SARI requirements for the IGDP MatSE program include completion of an online Responsible Conduct of Research training program and a 1 credit Professional Development course (MATSE 582). Students should complete the SARI requirements by the end of their first year of study.

Qualifying Examination

Successful completion of a qualifying examination is required for formal admission into the IGDP MatSE Ph.D. program. The exam is scheduled each Fall and Spring semester. It is recommended that the exam be taken after at least 12 credits of formal coursework have been earned beyond the

B.S. degree. The examination must be taken within three semesters (excluding summer sessions) of entry into the doctoral program.

Students will write a research proposal meeting the following requirements:

- The document will summarize background information and briefly review the literature as appropriate to motivate the proposal hypothesis/objective.
- The document will list either an overarching HYPOTHESIS for a scientific proposal or an OBJECTIVE statement for an engineering/synthetic proposal.
- The document will succinctly list up to three (3) specific aims/tasks that test the stated hypothesis or accomplish the stated objective. Aims/tasks will directly follow hypothesis/objective statement.
- The document will be written in the 3rd person.
- The document should not exceed ten (10) pages (excluding references), double spaced, written in Times New Roman or Arial 12-point font with embedded figures no smaller than 1.25" in the shortest dimension. Figures must be sequentially numbered and include captions. Page margins must be no smaller than 1" all around.
- Documents failing to meet guidelines will be returned to candidate ungraded and candidate will reschedule qualifying exam for the next round.

Students have 1.5 hours for an oral presentation to three members of the program qualifying committee, whose members will ask questions about the proposal and other topics related to the student's knowledge and critical thinking ability in materials science and engineering. The student will choose one of three topics for the proposal provided by the faculty committee. These topics will be chosen to reflect the interest area(s) of the individual candidate. Students will be given 3 weeks to write the proposal and turn it in to the IGDP MatSE Graduate Office in electronic form. An additional week is provided when the exam is scheduled over the winter break to allow students time off. *The proposal must be prepared and written by the candidate alone.*

The qualifying committee is populated by the faculty members of the graduate program, including a chair. A sub-committee of three faculty members will evaluate each candidate. Members of the student's sub-committee will be selected on the basis of relevant expertise and to avoid conflict of interest. If the exam is not passed on the first try, it must be taken again within the next year. If the student does not pass on the second try, he/she will not be permitted to enter the IGDP MatSE Ph.D. program.

Additional details:

- a) To register for the Ph.D. qualifying exam, students will provide the IGDP MatSE grad office with an electronic version of a completed application form by the deadline announced prior to the start of classes for that semester. The application will include the name of the student's adviser, degrees received, current thesis topic, classes taken to date (including ESL courses) and grades, plans for future coursework, and an abstract of current research (between one and two pages). The application can be obtained from the graduate office and is also available on the website.
- b) At least one member of each student's sub-committee must have expertise in the student's general area(s) of interest.
- c) The qualifying exam sub-committees will establish 3 possible paper topics for each student. These topics will be communicated to the students 5-6 weeks before the start of the semester on a date provided to the students at the time of registering for the exam. The paper is due 3 weeks from that date. The paper must be delivered in electronic format to the grad office.
- d) The paper should be in the form of a proposal. Students are directed to provide background to the area/problem, a hypothesis for the proposed study, and evaluation/testing of the hypothesis. It is important that the paper address the problem in scientific/engineering depth.
- e) The oral presentation and questioning of the student's proposal will generally take place during the first week of classes. Questioning can range from topics in the paper, presentation, and prior coursework. The IGDP MatSE grad office will coordinate the timing and location of student presentations to their sub-committees, which are to be held approximately a week to 10 days after the paper is received in the grad office.
- f) The qualifying exam committee decides whether the student has passed, failed, or passed provisionally, along with any coursework recommendations.
- g) Regardless of the outcome of the exam the student is required to meet with the chair of the committee to discuss the exam and any recommendations. The chair and the student are required to sign the form to finalize the exam result.
- h) Assessment of English competency (written and oral) will also take place at the qualifying exam. This separately scored assessment applies to both native and non-native speakers of English. If the committee decides that English competency is unsatisfactory, the student will be required to take coursework (in ESL or ENGL) and receive a grade of B or higher. This coursework could include but is not limited to ESL 114G (American Oral English for Academic Purposes), ESL 116G (Composition for Academic Disciplines), CAS 100 (Effective Speech), or ENGL 418 (Advanced Technical Writing and Editing).
- i) Also, please note that all ESL courses required as a condition of provisional admission must be taken and passed before taking the qualifying exam.
- j) Plagiarism will not be tolerated. Please see Penn State's statement on plagiarism and academic dishonesty. <http://academicintegrity.psu.edu>

