ENERGY AND MINERAL ENGINEERING

Graduate Program Head
Sanjay Srinivasan
Program Code
EME
Campus(es)
University Park (Ph.D., M.S.)
Doctor of Philosophy (Ph.D.)
Master of Science (M.S.)
Dual-Title Ph.D. and M.S. in Energy and Mineral Engineering and Human Dimensions of Natural Resources and the Environment
Dual-Title Ph.D. and M.S. in Energy and Mineral Engineering and Operations Research
Integrated B.S. in Energy Business and Finance and M.S. in Energy and Mineral Engineering
Integrated B.S. in Energy Engineering and M.S. in Energy and Mineral Engineering
Integrated B.S. in Environmental Systems Engineering and M.S. in Energy and Mineral Engineering
Integrated B.S. in Mining Engineering and M.S. in Energy and Mineral Engineering
Integrated B.S. in Petroleum and Natural Gas Engineering and M.S. in Energy and Mineral Engineering

The Graduate Faculty

The John and Willie Leone Family Department of Energy and Mineral Engineering provides a vertically integrated approach to research and education in all aspects of the energy and mineral industries, including scientific and engineering issues, health and safety, and maintenance of high environmental standards. The department’s mission is to forge an intellectual and scientific cohesiveness in energy and mineral resource technology. This objective is achieved by exploiting the natural synergy between the exploration, extraction, processing, and utilization of energy and mineral resources so as to cater to the emerging needs of society.

The Energy and Mineral Engineering (EME) program is a single graduate program with a focus on the production of energy and minerals in an economic, safe and efficient manner. The program provides flexible education of students in energy and mineral sciences and engineering, with focus on both non-renewable and renewable resource and energy industries. The program is designed to resolve the sometimes competing goals of flexible education of requisite breadth while still providing in-depth study; students are required to follow a focused curriculum that combines the requisite rigor with flexibility in a rapidly changing field of endeavor.

Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (http://gradschool.psu.edu/prospective-students/how-to-apply). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions (http://gradschool.psu.edu/graduate-education-policies).

Scores for the Graduate Record Examinations (GRE) are required for admission, though this may be waived at the discretion of the Energy and Mineral Engineering graduate program. The best-qualified applicants will be accepted by the Energy and Mineral Engineering graduate program up to the number of spaces available for new students. At the discretion of the Energy and Mineral Engineering graduate program, a student may be granted provisional admission (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-300/provisional-admission).

Admission to the Energy and Mineral Engineering graduate program in the John and Willie Leone Family Department of Energy and Mineral Engineering is competitive. Entering students must hold a bachelor’s degree in a science or engineering discipline unless they are applying to an Integrated Undergraduate-Graduate (IUG) program. Students with 3.00 or better (out of 4.00) junior/senior cumulative grade-point averages and appropriate course backgrounds will be considered for admission. Exceptions to the minimum 3.00 grade-point average may be made for students with special backgrounds, abilities, and interests.

Letters of recommendation and an applicant’s statement of purpose are also required.

The language of instruction at Penn State is English. English proficiency test scores (TOEFL/IELTS) may be required for international applicants. See GCAC-305 Admission Requirements for International Students (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-305-admission-requirements-international-students) for more information.

Degree Requirements

Master of Science (M.S.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Requirements. (http://gradschool.psu.edu/graduate-education-policies)

The M.S. degree program in Energy and Mineral Engineering is designed for students to gain advanced knowledge for research, analysis, and design in Energy and Mineral Engineering. Students pursuing an M.S. degree will be required to complete 24 course credits and submit a thesis (6 credits) to the Graduate School. At least 18 of the total course credits must be at the 500 and 600 level, combined. Prescribed courses are:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EME 501</td>
<td>Design Under Uncertainty in Energy and Mineral Systems</td>
<td>3</td>
</tr>
<tr>
<td>EME 580</td>
<td>Interdisciplinary Team Project in EME Systems</td>
<td>3</td>
</tr>
<tr>
<td>EME 590</td>
<td>Colloquium</td>
<td>1</td>
</tr>
<tr>
<td>EME 600</td>
<td>Thesis Research</td>
<td>6</td>
</tr>
</tbody>
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An additional 17 credits of electives are required (for students choosing to complete an option, 12 of these elective credits are prescribed)

