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

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Course Units</th>
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<tbody>
<tr>
<td>ENGR 504</td>
<td>Fundamental Concepts in Nanotechnology</td>
<td>1</td>
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<tr>
<td>ESE/MSE 525</td>
<td>Nanoscale Science and Engineering</td>
<td>1</td>
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<tr>
<td>ESE 536</td>
<td>Nanofabrication and Nanocharacterization</td>
<td>1</td>
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<tr>
<td>or MSE 565</td>
<td>Fabrication and Characterization of Micro and Nanostructured Materials</td>
<td>1</td>
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Nanotechnology Core

Select 4 from the following: ⁴

- BE 555  Nanoscale Systems Biology
- CBE 525  Molecular Modeling and Simulations
- CBE 535  Interfacial Phenomena
- CBE 545  Electrochemical Energy Conversion and Storage
- CBE 546  Fundamentals of Industrial Catalytic Processes
- CBE 555  Nanoscale Systems Biology
- CBE 641  Transport Processes II (Nanoscale Transport)
- ESE 510  Electromagnetic and Optics
- ESE 513  Prin of Quantum Tech
- ESE 521  The Physics of Solid State Energy Devices
- ESE 523  Quantum Engineering
- ESE 529  Introduction to Micro- and Nano-electromechanical Technologies
- ESE 611  Nanophotonics: Light at the Nanoscale
- ESE 621  Nanoelectronics
- ESE 625  Nanorobotics
- MSE 505  Mechanical Properties of Macro/Nanoscale Materials
- MSE 520  Structure of Materials
- MSE 537  Nanotribology
- MSE 550  Elasticity and Micromechanics of Materials
- MSE 555  Electrochemical Engineering of Materials
- MSE 561  Atomic Modeling in Materials Science
- MSE 570  Physics of Materials I
- MSE 575  Statistical Mechanics
- MSE 611  Advanced Synchrotron and Electron Characterization of Materials
- MSE 640  Optical Materials

Science or Technology-Relevant Electives

Select 3 pre-approved Science or Technology-Relevant electives ³

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<tr>
<td>MEAM 504</td>
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<td>MEAM 537</td>
<td>Nanotribology</td>
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<tr>
<td>MEAM 550</td>
<td>Design of Microelectromechanical Systems</td>
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<tr>
<td>MEAM 555</td>
<td>Nanoscale Systems Biology</td>
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<tr>
<td>MEAM 570</td>
<td>Transport Processes I</td>
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<tr>
<td>MEAM 575</td>
<td>Micro and Nano Fluidics</td>
</tr>
<tr>
<td>MEAM 580</td>
<td>Electrochemistry for Energy, Nanofabrication and Sensing</td>
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</tbody>
</table>

Total Course Units 10

¹ Students must complete 10 course units at the graduate level (500+)
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 597 Master’s Thesis Research, special topics, and/or NANO 599 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 2021 and later. Students should consult with their academic program regarding final certifications and requirements for graduation.

2021-22 Catalog | Generated 08/18/21