MASTER OF ENGINEERING IN MATERIALS SCIENCE AND ENGINEERING WITH SPECIALIZATION IN ENERGY/ENVIRONMENT/ECONOMICS (E3)

The Energy/Environment/Economics (E3) program was developed to respond to the rapidly changing needs of the energy industry by providing the interdisciplinary research and training required to produce a new breed of engineer—one who specializes in energy technologies and who understands the associated environmental issues and economic forces that drive technology choices.

The E3 specialization requires an interdisciplinary graduate project in an E3 area. Graduate students in E3 should also be enrolled in fundamental courses related to the topics of energy, environment, and economics. E3 is designed primarily for students majoring in mechanical and aerospace, materials, chemical, environmental, or electrical engineering who are planning careers in energy-related fields. This interdisciplinary training prepares students to be not only creative and expert in a specialized area of energy extraction, conversion, or utilization, but also to possess a broad knowledge base of different energy sources, environmental issues related to energy extraction, conversion, and utilization, and of the impact of industrial ecology principles on the design and operation of energy systems. Furthermore, students will gain sufficient knowledge of economic and regulatory issues to enable them to make more viable technology choices.

General Degree Requirements
Students pursuing a master’s degree are required to take 30-32 credit hours beyond the requirements of a B.S. degree program. The curriculum consists of two components: department core courses that provide a strong background in basic principles of the chosen engineering field and E3 specialization courses. Selected E3 undergraduate courses may be substituted for graduate courses with the approval of the adviser, if the total undergraduate credit hours do not exceed departmental constraints.

Curriculum

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 543</td>
<td>Energy, Environment, and Economics</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 554</td>
<td>Electrical, Magnetic and Optical Properties of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 569</td>
<td>Advanced Physical Metallurgy</td>
<td>3</td>
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Select a minimum of one course from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>CHE 503</td>
<td>Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>CHE 553</td>
<td>Advanced Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 520</td>
<td>Advanced Thermodynamics</td>
<td>3</td>
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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>CHE 541</td>
<td>Renewable Energy Technologies</td>
<td>3</td>
</tr>
<tr>
<td>CHE 566</td>
<td>Electrochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 522</td>
<td>Nuclear, Fossil-Fuel, and Sustainable Energy Systems</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 523</td>
<td>Fundamentals of Power Generation</td>
<td>3</td>
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</table>

Non-Core Courses

Select a minimum of two courses from the following:

<table>
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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>MMAE 470</td>
<td>Introduction to Polymer Science</td>
<td>3</td>
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<tr>
<td>MMAE 525</td>
<td>Fundamentals of Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 561</td>
<td>Solidification and Crystal Growth</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 563</td>
<td>Advanced Mechanical Metallurgy</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 566</td>
<td>Problems in High-Temperature Materials</td>
<td>3</td>
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<tr>
<td>MMAE 579</td>
<td>Advanced Materials Processing</td>
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<tbody>
<tr>
<td>CHE 567</td>
<td>Fuel Cell Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>ENVE 501</td>
<td>Environmental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>ENVE 506</td>
<td>Chemodynamics</td>
<td>3</td>
</tr>
<tr>
<td>ENVE 542</td>
<td>Physiochemical Processes in Environmental Engineering</td>
<td>3</td>
</tr>
<tr>
<td>ENVE 551</td>
<td>Industrial Waste Treatment</td>
<td>3</td>
</tr>
<tr>
<td>ENVE 570</td>
<td>Air Pollution Meteorology</td>
<td>3</td>
</tr>
<tr>
<td>ENVE 577</td>
<td>Design of Air Pollution Control Devices</td>
<td>3</td>
</tr>
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</table>
### E3 Courses

See descriptions under the respective department’s course listings.

#### Group A

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>CHE 503</td>
<td>Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>CHE 536</td>
<td>Computational Techniques in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CHE 541</td>
<td>Renewable Energy Technologies</td>
<td>3</td>
</tr>
<tr>
<td>CHE 542</td>
<td>Fluidization and Gas-Solids Flow Systems</td>
<td>3</td>
</tr>
<tr>
<td>CHE 556</td>
<td>Fundamentals of Electrochemistry</td>
<td>3</td>
</tr>
<tr>
<td>ECE 550</td>
<td>Power Electronic Dynamics and Control</td>
<td>3</td>
</tr>
<tr>
<td>ECE 551</td>
<td>Advanced Power Electronics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 552</td>
<td>Adjustable Speed Drives</td>
<td>3</td>
</tr>
<tr>
<td>ECE 553</td>
<td>Power System Planning</td>
<td>3</td>
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<tr>
<td>ECE 554</td>
<td>Power System Relaying</td>
<td>3</td>
</tr>
<tr>
<td>ECE 555</td>
<td>Power Market Operations</td>
<td>3</td>
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<tr>
<td>ECE 557</td>
<td>Fault-Tolerant Power Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 558</td>
<td>Power System Reliability</td>
<td>3</td>
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<tr>
<td>ECE 559</td>
<td>High Voltage Power Transmission</td>
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<tr>
<td>ECE 560</td>
<td>Power Systems Dynamics and Stability</td>
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<tr>
<td>ECE 561</td>
<td>Deregulated Power Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 562</td>
<td>Power System Transaction Management</td>
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<tr>
<td>ECE 563</td>
<td>Computational Intelligence in Engineering</td>
<td>3</td>
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<tr>
<td>ECE 564</td>
<td>Control and Operation of Electric Power Systems</td>
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</tr>
<tr>
<td>MMAE 517</td>
<td>Computational Fluid Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 520</td>
<td>Advanced Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>MMAE 522</td>
<td>Nuclear, Fossil-Fuel, and Sustainable Energy Systems</td>
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</tr>
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<td>MMAE 523</td>
<td>Fundamentals of Power Generation</td>
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</tr>
<tr>
<td>MMAE 524</td>
<td>Fundamentals of Combustion</td>
<td>3</td>
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<tr>
<td>MMAE 525</td>
<td>Fundamentals of Heat Transfer</td>
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</tr>
<tr>
<td>MMAE 526</td>
<td>Heat Transfer: Conduction</td>
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</tr>
<tr>
<td>MMAE 527</td>
<td>Heat Transfer: Convection and Radiation</td>
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#### Group B

<table>
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<tr>
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<tbody>
<tr>
<td>CHE 541</td>
<td>Renewable Energy Technologies</td>
<td>3</td>
</tr>
<tr>
<td>CHE 560</td>
<td>Statistical Quality and Process Control</td>
<td>3</td>
</tr>
<tr>
<td>ENVE 501</td>
<td>Environmental Chemistry</td>
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</tr>
<tr>
<td>ENVE 506</td>
<td>Chemodynamics</td>
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<tr>
<td>ENVE 577</td>
<td>Design of Air Pollution Control Devices</td>
<td>3</td>
</tr>
<tr>
<td>ENVE 578</td>
<td>Physical and Chemical Processes for Industrial Gas Cleaning</td>
<td>3</td>
</tr>
<tr>
<td>ENVE 580</td>
<td>Hazardous Waste Engineering</td>
<td>3</td>
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