Total Credits: 30

Graduate committees in the Energy and Mineral Engineering graduate program play an important role in formulating individual course and research schedules.
All graduate students are expected to attend general Department seminars. Graduate students may be asked to contribute to the instructional programs of the Department by assisting with undergraduate laboratory and lecture courses.

**Doctor of Philosophy (Ph.D.)**

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Requirements. (http://gradschool.psu.edu/graduate-education-policies)

The Ph.D. program in Energy and Mineral Engineering emphasizes scholarly research and helps students prepare for research and related careers in industry, government and academe. Acceptance into the Ph.D. degree program in Energy and Mineral Engineering is based on the student’s performance on the Ph.D. qualifying examination administered by the faculty of the EME graduate program. A comprehensive examination is required of all Ph.D. candidates and should be taken after substantial completion of course work. The comprehensive examination is the responsibility of the candidate’s dissertation committee and administered according to the rules specified by the Graduate Council.

The Ph.D. program in Energy and Mineral Engineering is quite flexible, with minimum formal requirements. A minimum of 12 post-M.S. course credits and 12 research credits are required. At least 18 course credits for the graduate program must be at the 500 level or above. For students entering the program with an M.S. degree, 500-level or above courses already taken either at Penn State or other institutions may be accepted in partial fulfillment of the 18 credits of 500-level or above course requirements if they are found to be appropriate.

Students meet the general communication requirement for all Ph.D. candidates through the qualifying examination where a student is required to submit a written research paper or proposal of less than 15 double-spaced pages and make a formal public presentation and defense of the research proposal. The student is assessed by the exam committee on both technical and communication proficiency. Although encouraged, competency in a foreign language is not required for the Ph.D. degree. However, each Ph.D. student is expected to demonstrate competency in communication and language by successfully completing EME 581 which teaches students methods for the conduct, analysis, and effective communication of scientific research and spatial characterization.

All graduate students are expected to attend general Department seminars. Graduate students may be asked to contribute to the instructional programs of the Department by assisting with undergraduate laboratory and lecture courses.

**Options**

Students are not required to choose an option. However, a student who desires disciplinary identity may choose from among the five available options for both the M.S. and Ph.D.:

1. energy management and policy
2. environmental health and safety engineering
3. fuel science
4. mining and mineral process engineering
5. petroleum and natural gas engineering

**Dual-Titles**

**Dual-title M.S. and Ph.D. in Human Dimensions of Natural Resources and the Environment**

Requirements listed here are in addition to requirements listed in GCAC-208 Dual-Title Graduate Degree Programs (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-208-dual-title-graduate-degree-programs).

**Admission Requirement**

Students must apply and be admitted to the graduate program in Energy and Mineral Engineering and The Graduate School before they can apply for admission to the dual-title degree program. After admission to their primary program, students must apply for admission to and meet the admissions requirements of the Human Dimensions of Natural Resources and the Environment dual-title program. Refer to the Admission Requirements section of the Human Dimensions of Natural Resources and the Environment Bulletin page (http://bulletins.psu.edu/graduate/programs/majors/human-dimensions-natural-resources-environment). Doctoral students must be admitted into the dual-title degree program in Human Dimensions of Natural Resources and the Environment prior to taking the qualifying examination in their primary graduate program.

**Degree Requirements**

To qualify for the dual-title degree, students must satisfy the degree requirements for the degree they are enrolled in Energy and Mineral Engineering, listed in the Degree Requirements section. In addition, students must complete the degree requirements for the dual-title in Human Dimensions of Natural Resources and the Environment, listed on the Human Dimensions of Natural Resources and the Environment Bulletin page (http://bulletins.psu.edu/graduate/programs/majors/human-dimensions-natural-resources-environment).