Ph.D. Committee Formulation

The Ph.D. Committee will be appointed by the Dean of the Graduate School upon the recommendation/request of the IGDP MatSE chair or co-chair, in consultation with the student's advisor. This should be done within six months of passing the qualifying exam or completion of the M.S. thesis. For students entering with a Master's degree from another university, the committee should be chosen within six months of enrolling at Penn State. The Ph.D. Committee must consist of a minimum of four members of the Graduate Faculty, including at least two from the IGDP MatSE Graduate Faculty. The committee must contain at least one representative from outside the student's major field. This point requires clarification for an Intercollege Graduate Degree Program: the "outside" member of the student's committee is a faculty member from a Department that differs from the student's advisor's tenure home. The committee chair will normally be an IGDP MatSE faculty member, generally the student's research advisor. If the student is pursuing a minor, a representative from the minor field should be on the committee. Persons from outside of Penn State can be members of the Ph.D. Committee with special approval (see Graduate Degree Programs Bulletin): <http://www.psu.edu/bulletins/whitebook/>.

Comprehensive Examination

The purpose of the comprehensive exam is to ensure that the student has developed a comprehensive and integrated knowledge in the field and has developed a sound plan for doctoral thesis research. Students should take the comprehensive exam as soon as possible after completing coursework requirements and passing the qualifying exam. It is appropriate to take the comprehensive exam before preliminary work for the thesis proposal has been published. It is also desirable to take the exam before work is too far along to take full advantage of feedback from the committee at all stages of the project. Although prior versions of the handbook have stipulated that the comprehensive exam should be completed no later than the 7th semester, students are encouraged to do so even earlier.

The comprehensive exam consists of a written review of the student's thesis research and future research plans, and their defense in an oral presentation. The exam involves a research progress report, plans for further work, and a review of academic progress. The committee shall make recommendations for modifying the research plan, alerting the student to related work, and identifying unforeseen pitfalls. In addition, the committee may recommend additional research

and/or coursework at this time. *The student must complete paperwork to schedule the comprehensive exam and receive approval from the graduate school at least two weeks before the exam. Please contact the IGDP MatSE graduate office to schedule the exam. Also, students must be registered during the semester that they take the comprehensive exam.*

Unlike the qualifying exam, the proposal for the comprehensive exam should be prepared with guidance from the student's thesis advisor. It is commonplace for the thesis advisor to review versions of the document and make suggestions prior to its distribution the committee members. More detailed requirements for the comprehensive examination proposal are listed below:

1. Broad Guidelines

- Report not to exceed twenty (20) pages (excluding cover page, citations and appendix), double spaced, written in Times New Roman or Arial 12-point font with embedded figures no smaller than 1.25" in the shortest dimension. Figures must be sequentially numbered and include captions. Margins no smaller than 0.5" all round.
- Report distributed to committee no less than 2 weeks before exam date.
- Exam includes a 30-minute presentation introducing research topic and summarizing important outcomes, ending with a statement of aims/tasks required to complete dissertation work with a timeline leading to projected date of thesis defense.

