

NANOTECHNOLOGY, MSE

Nanotechnology, the application of the science of the very small, is an exciting field that is enabling solutions in alternative energy, electronic devices, medical diagnostics and therapeutics. Penn's Nanotechnology Master's degree can prepare students for leadership roles, both technical and managerial, in emerging high tech industries as well as in traditional industries that exploit nanoscale phenomena.

For more information: <https://masters.nano.upenn.edu/>

Curriculum

10 course units are required for the MSE in Nanotechnology.^{1,2}

| Code | Title | Course Units |
|------------------------------|--|--------------|
| Required Courses | | |
| ENGR 5040 | Fundamental Concepts in Nanotechnology | 1 |
| ESE/MSE 5250 | Nanoscale Science and Engineering | 1 |
| ESE 5360 | Nanofabrication and Nanocharacterization | 1 |
| or MSE 5650 | Fabrication and Characterization of Micro and Nanostructured Materials | |
| Nanotechnology Core | | |
| Select 4 from the following: | | 4 |
| BE 5550 | Nanoscale Systems Biology | |
| CBE 5250 | Molecular Modeling and Simulations | |
| CBE 5350 | Interfacial Phenomena | |
| CBE 5450 | Electrochemical Energy Conversion and Storage | |
| CBE 5460 | Fundamentals of Industrial Catalytic Processes | |
| CBE 5550 | Nanoscale Systems Biology | |
| CBE 6410 | Transport Processes II (Nanoscale Transport) | |
| ESE 5100 | Electromagnetic and Optics | |
| ESE 5130 | Prin of Quantum Tech | |
| ESE 5210 | The Physics of Solid State Energy Devices | |
| ESE 5230 | Quantum Engineering | |
| ESE 5290 | Introduction to Micro- and Nano-electromechanical Technologies | |
| ESE 6110 | Nanophotonics: Light at the Nanoscale | |
| ESE 6210 | Nanoelectronics | |
| ESE 6250 | Nanorobotics | |
| ESE 6730 | Integrated Photonic Systems | |
| MSE 5050 | Mechanical Properties of Macro/Nanoscale Materials | |
| MSE 5200 | Structure of Materials | |
| MSE 5370 | Nanotribology | |
| MSE 5400 | Phase Transformations | |
| MSE 5500 | Elasticity and Micromechanics of Materials | |
| MSE 5550 | Electrochemical Engineering of Materials | |
| MSE 5610 | Atomic Modeling in Materials Science | |
| MSE 5700 | Physics of Materials I | |
| MSE 5750 | Statistical Mechanics | |
| MSE 6100 | Transmission Electron Microscopy | |

| | | |
|---|---|-----------|
| MSE 6110 | Advanced Synchrotron and Electron Characterization of Materials | |
| MSE 6400 | Optical Materials | |
| MEAM 5030 | Direct Energy Conversion: from Macro to Nano | |
| MEAM 5040 | Tribology | |
| MEAM 5050 | Mechanical Properties of Macro/Nanoscale Materials | |
| MEAM 5190 | Elasticity and Micromechanics of Materials | |
| MEAM 5290 | Introduction to Micro- and Nano-electromechanical Technologies | |
| MEAM 5370 | Nanotribology | |
| MEAM 5500 | Design of Microelectromechanical Systems | |
| MEAM 5550 | Nanoscale Systems Biology | |
| MEAM 5700 | Transport Processes I | |
| MEAM 5750 | Micro and Nano Fluidics | |
| MEAM 5800 | Electrochemistry for Energy, Nanofabrication and Sensing | |
| MEAM 6630 | Mechanics of Macromolecules | |
| Science or Technology-Relevant Electives | | |
| Select 3 pre-approved Science or Technology-Relevant electives ³ | | 3 |
| Total Course Units | | 10 |

1

Students must complete 10 course units at the graduate level (5000+)

2

Students must attend and submit reports on four technical seminars (two seminars per year for full-time students). Students are expected to present on seminars they attended during their first year to the new cohort of Nano students the following year.

3

Science or Technology-Relevant Electives:

- These courses may be chosen from: any SEAS course (including engineering entrepreneurship, technology policy, NANO 5970 Master's Thesis Research, special topics, and/or NANO 5990 Master's Independent Study, as well as technology-relevant courses from other Penn departments (typically physics, chemistry, math, biology, etc.).
- The courses must have significant technical and scientific content and relevance to the student's program.
- Approval must be obtained from the NANO program prior to enrollment in the course.

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.