The qualifying examination committee for the dual-title Ph.D. degree will be composed of Graduate Faculty from Energy and Mineral Engineering and must include at least one Graduate Faculty member from the Human Dimensions of Natural Resources and the Environment program. Faculty members who hold appointments in both programs’ Graduate Faculty may serve in a combined role. There will be a single qualifying examination, containing elements of both Energy and Mineral Engineering and Human Dimensions of Natural Resources and the Environment. Dual-title graduate degree students may require an additional semester to fulfill requirements for both areas of study and, therefore, the qualifying examination may be delayed one semester beyond the normal period allowable.

In addition to the general Graduate Council requirements for dissertation committees (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation), the dissertation committee of an Energy and Mineral Engineering and Human Dimensions of Natural Resources and the Environment dual-title Ph.D. student must include at least one member of the Human Dimensions of Natural Resources and the Environment Graduate Faculty. Faculty members who hold appointments in both programs’ Graduate Faculty may serve in a combined role. If the chair of the dissertation committee is not also a member of the Graduate Faculty in Human Dimensions of Natural Resources and the Environment, the member of the committee representing Human Dimensions of Natural Resources and the Environment must be appointed as co-chair. The Human Dimensions of Natural Resources and the Environment representative on the student’s
dissertation committee will develop questions for and participate in the evaluation of the comprehensive examination.

Students in the dual-title program are required to write and orally defend a dissertation on a topic that is approved in advance by their dissertation committee and reflects their original research and education in Energy and Mineral Engineering and Human Dimensions of Natural Resources and the Environment. Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. The dissertation must be accepted by the dissertation committee, the head of the graduate program, and the Graduate School.

**Dual-title M.S. and Ph.D. in Energy and Mineral Engineering and Operations Research**

Requirements listed here are in addition to requirements listed in GCAC-208 Dual-Title Graduate Degree Programs (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-208-dual-title-graduate-degree-programs).

**Admission Requirements**

Students must apply and be admitted to the graduate program in Energy and Mineral Engineering and The Graduate School before they can apply for admission to the dual-title degree program. After admission to their primary program, students must apply for admission to and meet the admissions requirements of the Operations Research dual-title program. Refer to the Admission Requirements section of the Operations Research Bulletin page (http://bulletins.psu.edu/graduate/programs/majors/operations-research). Doctoral students must be admitted into the dual-title degree program in Operations Research prior to taking the qualifying examination in their primary graduate program.

**Degree Requirements**

To qualify for the dual-title degree, students must satisfy the degree requirements for the degree they are enrolled in Energy and Mineral Engineering, listed in the Degree Requirements section. In addition, students must complete the degree requirements for the dual-title in Operations Research, listed on the Operations Research Bulletin page (http://bulletins.psu.edu/graduate/programs/majors/operations-research).

The qualifying examination committee for the dual-title Ph.D. degree will be composed of Graduate Faculty from Energy and Mineral Engineering and must include at least one Graduate Faculty member from the Operations Research program. Faculty members who hold appointments in both programs’ Graduate Faculty may serve in a combined role. There will be a single qualifying examination, containing elements of both Energy and Mineral Engineering and Operations Research. Dual-title graduate degree students may require an additional semester to fulfill requirements for both areas of study and, therefore, the qualifying examination may be delayed one semester beyond the normal period allowable.

In addition to the general Graduate Council requirements for dissertation committees (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation), the dissertation committee of an Energy and Mineral Engineering and Operations Research dual-title Ph.D. student must include at least one member of the Operations Research Graduate Faculty. Faculty members who hold appointments in both programs’ Graduate Faculty may serve in a combined role. If the chair of the dissertation committee is not also a member of the Graduate Faculty in Operations Research, the member of the committee representing Operations Research must be appointed as co-chair. The Operations Research representative on the student’s dissertation committee will develop questions for and participate in the evaluation of the comprehensive examination.

