MATERIALS SCIENCE AND ENGINEERING

Graduate Program Head	John Mauro
Program Code	MATSC
Campus(es)	University Park (Ph.D., M.S.)
Degrees Conferred	Doctor of Philosophy (Ph.D.) Master of Science (M.S.) Dual-Title Ph.D. in Materials Science and Engineering and Biogeochemistry
The Graduate Faculty	View (https://secure.gradsch.psu.edu/gpms/?searchType=fac&prog=MATSC)

The Intercollege Graduate Degree Program in Materials Science and Engineering offers comprehensive graduate education in the fundamentals of materials science (synthesis-structure-property-performance relationships). Faculty have interests in many research areas including biomaterials, ceramics, composites and hybrids, computational materials science, electronic and photonic materials, materials chemistry and physics, metals, nanostructured and nanoscale materials, piezoelectrics and ferroelectrics, polymers and soft materials. 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.

Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (https://gradschool.psu.edu/graduate-admissions/how-to-apply/). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions Policies (https://gradschool.psu.edu/graduate-education-policies/).

Applicants with baccalaureate degrees in the physical sciences and engineering with a Junior/Senior grade point average of 3.2/4.0 or higher will be considered for admission.

Scores for the Graduate Record Examinations (GRE) are encouraged but not required for admission.

The language of instruction at Penn State is English. English proficiency test scores (TOEFL/IELTS) may be required for international applicants. See GCAC-305 Admission Requirements for International Students (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-300/gcac-305-admission-requirements-international-students/) for more information.

Degree Requirements

Master of Science (M.S.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (https://gradschool.psu.edu/graduate-education-policies/)

A minimum of 30 credits is required for the completion of the M.S. degree. At least 18 credits must be at the 500 or 600 level, and the remaining credits may be at the 400 or 800 level. There are 12 credits required in the following core courses:

Code	Title	Credits
Required Courses		
MATSE 501	Thermodynamics of Materials	3
MATSE 512	Principles of Crystal Chemistry	3
MATSE 542	Polymeric Materials: The Solid State	3
or MATSE 503	Kinetics of Materials Processes	
MATSE 582	Materials Science and Engineering Professional Development	1
MATSE 590	Colloquium	2
Electives		
The remaining elective credits may be chosen from a list of approved electives maintained by the program office.		12
Culminating Experience		
MATSE 600	Thesis Research	6
or MATSE 596	Individual Studies	
Total Credits		**30**

As a culminating experience for the M.S. degree, students may choose to complete either a thesis or a scholarly paper. Students who choose to complete a thesis must take at least 6 credits of thesis research (MATSE 600). A thesis describing independent research performed by the student must be written and defended at an oral examination. Bound copies will be made available for the University Libraries and the thesis adviser. A thesis committee will administer the final oral examination of the thesis. The committee must consist of at least three Graduate Faculty members. The thesis must be accepted by the committee members, the head of the graduate program, and the Graduate School, and the student must pass the thesis defense.

The non-thesis track is designed to be completed in 3 semesters, or one calendar year (fall, spring, and summer). Students in this program will be required to begin in the fall semester and be registered continuously until the culminating research experience is completed at the end of the summer. A research adviser will be assigned to students in their first semester. Students in the non-thesis option must write a satisfactory scholarly paper while enrolled in MATSE 596. A total of 6 credits of MATSE 596 will be taken, 1 credit each in the fall and spring, and 4 credits in the summer. It is expected that the scholarly paper will be submitted and approved at the end of the summer semester. Students who need more time to complete the final paper will be allowed to complete the paper, and have it reviewed and approved after the third semester has ended. Students are not required to remain in residence while they complete the final paper. However, extensions granted to students in this program must comply with the Graduate Council policy on deferred grades (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-400/grading-system/).

Doctor of Philosophy (Ph.D.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Policies. (https://gradschool.psu.edu/graduate-education-policies/)

A doctoral program consists of a combination of courses, seminars, and research that fulfills the minimum requirements of Graduate Council and is approved by the Ph.D. committee for each individual student. 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 provided 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 of the department.

A minimum of 18 credits of 500-level courses is required for completing a Ph.D. degree in Materials Science and Engineering, including 9 credits in required core courses:

Code	Title	Credits
Required Courses		
MATSE 501	Thermodynamics of Materials	3
MATSE 503	Kinetics of Materials Processes	3
MATSE 512	Principles of Crystal Chemistry	3

Ph.D. students are also required to take 2 credits of MATSE 590 each year, and complete MATSE 582; credits for MATSE 582 and MATSE 590 will not count towards the minimum 18 credits required. Additional specific course requirements are determined by the student and the adviser in consultation with the student's Ph.D. committee. A student with an M.S. degree from Penn State can use credits earned during his or her M.S. study to fulfill the Ph.D. course requirements. Upon approval by the Ph.D. committee and the graduate program coordinator, some or all of the course requirements may be waived for students holding an M.S. degree from another institution.

Dual-Titles

Dual-title Ph.D. in Materials Science and Engineering and Biogeochemistry

Requirements listed here are in addition to requirements listed in GCAC-208 Dual-Title Graduate Degree Programs (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-208-dual-titles/).

