

MATERIALS SCIENCE AND ENGINEERING

UNIVERSITY OF DELAWARE

POLICY STATEMENT SUMMARY FOR MASTER OF MATERIALS SCIENCE AND ENGINEERING AND DOCTOR OF PHILOSOPHY IN MATERIALS SCIENCE AND ENGINEERING

November 2016

Graduate degrees (M.M.S.E. and Ph.D.) in Materials Science and Engineering are offered by the interdisciplinary Department of Materials Science and Engineering of the College of Engineering.

The requirements for the M.M.S.E. and Ph.D. are described in the following document “Academic Requirements for Advanced Degrees in Materials”.

A student entering the Materials Science and Engineering Graduate Program normally possesses a bachelor’s (or higher) degree in a physical science or engineering discipline. A successful candidate for admission would minimally have taken courses to the following levels: mathematics, through partial differential equations; physics, including mechanics, heat, electricity, magnetism and introductory modern physics; chemistry, through physical chemistry; and introduction to materials science. In addition, courses in thermodynamics, field concepts, phase transformations, and structure and mechanical properties of materials are considered very useful.

Students who have not yet completed their bachelor’s degree may only be admitted under a special program, such as the 4+1 program for qualified UD undergraduates or in another joint program (e.g. 3+2) for schools with which an articulation agreement is in effect. The admissions requirements for these programs are otherwise the same as for other applicants as delineated below.

Admission requirements are normally (1) completion of a bachelor’s program with a GPA

of at least 3.2, (2) competitive GRE score of at least 155 or higher for Quantitative and 300 or higher for Quantitative + Verbal and for applicants with the older GRE test – at least 700 for Quantitative and 1200 or higher for Quantitative + Verbal, (3) three excellent letters of recommendation from faculty or scholars. Admission decisions are made by the Materials Science and Engineering Faculty on the advice of its Chairperson and/or Graduate Admissions Committee.

Admission to the graduate program is competitive. Those who meet stated requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer other appropriate strengths.

The Master’s thesis must be accepted by both the research advisor and the Chairperson of the Materials Science and Engineering Faculty. A formal defense of the Master’s thesis before the committee may be required. The Ph.D. dissertation must be defended before the student’s advisory committee. That committee consists of the student’s research advisor and at least three other members, at least one of whom must be from outside of the Materials Science and Engineering Faculty. The Ph.D. Committee will be set up at the time of the student’s Ph.D. Qualifier, within the student’s first five semesters, and will meet with the student annually. The thesis or dissertation must meet the criterion of scholarly excellence and there must be no barriers to its publication.

Stipend and tuition support is awarded to meritorious students. The authorization of such support resides with the Chairperson of the Department.

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Academic Requirements for Advanced Degrees

In

**DEPARTMENT OF MATERIALS SCIENCE AND
ENGINEERING**

In order to receive an advanced degree, a student must satisfy both the University's basic requirements and the programmatic requirements given below. Deviations from the program outlined below may be authorized in writing by the faculty advisor to the Chairperson and to the Graduate Office in exceptional circumstances such as may apply for transfer students or students entering the Department in the Spring.

A. Degree of Master of Materials Science and Engineering

Two options are available, one with a thesis and the other by lecture course credit only. The first is available to all students. The second is intended for outreach or part-time students and does not require a thesis. Transfer between options is permitted only upon the recommendation of the student's research advisor and with the approval of the Department Chairperson and the Chair of the graduate committee.

Master of Materials Science and Engineering with Thesis

1. 26 credit hours of course work and 6 credit hours of thesis research are necessary for the thesis-option Master's degree (32 total credits required).

2. The following courses, totaling 12 credits, are required of all students. Equivalent courses may be substituted as approved by the faculty advisor and Chairperson:

MSEG 608	Structure and Properties of Materials I (3 credits)
MSEG 609	Structure and Properties of Materials II (3 credits)
MSEG 803	Equilibria in Materials Systems (3 credits)
MSEG 804	Kinetics in Materials Systems (3 credits)

3. Students must select a specialization and complete the required courses for that specialization

Soft Materials Specialization

MSEG 832	Principles of Polymer Synthesis (3 credits)
MSEG 833	Polymer Synthesis and Characterization Laboratory (3 cr.)
MSEG 835	Polymer Physics (3 credits)