Students in the dual-title program are required to write and orally defend a dissertation on a topic that is approved in advance by their dissertation committee and reflects their original research and education in Energy and Mineral Engineering and Operations Research. Upon completion of the doctoral dissertation, the candidate must pass a final oral examination (the dissertation defense) to earn the Ph.D. degree. The dissertation must be accepted by the dissertation committee, the head of the graduate program, and the Graduate School.

**Integrated Undergrad-Grad Programs**

The John and Willie Leone Family Department of Energy and Mineral Engineering offers integrated B.S./M.S. programs that are designed to allow academically superior and research-focused undergraduate students in any of our five B.S. degree programs—Energy Business and Finance (EBF); Energy Engineering (ENENG); Environmental Systems Engineering (ENVSE); Mining Engineering (MNGE); and Petroleum and Natural Gas Engineering (PNGE)—also to obtain an M.S. degree in Energy and Mineral Engineering (EME) within five years of study. Students interested in the five-year Integrated Undergraduate-Graduate (IUG) program must apply for admission to The Graduate School and be admitted into the EME IUG program by the end of their junior year.

In the first three years IUG students will follow the course scheduling of the undergraduate major in the department (see the Undergraduate Bulletin (http://bulletins.psu.edu/undergraduate)). Students interested in the IUG program will, however, be encouraged to take upper-level classes, whenever appropriate. An admitted student will begin the senior year working towards the B.S./M.S. with an M.S. Advising Committee. The student will follow the course scheduling of the B.S. major while also taking 500-level courses, whenever appropriate, to satisfy the M.S. requirements. The student will also start work on a thesis designed to meet the requirements of the M.S. thesis. In the fifth year the student will continue to work towards satisfying all degree requirements for the B.S. and M.S. degrees including the M.S. thesis.

**Integrated B.S. in Energy Business and Finance and M.S. in Energy and Mineral Engineering**

Requirements listed here are in addition to requirements listed in GCAC-210 Integrated Undergraduate-Graduate (IUG) Degree Programs (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-210-integrated-undergraduate-graduate-degree-programs).

The integrated undergraduate-graduate (IUG) program between the Energy Business and Finance undergraduate program and the Energy and Mineral Engineering graduate program enables academically superior and research-focused EBF undergraduate students to also obtain an M.S. degree in Energy and Mineral Engineering in five years of study.

**Admission Requirements**

Undergraduate students from the John and Willie Leone Family Department of Energy and Mineral Engineering with sixth semester standing and minimum grade-point average of 3.5 who wish to complete the Integrated B.S./M.S. program may apply to the Graduate School and the EME IUG program before the end of their junior year. Three faculty letters of recommendation are required. A statement of purpose and a plan of study covering the five year period, prepared in consultation with an adviser, and approved by the program officers of the B.S. major and the EME graduate program must accompany the application. The...
plan should be presented in person to the undergraduate and graduate program officers prior to being admitted into the program. Graduate Record Examination (GRE) scores may be submitted by IUG applicants but are not required. The application will be reviewed by the Admissions Committee of the EME Graduate program and acted upon by the EME Graduate Program Officer.

**Degree Requirements**

The degree requirements will be in accordance with the approved requirements of the Energy Business and Finance undergraduate degree program and the Energy and Mineral Engineering graduate program. However, 12 of the 500-level credits required for the master’s degree may be applied to both undergraduate and graduate degree programs. The undergraduate degree program officer will determine the specific undergraduate required courses for which the 500-level courses may be used to substitute to meet institutional and accreditation requirements.

Once admitted into the IUG program, students are bound by the same guidelines, credit requirements, and program procedures as all other students in the Energy and Mineral Engineering graduate program.

As many as 12 of the credits required for the master’s degree may be applied to both the B.S. and the M.S. degrees. A minimum of 6 credits counted for both the B.S. and M.S. degrees must be at the 500 level. To meet the number of 500 or above credit requirements, students will be advised to take the graduate courses and use them to substitute for the undergraduate courses.