2. Comprehensive Report Outline

I. Cover page

- a. Title
- b. Exam date/time/place
- c. Author address and contact information

II. Dissertation Overview

- a. ~1-2 pages summarizing project rationale: scientific contributions and/or socioeconomic benefit
- b. Itemized descriptive list (itemized paragraphs) of significant research accomplishments to date
- c. Itemized descriptive list of publications in print, press, or submitted (not to include planned publications or in preparation)

III. Introduction

- a. Introduces thesis topic background written in terms broadly understandable by faculty who are not directly involved in this research

IV. Hypothesis or Project Objective Statement

- a. Statement of overarching hypothesis OR objective
- b. Expected outcomes

V. Brief Overview of Methods and Materials

- a. Key experimental/theoretical methods required to understand how work has been done and/or will be completed

VI. Key Findings

- a. Succinct paragraphs highlighting significant research results

VII. Ongoing Research and Future Work

- a. Itemized descriptive list of specific aims/tasks to complete dissertation work
- b. Timeline leading to projected date of thesis defense

VIII. References

IX. Appendix

- a. Copies of papers in print, press, or submitted to a journal (not including papers in preparation)

Summary of Ph.D. Degree Requirements

<p>Qualifying exam (Offered twice a year at the beginning of Spring and Fall semesters)</p>	<p>Successful completion of a qualifying examination is required for formal admission into the IGDP MatSE Ph.D. program. The exam is scheduled each Fall and Spring semester. It is recommended that the exam be taken after completion of at least 12 graduate course credits which includes the 9 credits of required graduate core courses.</p> <p>Students will write a research proposal (<i>maximum</i> of 10 pages of text, including references and figures) and give a 20-minute oral presentation to three members of the program Qualifying Exam Committee, whose members will ask questions about the proposal and other topics related to the student's prior coursework. The student will choose one of three topics for the proposal provided by the faculty committee. These topics will be chosen to reflect the interest area(s) of the individual candidate. Students will be given 3 weeks to write the proposal and turn it in to the grad office in electronic form. <i>This proposal must be prepared and written by the candidate alone.</i></p>
<p>Minimum formal course work requirements</p>	<p>18 credits of 500-level courses after B.S. [<i>excluding</i> MatSE 590 and MatSE 582 Professional Development].</p> <p>The instructional program includes three required graduate core courses in materials including Thermodynamics of Materials (MATSE 501), Kinetics of Materials Processes (MATSE 503) and Principles of Crystal Chemistry (MATSE 512). Any substitution of courses must be approved by the graduate program chair or co-chair.</p> <p>Additional courses to be taken are determined by the student, their advisor, and a thesis committee made up of at least 4 faculty members, including a minimum of 2 faculty members from the program.</p>
<p>Comprehensive exam</p>	<p>Progress report and thesis proposal (administered by the student's Doctoral Committee)</p>
<p>Seminar</p>	<p>2 credits of MatSE 590/year</p>
<p>Scholarship and Research Integrity (<i>students beginning Fall 2009 or later</i>)</p>	<p>Online training and 1-credit MatSE 582 "Materials Science and Engineering Professional Development"</p>
<p>Minimum GPA</p>	<p>3.0</p>
<p>Thesis</p>	<p>A written thesis and an oral defense administered by the Doctoral committee</p>

Ph.D. Residency Requirements

There is no required minimum number of semesters of study, but over some twelve-month period during the interval between passing the qualifying examination and completion of the Ph.D. program the candidate must spend at least two semesters (which may include the semester in which the qualifying examination is taken) as a registered full-time student (at least nine credits) engaged in academic work on the University Park campus.

Ph.D. Continuous Registration Requirements

After a student has passed the comprehensive examination *and* has met the two-semester residence requirement, no further registration for courses is required by the Graduate School. *However, status as a student must be maintained by registering continuously each Fall and Spring semester (beginning with the first semester after both of the requirements mentioned above have been met) until the thesis is accepted by the Doctoral Committee.* Information on the registration requirements for students who have passed the comprehensive exam is included in the *Course Registration* section of this document.

If a Ph.D. student will not be in residence for an extended period for compelling reasons, the Dean of the Graduate School will consider a petition for a waiver of the continuous registration requirement. The petition must come from the Doctoral Committee chair and carry the endorsement of the graduate program chair or co-chair.

