Energy Systems Engineering

The master of science in energy systems engineering is designed for students with undergraduate degrees in engineering or a closely related STEM discipline. The program will provide students opportunities to expand and strengthen their scholastic background and skills relative to the production, conversion, transmission and utilization of energy; carbon-based and “green” energy; renewable or alternate energy sources; energy storage, modeling and simulation of energy systems; and critical materials for energy generation and utilization.

Students enrolled and graduating from this program will fulfill a need for specially trained professionals to satisfy growing needs of governmental agencies and industrial companies in West Virginia, the region and the country for technical personnel with advanced training in specialized areas of energy systems and energy supply-chain management. The program will produce master's-level students who are able to function at the highest levels of expertise in their chosen sub-discipline of energy, and who are well versed in the overall concepts of getting energy to consumers.

The degree can be used as a terminal degree or prepare students, with unique perspectives in the field of energy, for prospective study in existing Ph.D. programs at WVU and other universities nationally and internationally.

FACULTY

COMMITTEE

- Kashy Aminian
- Roger Chen
- Bhaskaran Gopalakrishnan
- Hailin Li
- Yi Luo
- Jignesh Solanki

To enter the Energy Systems Engineering program, students are required to have, as a minimum, a B.S. degree in engineering or a closely related STEM discipline, single- and multi-variable calculus, calculus based introductory probability and statistics and a course in thermodynamics.

All students must submit a completed application accompanied by three letters of reference/recommendation.

- Students not having sufficient mathematics or calculus-based probability and statistics on thermodynamics coursework will only be admitted as provisional students and will not be admitted to regular student status until they meet these minimum coursework requirements.
- Applicants having a grade point average (GPA) of 3.0 or better (out of a possible 4.0) in all previous college work, and who meet all other admissions requirements will be admitted as regular graduate students.
- Applicants having a GPA less than 3.0 but greater than 2.75 in previous college work and who meets all other admission requirements may be admitted as provisional students.
- Applicants having a GPA below 2.75 in previous college work cannot be admitted without approval from the dean or designate. If admission would be granted, it would be a provisional admission.

Students admitted to provisional status must maintain a 3.0 GPA or better in their first semester.

The Graduate Record Examination (GRE) is not required for admission; however, high scores on the GRE will provide additional evidence that the applicant is qualified for admission.

A minimum score of 213 (equivalent to 550 on the former scale) on the Test of English as a Foreign Language (TOEFL) is required for all applicants from countries where the native language is not English. This requirement will be waived for students who have completed a recent four-year bachelor's degree in the United States. In some cases, it may be possible to consider applications from students who lack the adequate TOEFL scores but who will enroll in WVU's Intensive English Program.

Curriculum in Master of Science in Energy Systems Engineering

A candidate for the M.S. degree in energy systems engineering must comply with the rules and regulations as outlined in the WVU Graduate Catalog and the specific requirements of the Statler College and the specific department in which the student’s concentration is in.

Program Requirements

All M.S. degree candidates are required to perform research and follow a planned program of study. The student’s research advisor, in conjunction with the student’s Advising and Examining Committee (AEC) will be responsible for determining the plan of study appropriate to the student’s needs. The underlying principle of the planned program is to provide the students with the necessary support to complete their degree and prepare them for their career.
Curriculum Requirements

A minimum cumulative GPA of 3.0 is required in all courses.

Course Requirements

A minimum of 60% of courses must be from 500 level or above.

Extraction

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>MINE 411</td>
<td>Rock Mechanics/Ground Control</td>
</tr>
<tr>
<td>MINE 505</td>
<td>Integrated Mining Systems</td>
</tr>
<tr>
<td>MINE 611</td>
<td>Advanced Ground Control-Coal Mines</td>
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or any other approved course in the area of extraction