**Integrated B.S. in Energy Engineering and M.S. in Energy and Mineral Engineering**

Requirements listed here are in addition to requirements listed in GCAC-210 Integrated Undergraduate-Graduate (IUG) Degree Programs (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-210-integrated-undergraduate-graduate-degree-programs).

The integrated undergraduate-graduate (IUG) program between the Energy Engineering undergraduate program and the Energy and Mineral Engineering graduate program enables academically superior and research-focused ENENG undergraduate students to also obtain an M.S. degree in Energy and Mineral Engineering in five years of study.

**Admission Requirements**

Undergraduate students from the John and Willie Leone Family Department of Energy and Mineral Engineering with sixth semester standing and minimum grade-point average of 3.5 who wish to complete the Integrated B.S./M.S. program may apply to the Graduate School and the EME IUG program before the end of their junior year. Three faculty letters of recommendation are required. A statement of purpose and a plan of study covering the five year period, prepared in consultation with an adviser, and approved by the program officers of the B.S. major and the EME graduate program must accompany the application. The plan should be presented in person to the undergraduate and graduate program officers prior to being admitted into the program. Graduate Record Examination (GRE) scores may be submitted by IUG applicants but are not required. The application will be reviewed by the Admissions Committee of the EME Graduate program and acted upon by the EME Graduate Program Officer.

**Degree Requirements**

The degree requirements will be in accordance with the approved requirements of the Energy Engineering undergraduate degree program and the Energy and Mineral Engineering graduate program. However, 12 of the 500-level credits required for the master’s degree may be applied to both undergraduate and graduate degree programs. The undergraduate degree program officer will determine the specific undergraduate required courses for which the 500-level courses may be used to substitute to meet institutional and accreditation requirements.

Once admitted into the IUG program, students are bound by the same guidelines, credit requirements, and program procedures as all other students in the Energy and Mineral Engineering graduate program.

As many as 12 of the credits required for the master’s degree may be applied to both the B.S. and the M.S. degrees. A minimum of 6 credits counted for both the B.S. and M.S. degrees must be at the 500 level. To meet the number of 500 or above credit requirements, students will be advised to take the graduate courses and use them to substitute for the undergraduate courses.

**Integrated B.S. in Environmental Systems Engineering and M.S. in Energy and Mineral Engineering**

Requirements listed here are in addition to requirements listed in GCAC-210 Integrated Undergraduate-Graduate (IUG) Degree Programs (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-210-integrated-undergraduate-graduate-degree-programs).

The integrated undergraduate-graduate (IUG) program between the Environmental Systems Engineering undergraduate program and the Energy and Mineral Engineering graduate program enables academically superior and research-focused ENVSE undergraduate students to also obtain an M.S. degree in Energy and Mineral Engineering in five years of study.

**Admission Requirements**

Undergraduate students from the John and Willie Leone Family Department of Energy and Mineral Engineering with sixth semester standing and minimum grade-point average of 3.5 who wish to complete the Integrated B.S./M.S. program may apply to the Graduate School and the EME IUG program before the end of their junior year. Three faculty letters of recommendation are required. A statement of purpose and a plan of study covering the five year period, prepared in consultation with an adviser, and approved by the program officers of the B.S. major and the EME graduate program must accompany the application. The plan should be presented in person to the undergraduate and graduate program officers prior to being admitted into the program. Graduate Record Examination (GRE) scores may be submitted by IUG applicants but are not required. The application will be reviewed by the Admissions Committee of the EME Graduate program and acted upon by the EME Graduate Program Officer.

**Degree Requirements**

The degree requirements will be in accordance with the approved requirements of the Environmental Systems Engineering undergraduate degree program and the Energy and Mineral Engineering graduate program. However, 12 of the 500-level credits required for the master’s degree may be applied to both undergraduate and graduate degree programs. The undergraduate degree program officer will determine the specific undergraduate required courses for which the 500-level courses may be used to substitute to meet institutional and accreditation requirements.