Admission Requirements

Students must apply and be admitted to the graduate program in Materials Science and Engineering and The Graduate School before they can apply for admission to the dual-title degree program. After admission to their primary program, students must apply for admission to and meet the admissions requirements of the Biogeochemistry dual-title program. Refer to the Admission Requirements section of the Biogeochemistry Bulletin page (http://bulletins.psu.edu/graduate/programs/majors/biogeochemistry/). Doctoral students must be admitted into the dual-title degree program in Biogeochemistry prior to taking the qualifying examination in their primary graduate program.

Degree Requirements

To qualify for the dual-title degree, students must satisfy the degree requirements for the degree they are enrolled in Materials Science and Engineering. In addition, students must complete the degree requirements for the dual-title in Biogeochemistry, listed on the Biogeochemistry Bulletin page (http://bulletins.psu.edu/graduate/programs/majors/biogeochemistry/).

The qualifying examination committee for the dual-title Ph.D. degree will be composed of Graduate Faculty from Materials Science and Engineering and must include at least one Graduate Faculty member from the Biogeochemistry program. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. There will be a single qualifying examination, containing elements of both Materials Science and Engineering and Biogeochemistry. Dual-title graduate degree students may require an additional semester to fulfill requirements for both areas of study and, therefore, the qualifying examination may be delayed one semester beyond the normal period allowable.

In addition to the general Graduate Council requirements for Ph.D. committees (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation/), the Ph.D. committee of a Materials Science and Engineering and Biogeochemistry dual-title Ph.D. student must include at least one member of the Biogeochemistry Graduate Faculty. Faculty members who hold appointments in both programs' Graduate Faculty may serve in a combined role. If the chair of the Ph.D. committee is not also a member of the Graduate Faculty in Biogeochemistry, the member of the committee representing Biogeochemistry must be appointed as co-chair. The Biogeochemistry representative on the student's Ph.D. committee will develop questions for and participate in the evaluation of the comprehensive examination.

Students in the dual-title program are required to write and orally defend a dissertation on a topic that is approved in advance by their Ph.D. committee and reflects their original research and education in Materials Science and Engineering and Biogeochemistry. Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. The dissertation must be accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School.

Minor

A graduate minor is available in any approved graduate major or dual-title program. The default requirements for a graduate minor are stated in Graduate Council policies listed under GCAC-600 Research Degree Policies (https://gradschool.psu.edu/graduate-education-policies/) and GCAC-700 Professional Degree Policies (https://gradschool.psu.edu/graduate-education-policies/), depending on the type of degree the student is pursuing:

- GCAC-611 Minor - Research Doctorate (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-611-minor-research-doctorate/)
- GCAC-641 Minor - Research Master's (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/gcac-641-minor-research-masters/)
- GCAC-709 Minor - Professional Doctorate (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-709-professional-doctoral-minor/)
- GCAC-741 Minor - Professional Master's (https://gradschool.psu.edu/graduate-education-policies/gcac/gcac-700/gcac-741-masters-minor-professional/)

Student Aid

Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (https://gradschool.psu.edu/graduate-funding/) section of The Graduate School's website. Students on graduate assistantships must adhere to the course load limits (https://gradschool.psu.edu/graduate-education-policies/gsad/gsad-900/gsad-901-graduate-assistants/) set by The Graduate School.

Graduate assistantships are not available to students in the accelerated MATSC M.S. track.

Courses

Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Materials Science and Engineering (MATSE) Course List (https://bulletins.psu.edu/university-course-descriptions/graduate/matse/)

Learning outcomes

Master of Science (m.S.)

1. **KNOW:** Demonstrate appropriate breadth and depth of fundamental knowledge in materials science and engineering.
2. **THINK:** Review and critically analyze the ideas of other scientists and engineers, especially those addressing problems closely related to their own research.
3. **APPLY/CREATE:** Apply the scientific method using laboratory, computational and/or theoretical techniques to create new knowledge in material science and engineering or to design new materials.
4. **COMMUNICATE:** Effectively communicate unanswered questions about materials in writing and oral presentations; express the scientific and societal impact of their work; and disseminate new knowledge through archived publications, such as articles and theses.
5. **PROFESSIONAL PRACTICE:** Employ the highest ethical and professional standards, and the best practices in laboratory safety, in all research and academic endeavors.

Doctor of Philosophy (Ph.D.)

1. **KNOW:** Demonstrate appropriate breadth and depth of fundamental knowledge in materials science and engineering.
2. **THINK:** Review and critically analyze the ideas of other scientists and engineers, especially those addressing problems closely related to their own research.
3. **APPLY/CREATE:** Apply the scientific method using laboratory, computational and/or theoretical techniques to create new knowledge in material science and engineering or to design new materials.
4. **COMMUNICATE:** Effectively communicate unanswered questions about materials in writing and oral presentations; express the scientific and societal impact of their work; and disseminate new knowledge through archived publications, such as articles and theses.
5. **PROFESSIONAL PRACTICE:** Employ the highest ethical and professional standards, and the best practices in laboratory safety, in all research and academic endeavors.

Contact

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