Conversion

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>CHE 414</td>
<td>Coal Conversion Engineering</td>
</tr>
<tr>
<td>MINE 427</td>
<td>Coal Preparation</td>
</tr>
<tr>
<td>MAE 438</td>
<td>Introduction to Gas Dynamics</td>
</tr>
<tr>
<td>MAE 528</td>
<td>Introduction to Fuel Cell Technology</td>
</tr>
<tr>
<td>MINE 627</td>
<td>Advanced Coal Preparation</td>
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</tbody>
</table>

or any other approved course in the area of conversion

Distribution/storage

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>EE 533</td>
<td>Computer Applications in Power System Analysis</td>
</tr>
<tr>
<td>PNGE 471</td>
<td>Natural Gas Production and Storage</td>
</tr>
</tbody>
</table>

or any other approved course in the area of distribution/storage

Utilization

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>MAE 424</td>
<td>Applications in Heat Transfer</td>
</tr>
<tr>
<td>MAE 425</td>
<td>Internal Combustion Engines</td>
</tr>
<tr>
<td>IEENG 433</td>
<td>Energy Efficiency and Sustainability</td>
</tr>
<tr>
<td>MAE 427</td>
<td>Heating, Ventilating, and Air Conditioning</td>
</tr>
<tr>
<td>MAE 525</td>
<td>Heavy Duty Vehicle Emissions</td>
</tr>
</tbody>
</table>

or any other approved course in the area of utilization

Technical Electives selected from the table of technical electives below.

Complete 1 of the following options:

- Thesis Option - 6 hours
  - Research (6 hours)
  - Written Research Proposal
  - Thesis
  - Final Oral or Written Examination

- Problem Report Option - 9 hours
  - Complete 6 additional hours of Technical Electives. A minimum of 12 credit hours of the 18 credit hours of technical elective course work must be taken in the Statler College.
  - Research (3 hours)
  - Written Research Proposal
  - Formal written report or professional report/paper
  - Final Oral or Written Examination

- Coursework Option - 9 hours
  - Complete 9 additional hours of Technical Electives.
  - Final Oral or Written Examination

Total Hours: 30-33

* Students who do not hold a baccalaureate degree in engineering may be required to take a set of undergraduate engineering courses above and beyond the minimum coursework requirements.
TECHNICAL ELECTIVES

Any 400 level or higher CE, CHE, CPE, EE, IENG, MAE, MINE, or PNGE course dealing with issues related to extraction, conversion, distribution/storage, and utilization of energy.

- ARE 445 Energy Economics 3
- WDS 444 Bio-based Energy Systems 3
- ARE 410 Environmental and Resource Economics 3
- ARE 632 Natural Resource and Environmental Economics 3
- RESM 440 Foundations of Applied Geographic Information Systems 3
- RESM 480 Environmental Regulation 3
- FOR 670 Human Dimensions of Natural Resource Management 3
- BADM 511 Managerial Economics 3
- BADM 531 Operation/Supply Chain 3
- BADM 532 Corporate Finance 3
- ILR 511 Human Capital Management 3
- LAW 613 International Environmental Law 2-3
- LAW 604 Natural Resources 3
- LAW 630 Energy Law 3
- LAW 689D Seminar: Environmental Law 2
- LAW 689W Seminar: Issues in Energy Law 2

Final Examination

M.S. students following the thesis or problem report option must prepare a written research proposal. The proposal must be approved by the student’s AEC at least one semester prior to the final oral examination.

All students, regardless of option, are required to pass a final oral or written examination, administered by their AEC, covering the thesis or problem report and/or related course material.

SUGGESTED PLAN OF STUDY

The plan below illustrates the Problem Report Option. It is important for students to take courses in the order specified as much as possible; all prerequisites and concurrent requirements must be observed. A typical M.S.E.S.E degree program that completes degree requirements in one year is as follows.

<table>
<thead>
<tr>
<th>First Year</th>
<th>Hours</th>
<th>Hours</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>Critical Subject Area Courses</td>
<td>Fall</td>
<td>Spring</td>
<td>Summer</td>
</tr>
<tr>
<td>12 Technical Elective Courses</td>
<td>12</td>
<td>15 Research</td>
<td>3</td>
</tr>
<tr>
<td>Technical Elective</td>
<td>3</td>
<td></td>
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<tr>
<td>Total credit hours: 33</td>
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Major Learning Outcomes

Upon graduation, with a Masters of Science degree in Energy Systems Engineering, students will have:

- Understanding of the supply chain for carbon based and “green” energy, for production, conversion or processing, transmission, and point of utilization;
- Advanced training in specialized areas of energy systems engineering;
- Ability to function at the highest levels of expertise in their chosen sub-discipline of energy, and who are well versed in the overall concepts of getting energy to consumers;
- Ability to complete on time specific professional-paper tasks
- Strong oral and written communication skills
- Ability to work independently in a collaborative environment
- Understanding of professional and ethical responsibility
- Ability to understand the impact of engineering solutions in global and societal context
- Recognition of the need to engage in life-long learning