Once admitted into the IUG program, students are bound by the same guidelines, credit requirements, and program procedures as all other students in the Energy and Mineral Engineering graduate program.
As many as 12 of the credits required for the master's degree may be applied to both the B.S. and the M.S. degrees. A minimum of 6 credits counted for both the B.S. and M.S. degrees must be at the 500 level. To meet the number of 500 or above credit requirements, students will be advised to take the graduate courses and use them to substitute for the undergraduate courses.

**Integrated B.S. in Mining Engineering and M.S. in Energy and Mineral Engineering**

Requirements listed here are in addition to requirements listed in GCAC-210 Integrated Undergraduate-Graduate (IUG) Degree Programs (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-210-integrated-undergraduate-graduate-degree-programs).

The integrated undergraduate-graduate (IUG) program between the Mining Engineering undergraduate program and the Energy and Mineral Engineering graduate program enables academically superior and research-focused MNGE undergraduate students to also obtain an M.S. degree in Energy and Mineral Engineering in five years of study.

**Admission Requirements**

Undergraduate students from the John and Willie Leone Family Department of Energy and Mineral Engineering with sixth semester standing and minimum grade-point average of 3.5 who wish to complete the Integrated B.S./M.S. program may apply to the Graduate School and the EME IUG program before the end of their junior year. Three faculty letters of recommendation are required. A statement of purpose and a plan of study covering the five year period, prepared in consultation with an adviser, and approved by the program officers of the B.S. major and the EME graduate program must accompany the application. The plan should be presented in person to the undergraduate and graduate program officers prior to being admitted into the program. Graduate Record Examination (GRE) scores may be submitted by IUG applicants but are not required. The application will be reviewed by the Admissions Committee of the EME Graduate program and acted upon by the EME Graduate Program Officer.

**Degree Requirements**

The degree requirements will be in accordance with the approved requirements of the Petroleum and Natural Gas Engineering undergraduate degree program and the Energy and Mineral Engineering graduate program. However, 12 of the 500-level credits required for the master's degree may be applied to both undergraduate and graduate degree programs. The undergraduate degree program officer will determine the specific undergraduate required courses for which the 500-level courses may be used to substitute to meet institutional and accreditation requirements.

Once admitted into the IUG program, students are bound by the same guidelines, credit requirements, and program procedures as all other students in the Energy and Mineral Engineering graduate program.

As many as 12 of the credits required for the master's degree may be applied to both the B.S. and the M.S. degrees. A minimum of 6 credits counted for both the B.S. and M.S. degrees must be at the 500 level. To meet the number of 500 or above credit requirements, students will be advised to take the graduate courses and use them to substitute for the undergraduate courses.

**Integrated B.S. in Petroleum and Natural Gas Engineering and M.S. in Energy and Mineral Engineering**

Requirements listed here are in addition to requirements listed in GCAC-210 Integrated Undergraduate-Graduate (IUG) Degree Programs (http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-200/gcac-210-integrated-undergraduate-graduate-degree-programs).

The integrated undergraduate-graduate (IUG) program between the Petroleum and Natural Gas Engineering undergraduate program and the Energy and Mineral Engineering graduate program enables academically superior and research-focused PNGE undergraduate students to also obtain an M.S. degree in Energy and Mineral Engineering in five years of study.

**Admission Requirements**

Undergraduate students from the John and Willie Leone Family Department of Energy and Mineral Engineering with sixth semester standing and minimum grade-point average of 3.5 who wish to complete the Integrated B.S./M.S. program may apply to the Graduate School and the EME IUG program before the end of their junior year. Three faculty letters of recommendation are required. A statement of purpose and a plan of study covering the five year period, prepared in consultation with an adviser, and approved by the program officers of the B.S. major and the EME graduate program must accompany the application. The plan should be presented in person to the undergraduate and graduate program officers prior to being admitted into the program. Graduate Record Examination (GRE) scores may be submitted by IUG applicants but are not required. The application will be reviewed by the Admissions Committee of the EME Graduate program and acted upon by the EME Graduate Program Officer.

