

MATERIALS SCIENCE AND ENGINEERING, MSE

The master's program in Materials Science and Engineering prepares students to be leaders, innovators, and visionaries in the materials revolution that is being driven by discoveries that cross the boundaries of physics, chemistry, engineering and biology, such as in the growing fields of nanobioscience, nanophotonics and optoelectronics.

Penn is one of the first universities to establish a center for materials research. By remaining at the forefront of technology innovations, this center, the Laboratory for Research on the Structure of Matter (LRSM), has grown to be one of the largest in the nation. We are opening up new fields in materials science, preparing tomorrow's leaders, and putting our knowledge to practical use in today's high-tech society. Our multidisciplinary program allows you to tailor your education to your own professional and career goals, from ceramics, polymers, and metals to non-structured and soft materials. Our graduates can be found in positions in industries that range from electronics, manufacturing, and communications to transportation and energy, or pursuing doctoral degrees at Penn and other top-ranked research universities.

For more information: <https://mse.seas.upenn.edu/>

Curriculum

10 course units are required for the MSE in Materials Science and Engineering.¹⁻⁵

Code	Title	Course Units
MSE Courses		
Select 5-7 from the approved list: ¹		5-7
MSE 5000	Experimental Methods in Materials Science	
MSE 5050	Mechanical Properties of Macro/Nanoscale Materials	
MSE 5060	Failure Analysis of Engineering Materials	
MSE 5070	Fundamentals of Materials	
MSE 5150	Mathematics for Materials Science	
MSE 5200	Structure of Materials	
MSE 5250	Nanoscale Science and Engineering	
MSE 5300	Thermodynamics and Phase Equilibria	
MSE 5360	Electronic Properties of Materials	
MSE 5400	Phase Transformations	
MSE 5450	Materials for Energy and Environmental Sustainability	
MSE 5500	Elasticity and Micromechanics of Materials	
MSE 5550	Electrochemical Engineering of Materials	
MSE 5610	Atomic Modeling in Materials Science	
MSE 5650	Fabrication and Characterization of Micro and Nanostructured Materials	
MSE 5700	Physics of Materials I	
MSE 5750	Statistical Mechanics	
MSE 5800	Introduction to Polymers	
MSE 6100	Transmission Electron Microscopy	
MSE 6110	Advanced Synchrotron and Electron Characterization of Materials	

MSE 6400	Optical Materials	
MSE 6500	Mechanics of Soft and Biomaterials	
MSE 7900	Selected Topics in Materials Science and Engineering	
Electives		
Select up to 2 Electives and 2 SEAS courses relevant to materials science; a sample list is provided below: ⁵		4
CBE 5350	Interfacial Phenomena	
CIT 5900	Programming Languages and Techniques	
EAS 5100	Technical Communication and Academic Writing for Non-native Speakers of English	
EAS 5460	Engineering Entrepreneurship II	
ENM 5110	Foundations of Engineering Mathematics - II	
ESE 5210	The Physics of Solid State Energy Devices	
ESE 5360	Nanofabrication and Nanocharacterization	
PHYS 5518	Introduction to Condensed Matter Physics	
Total Course Units		10

Non-thesis or Thesis option:

- **Non-thesis course-based option:** Students successfully complete 10 course units at the 500 or higher level. All must carry a letter grade (A, B, C or D).
 - Students must secure written approval for all course selections from the Masters Program Advisor. Furthermore, all changes to these course selections must be approved in writing by the Masters Program Advisor. Students wishing to take courses not listed on the provided list are required to receive written approval from the Masters Program Advisor. All non-elective courses should have technical/scientific content relevant to the student's M.S.E. degree program.
 - 5 MSE courses (500 level or higher) requiring a letter grade are compulsory. Up to 7 MSE courses are highly recommended for obtaining a solid background in materials science. 3 MSE courses are compulsory in the first semester of study.
- **Non-thesis option with independent study:** Students take 8 courses credits at the 500 or higher level earning letter grades and complete 2 Masters Independent Study (MSE 59900) credits. Students receive a letter grade (A, B, C, D or F) in MSE 599. Independent Study requires a faculty advisor; see detail below about selecting an advisor.
 - Students interested in pursuing the non-thesis option with independent study or the thesis option are encouraged to attend Faculty Research Presentations in the late August and September. Students can also meet with individual faculty and the Master's Program Advisor to discuss their research interests.
- **Thesis option:** Students take 7 course units at the 500 or higher level earning letter grades and complete 3 course units of research with a faculty member by registering for two research credits (MSE 59700 Masters Thesis Research) and 1 Independent Study (MSE 59900). Students receive a letter grade (A, B, C, D or F) in both MSE 597 and MSE 599. Students must have their thesis approved by their thesis advisor and the Graduate Group Chair, as well as submit their thesis to the Graduate Group Coordinator. The thesis option requires a faculty advisor; see details below about selecting an advisor.

1

A maximum of two free electives (500 level or higher) are permitted. Free electives can be selected from across the university, including SEAS, SAS and Wharton. Also, free electives are not permitted for students pursuing a dual degree at Penn.

2

During the first semester, Masters degree students are not permitted to take Independent Study and are required to enroll in only MSE courses.

3

All Masters degree students must maintain a GPA of 2.7 or higher to be in good standing and for graduation. Students are required to attend weekly MSE seminars organized by the department as part of their education and exposure to latest scientific advances

4

Transfer of credits:

- A maximum of two graduate-level course units may be transferred from another school to apply toward the M.S.E. degree if approved by the Masters Program Advisor. These two courses cannot have been used in the fulfillment of an undergraduate degree.
- Sub-matriculants may count up to three 500 or higher level courses for both degrees.

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A maximum of two SEAS courses relevant to materials science are permitted. Note that only one Engineering Entrepreneurship course will count as a MSE related SEAS-course. A second entrepreneurship course will be counted as a free elective in addition.

Master's Scholars Program

A selected number of awards designated "Master's Scholars" will be made each year to deserving students to promote and enhance their research experience at Penn. The awards will enable highly motivated students (with a GPA of 3.25 or higher) to pursue a well-designed research project with a faculty member for one or two semesters and obtain valuable training in experimental and computational research. The award carries no financial benefit to the students; award funds are used solely to defray the costs of facility user fees, chemicals, computer resources, etc. Research proposals submitted by students will be evaluated and awards will be made on a competitive basis. A call for proposals occurs near the start of the fall and spring semesters.

The degree and major requirements displayed are intended as a guide for students entering in the Fall of 2022 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.