Final Oral Examination

Upon completion of the thesis, the Doctoral Committee examines the thesis and administers the final oral examination. The student and advisor are responsible for assuring that the defense draft of the thesis is complete, of acceptable format for the Graduate School, and in a form acceptable for evaluation by the committee, no later than two weeks prior to the defense date. *The student must complete paperwork to schedule the oral defense and receive approval from the graduate school at least two weeks in advance of the exam date. Please contact the IGDP MatSE graduate office to schedule the Ph.D. defense. Also note that students must be registered during the semester that they complete the thesis defense as described in the Course Registration section of this handbook. Students intending to graduate in a particular semester must activate their intent to graduate, submit the thesis for format review and submit a final version of the thesis to the graduate school by the specific dates listed on the graduate school website.* After the defense, the committee then makes recommendations as to the student's status (pass/fail) to the IGDP MatSE Graduate Office and Graduate School. When a period of more than six years has elapsed between the passing of the comprehensive examination and the completion of the thesis defense, the student is required to pass a second comprehensive examination before the final oral examination will be scheduled.

Annual Evaluations

The goal of the annual assessment is to evaluate student progress toward the degree and in meeting the Graduate Council's Scholarly and Professional Goals for all graduate degree students.

The faculty advisor is required to provide a written evaluation of the student's progress in academics and research (signed by both the advisor and the student) to the IGDP MatSE Graduate Office on an annual basis. This typically occurs during the spring semester. The Annual Evaluation should also be discussed with the student's Ph.D. committee, if formed.

Graduate School Information

General

The graduate catalog GRADUATE DEGREE PROGRAMS BULLETIN is the best source of information on the procedures and regulations of the Graduate School. The Graduate Degree Program Bulletin can be found on the web at <http://www.psu.edu/bulletins/whitebook/>. A student is expected to assume responsibility for knowing the regulations and procedures.

The Registrar's Office (863-8500), 112 Shields Building, is responsible for student course registration, commencement exercises, and the processing of student transcripts.

THE THESIS GUIDE, prepared by the Thesis Office, 115 Kern Building (865-5448) contains technical information and Graduate School format requirements for writing and submitting a thesis. The Thesis Guide can be found on the web at <http://www.gradsch.psu.edu/current/thesis.html>. The Thesis and Publications Office located in 115 Kern Building is also available for consulting on specific problems you may encounter in presenting your work.

Academic Credit and Appointments

The IGDP MatSE Program requires students on an assistantship to be registered as full-time status as described in the Course Registration section of this document. Maintenance of the established credit loads and responsibility for the consequences of a graduate student's change of course load rests with the student. The course load is a factor in determining whether a graduate student is classified as a full-time or part-time student, has met residence requirements, and is eligible to hold a fellowship, scholarship, assistantship, or departmental appointment. Students holding fellowships, traineeships, or other awards based on academic excellence are required to carry nine or more credits each semester.

Code of Conduct/Climate Issues

The Office of Student Conduct on campus handles a variety of issues concerning code of conduct. For more information regarding this very important and sometimes sensitive issue, please go to their

website: <https://studentaffairs.psu.edu/conduct>

Scholarship and Research Integrity (SARI)

Penn State is committed to modeling, teaching and promoting responsible conduct of research (RCR) within the University community. Research integrity is fundamental to good research and crosses all disciplines and areas of focus. The recent AMERICA Competes Act, which was signed into law in 2007, includes a requirement that graduate students who are supported as research personnel on National Science Foundation awards receive training in the responsible conduct of research. This regulation adds to existing requirements from the National Institutes of Health mandating RCR education for all graduate students and postdocs supported by National Research Service Awards.

As research has become more complex, more collaborative, and more costly, issues of research ethics have become similarly complex, extensive, and important. The education of graduate students at Penn State must prepare students to face these issues in their professional lives. The SARI (Scholarship and Research Integrity) program at Penn State is designed to offer graduate students comprehensive, multilevel training in the responsible conduct of research, in a way that is tailored to address the issues faced by individual disciplines.

The SARI program implemented by the IGDP MatSE program consists of two parts: an online training program to be completed in the first year of graduate study followed by five hours of discussion-based RCR education which the student will fulfill by registering and completing the 1 credit MatSE 582 course *Materials Science and Engineering Professional Development* offered each fall semester. The students will receive instructions from the IGDP MatSE Graduate Office on the procedure to be followed to complete the online training program. SARI training is required of all graduate students who begin their studies in Fall 2009 or later. Additional information on the SARI program is available on the Penn State Office of Research Protections website (www.research.psu.edu/orp).

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