Hard Materials Specialization

MSEG 640	Applied Quantum Mechanics I (3 credits)
MSEG 841	Solid State Materials I (3 credits)
MSEG 842	Solid State Materials II (3 credits)

Composite Materials Specialization

MSEG 832	Principles of Polymer Synthesis (3 credits)
MSEG 817	Composite Materials (3 credits)

4. The remaining 5-8 credits will be obtained with elective courses chosen after discussion with the faculty advisor, and will usually be related to the student's area of research. Courses required for a different specialization can be used as electives.
5. Six credit hours of thesis work must be completed, and the thesis must be accepted by the student's advisory committee and the Department Chairperson.
6. Students must complete the required credits of course work with an average GPA of 3.00 or higher.
7. All graduate students are expected to attend departmental seminars.
8. Master's Thesis: A thesis containing original results of the student's research effort must be presented and approved by the student's research advisor and the Department Chairperson.

Master of Materials Science and Engineering without Thesis

1. 30 credit hours of course work are required for the Master's degree without a thesis.

2. The following courses, totaling 12 credits, are required of all students. Equivalent courses may be substituted as approved by the faculty advisor and Department Chairperson:

MSEG 608 Structure and Properties of Materials I (3 credits)
MSEG 609 Structure and Properties of Materials II (3 credits)
MSEG 803 Equilibria in Materials Systems (3 credits)
MSEG 804 Kinetics in Materials Systems (3 credits)

3. Students must select a specialization and complete the required courses for that specialization

Soft Materials Specialization

MSEG 832 Principles of Polymer Synthesis (3 credits)
MSEG 833 Polymer Synthesis and Characterization Laboratory (3 cr.)
MSEG 835 Polymer Physics (3 credits)

Hard Materials Specialization

MSEG 640 Applied Quantum Mechanics I (3 credits)
MSEG 841 Solid State Materials I (3 credits)
MSEG 842 Solid State Materials II (3 credits)

Composite Materials Specialization

MSEG 832 Principles of Polymer Synthesis (3 credits)
MSEG 817 Composite Materials (3 credits)

4. The remaining 9-12 credits will be obtained with elective courses chosen after discussion with the faculty advisor, and will usually be related to the student's research interests. Courses required for a different specialization can be used as electives.
5. Students must complete the required credits of course work with an average GPA of 3.00 or higher.
6. All graduate students are expected to attend departmental seminars.
7. Candidates for the Master's Degree without thesis must demonstrate their comprehensive knowledge of materials science by successfully completing a final project. The project consists of a written analysis and research project proposal on a topic chosen by the candidate and his/her advisor. The written report should contain **no more than 15 pages single-spaced (12-pt. Font)** not including the bibliography. The written report should cover at least the following topics/issues:
 - a. Motivation and Significance of the Research
 - b. Definition of the Critical Issues
 - c. Literature Search/Bibliography
 - d. Research Objectives
 - e. Outline of a feasible Experimental/Theoretical Approach
 - f. Anticipated Results

g. Potential Impact (scientific or technological)

The written report must be approved by the student's faculty advisor and the Department Chairperson.

B. Ph.D. Degree in Materials Science and Engineering

1. 24 credit hours of course work and 9 credit hours of dissertation research are required for the Ph.D. Degree (33 total credits required). The distribution of required credits is described below.
2. Direct entry to the Ph.D. Program without prior completion of a Master's Degree is available for suitably qualified candidates.
3. The department may waive the requirement for up to 18 credit hours of course work for students entering with a Master's Degree or credits for graduate course work performed at another recognized graduate school. Waivers will only be granted for courses that cover subjects eligible for credit toward a Ph.D. in Materials Science and Engineering from the University of Delaware. Requests for a course waiver must be initiated by the student before the beginning of their second semester at UD. Waivers must be approved by the Department Chairperson upon the recommendation of the Chair of the Department Graduate Committee and will be contingent on the student's demonstration of satisfactory performance in course work taken at UD.
4. The following courses, totaling 12 credits, are required. Equivalent courses may be substituted when approved by the faculty advisor and Department Chairperson:

MSEG 608 Structure and Properties of Materials I (3 credits)
MSEG 609 Structure and Properties of Materials II (3 credits)
MSEG 803 Equilibria in Materials Systems (3 credits)
MSEG 804 Kinetics in Materials Systems (3 credits)
5. Students may choose two course from the following four courses with their advisor (6 credits total required). Any students taking more than the required two courses may count those additional courses as technical electives.