**Degree Requirements**

The degree requirements will be in accordance with the approved requirements of the Petroleum and Natural Gas Engineering undergraduate degree program and the Energy and Mineral Engineering graduate program. However, 12 of the 500-level credits required for the master's degree may be applied to both undergraduate and graduate degree programs. The undergraduate degree program officer will determine the specific undergraduate required courses for which the 500-level courses may be used to substitute to meet institutional and accreditation requirements.

Once admitted into the IUG program, students are bound by the same guidelines, credit requirements, and program procedures as all other students in the Energy and Mineral Engineering graduate program.

As many as 12 of the credits required for the master's degree may be applied to both the B.S. and the M.S. degrees. A minimum of 6 credits counted for both the B.S. and M.S. degrees must be at the 500 level. To meet the number of 500 or above credit requirements, students will be advised to take the graduate courses and use them to substitute for the undergraduate courses.

**Student Aid**

Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (http://gradschool.psu.edu/graduate-funding) section of The Graduate School’s website. Students on graduate assistantships must adhere to the course load limits (http://gradschool.psu.edu/graduate-education-policies/gsad/gsad-500/gsad-501-credit-loads-graduate-assistants) set by The Graduate School.

Graduate students are supported by a variety of government and industry fellowships, and research and teaching assistantships. Stipends vary depending on the source.
Courses
Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Energy and Mineral Engineering (EME) Course List (https://bulletins.psu.edu/university-course-descriptions/graduate/eme)

Fuel Science (FSC) Course List (https://bulletins.psu.edu/university-course-descriptions/graduate/fsc)

Mineral Processing (MNPR) Course List (https://bulletins.psu.edu/university-course-descriptions/graduate/mnpr)

Mining (MNG) Course List (https://bulletins.psu.edu/university-course-descriptions/graduate/mng)

Petroleum and Natural Gas Engineering (PNG) Course List (https://bulletins.psu.edu/university-course-descriptions/graduate/png)

Learning Outcomes

Master of Science (M.S.)
1. KNOW: Graduates will be able to demonstrate deep understanding and proficiency in project evaluation methods, optimization and application of mechanistic, thermodynamic, fluid flow, and kinetic analysis methods for integrative design of energy and mineral engineering systems.

2. CREATE: Graduates will demonstrate proficiency in designing and executing a research plan to address real-world problems in the field of energy and mineral engineering and economics.

3. CRITICAL THINKING: Graduates will be able to review and critically analyze work by others in the broad area of energy and mineral engineering and economics.

4. COMMUNICATE: Graduates will be able to effectively communicate their research findings to scholars in the field and broad audiences through formal presentations and written works.

5. PROFESSIONAL PRACTICE: Graduates will demonstrate a commitment to conduct themselves in accordance with the highest ethical standards and active engagement in service to the profession and society.

Doctor of Philosophy (Ph.D.)
1. KNOW: Graduates will demonstrate in-depth knowledge of the core theories and methods in the field of energy and mineral engineering as well as within one of the program options. This will include the application of physics, chemistry, advanced mathematics, economics and/or engineering principles to problems in energy and mineral engineering.

2. CREATE: Graduates will be able to creatively synthesize new ideas or hypotheses in energy and mineral engineering and economics, devise critical tests of hypotheses, and/or develop unique solutions to problems in energy and mineral engineering and economics.

3. APPLY: Graduates will be able to carry out independent and original research studies that address current problems in energy and mineral engineering synthesizing theory and/or experiments.

4. CRITICAL THINKING: Graduates will be able to review and critically analyze work by others in their field of specialty.

5. COMMUNICATE: Graduates will be able to convey ideas or arguments in clear, concise, well-organized proposals, papers and reports as well as in formal, oral presentations.

6. PROFESSIONAL PRACTICE: Graduates will demonstrate the ability to collaborate in a collegial and ethical manner with other professionals within their field and within diverse scientific backgrounds.

Contact

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