MSEG 640 Applied Quantum Mechanics I (3 credits)
MSEG 841 Solid State Materials I (3 credits)
MSEG 832 Principles of Polymer Synthesis (3 credits)
MSEG 835 Polymer Physics (3 credits)

6. Technical Electives (two courses – 6 credits total required). These courses should be chosen with student’s advisor, and will usually be related to the student’s area of research. MSEG 868 – Research may not be taken as Technical Electives. At least one course must be an 800 level
7. Students must complete the required credits of course work with an average GPA of 3.00 or higher.
8. Up to six credit hours of research (MSEG 868), taken prior to the admission to Candidacy, may be counted towards your degree, but cannot count as technical electives.
9. After admission to Candidacy, the student must complete 9 credit hours of Dissertation MSEG 969.
10. All graduate students are expected to attend departmental seminars.
11. Qualifying examination: Candidates for the Ph.D. degree are required to demonstrate proficiency in the knowledge of materials science by passing the qualifying examination. This is administered at the request of the student/advisor and consists of a comprehensive written and oral research project review on a topic chosen by the candidate and his/her advisor. The written part should contain **no more than 15 pages single-spaced (12-pt. Font)**, not including the bibliography. The oral presentation should be approximately 30 minutes in length. Both the written and oral presentations should include, but are not limited to, discussion on the following topics/issues:
 - a. Motivation and Significance of the Research
 - b. Definition of the Critical Issues
 - c. Literature Search/Bibliography
 - d. Research Objectives
 - e. Outline of the Experimental/Theoretical Approach
 - f. Anticipated Results
 - g. Timeline (sequence of accomplishments and milestones)
 - h. Metrics to Determine the Successful Outcome of the Research
 - i. Relevant Supporting Preliminary Data
 - j. Potential Impact (scientific or technological)

The oral exam is designed to evaluate *comprehensive knowledge* in materials science and engineering, “soft” skills, e.g., communication, awareness of market-driven technology, etc., and the ability to organize and plan a project. Thus questions during the oral exam will not only be directed towards the research topic but can also be directed toward peripheral materials issues related to the proposed research. Full time students entering the Ph.D. program with a Master’s Degree are expected to take the qualifying examination and set up a Qualifier/Dissertation Committee in their first five semesters. Under certain circumstances, an extension is possible upon request to and approval of the research advisor and Department Chairperson. The Qualifier/Dissertation

Committee will contain the student's advisor(s) and at least three other faculty, at least one of whom is not a member of the Materials Science and Engineering Faculty. Within the first two years, students will be admitted to candidacy based on three criteria:

- a. Results of Qualifying Examination
- b. Successful completion of the required courses with a GPA of 3.00 or higher.
- c. Satisfactory research progress as determined by the candidate's Qualifier/Dissertation Committee.

Admission to candidacy decisions will be made by the Department Chairperson with advice from the Departmental Graduate Committee.

For those who enter the program with a M.S. or equivalent or those exceptionally well qualified students (with a B. S. degree or equivalent) wishing to directly enter the Ph.D. program, they will have until the end of January of their second year (a second and final chance by June 1 in the same year if performance on first exam is unsatisfactory) to take the Qualifying examination.

Part-time students entering with a B.S. degree take the qualifying examination no later than the sixth semester, and will then follow the above procedure with the expectation that admission to candidacy requirements be satisfied by the second year after the qualifying exam is taken.

12. Pre-Defense Meeting: Candidates are required to present their research to their Ph.D. Qualifier/Dissertation Committee. This meeting should take place 3-6 months before the anticipated graduation date, before the student has engaged in formal job applications and before the written dissertation is complete. The purpose of this meeting is to get the committee's input about whether the scope and quality of research conducted is appropriate for graduation in the near future, to provide guidance on further work required, and to guide the writing of the dissertation.
13. Dissertation: A dissertation containing original results of the student's research effort must be presented and approved by the Ph.D. Committee and the Department Chairperson.
14. Final Oral Examination: After an oral presentation open to all interested persons, the student will be examined on the dissertation by the Ph.D. Qualifier/Dissertation Committee. In addition to examining the results of the original research contained in the dissertation, the committee will pay particular attention that suggestions for future work shall constitute a well-formulated and coherent plan to extend the research significantly.