PETROLEUM AND NATURAL GAS ENGINEERING, B.S.

Begin Campus: Any Penn State Campus
End Campus: University Park

Program Description

The undergraduate curriculum in Petroleum and Natural Gas Engineering has been designed to equip the student with the fundamentals necessary to achieve lifelong professional growth. Graduates are prepared to enter both the private and public sectors as petroleum and natural gas engineers or to pursue further education at the graduate level.

The courses are structured to serve as a melting pot for theory, application to case studies, and engineering project design. This enables the student to appreciate and understand that a successful engineering design project requires a sound theoretical foundation, experimentation and engineering judgment. The thrust of the program structure emphasizes the fundamentals of mathematics and earth and engineering sciences and integrates them in application to traditional petroleum and natural gas engineering topics. Design projects are required throughout the curriculum. Execution of these projects requires an amalgamation of problem formulation strategies, testing of alternative design methodologies, feasibility studies, and economic and environmental considerations. Graduates of the program are expected to perform in various facets of the petroleum industry including drilling, production, evaluation, transportation, and storage. The petroleum and natural gas engineering faculty and staff are committed to an interactive teaching and learning environment to ensure that the student is an active participant in the learning process. General education opportunities are sufficiently broad and diverse in scope to enable the student to tailor the educational experience to particular interests, background, and expected role in society.

What is Petroleum and Natural Gas Engineering?

Petroleum and natural gas engineers solve crucial problems related to one of the most important resources for society today: energy. It’s a dynamic field that allows graduates to work in a range of environments, from the Marcellus Shale regions in the Northeast to offshore sites in the Gulf of Mexico. The work can involve getting your hands dirty in the field or working in an office, planning out how to overcome obstacles related to drilling, production, evaluation, transportation, and storage—the entire scope of the energy extraction industry. Petroleum and natural gas engineers have the important job of assessing, locating, and extracting fuel resources while adhering to environmental standards. Petroleum engineers are also well suited to solve complex problems in aquifer cleanup of inorganic and organic contaminants and in design of geothermal energy extraction.

You Might Like This Program If...

- You want to use science and engineering principles to address the technological challenges of the petroleum and natural gas industry.
- You like traveling both within the U.S. and internationally, and working outside including in unique settings such as offshore rigs.
- You enjoy combining disciplines such as geology, physics, and math to solve problems, and using technical skills both in the office and in the field.

Entrance to Major

(Effective for students admitted beginning Summer 2013)—In the event that the major is under enrollment control, a higher minimum cumulative grade-point average (GPA) than the minimum described by University Policies is likely to be needed. In addition to this minimum grade-point average requirement, the following entrance-to-major requirements must also be completed with a minimum grade of C: CHEM 110, CHEM 112, MATH 140, MATH 141, PHYS 211. These courses must be completed by the end of the semester during which the entrance to major process is carried out. To be eligible for consideration for entrance to this major, students must be enrolled in the College of Earth and Mineral Sciences or Division of Undergraduate Studies at the time that they confirm their major choice.

Degree Requirements

For the Bachelor of Science degree in Petroleum and Natural Gas Engineering, a minimum of 129 credits is required:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
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<tbody>
<tr>
<td>General Education</td>
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<tr>
<td>Requirements for the Major</td>
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General Education

Connecting career and curiosity, the General Education curriculum provides the opportunity for students to acquire transferable skills necessary to be successful in the future and to thrive while living in interconnected contexts. General Education aids students in developing intellectual curiosity, a strengthened ability to think, and a deeper sense of aesthetic appreciation. These are requirements for all baccalaureate students and are often partially incorporated into the requirements of a program. For additional information, see the General Education Requirements (http://bulletins.psu.edu/undergraduate/general-education/baccalaureate-degree-general-education-program) section of the Bulletin and consult your academic adviser.

The keystone symbol appears next to the title of any course that is designated as a General Education course. Program requirements may also satisfy General Education requirements and vary for each program.

Foundations (grade of C or better is required.)

- Quantification (GQ): 6 credits
- Writing and Speaking (GWS): 9 credits

Knowledge Domains

- Arts (GA): 6 credits
- Health and Wellness (GHW): 3 credits
- Humanities (GH): 6 credits
- Social and Behavioral Sciences(GS): 6 credits
- Natural Sciences (GN): 9 credits

Integrative Studies (may also complete a Knowledge Domain requirement)

- Inter-Domain or Approved Linked Courses: 6 credits

30 of these 45 credits are included in the Requirements for the Major.
University Degree Requirements

First Year Engagement
All students enrolled in a college or the Division of Undergraduate Studies at University Park, and the World Campus are required to take 1 to 3 credits of the First-Year Seminar, as specified by their college First-Year Engagement Plan.

Other Penn State colleges and campuses may require the First-Year Seminar; colleges and campuses that do not require a First-Year Seminar provide students with a first-year engagement experience.

First-year baccalaureate students entering Penn State should consult their academic adviser for these requirements.

Cultures Requirement
6 credits are required and may satisfy other requirements
- United States Cultures: 3 credits
- International Cultures: 3 credits

Writing Across the Curriculum
3 credits required from the college of graduation and likely prescribed as part of major requirements.

Total Minimum Credits
A minimum of 120 degree credits must be earned for a baccalaureate degree. The requirements for some programs may exceed 120 credits. Students should consult with their college or department adviser for information on specific credit requirements.

Quality of Work
Candidates must complete the degree requirements for their major and earn at least a 2.00 grade-point average for all courses completed within their degree program.

Limitations on Source and Time for Credit Acquisition
The college dean or campus chancellor and program faculty may require up to 24 credits of course work in the major to be taken at the location or in the college or program where the degree is earned. Credit used toward degree programs may need to be earned from a particular source or within time constraints (see Senate Policy 83-80 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#83-80)). For more information, check the Suggested Academic Plan for your intended program.

Requirements for the Major
This includes 30 credits of General Education courses: 3 credits of GH courses; 9 credits of GN courses; 6 credits of GQ courses; 3 credits of GS courses; 9 credits of GWS courses.

To graduate, a student enrolled in the major must earn a grade of C or better in each course designated by the major as a C-required course, as specified by Senate Policy 82-44 (http://senate.psu.edu/policies-and-rules-for-undergraduate-students/82-00-and-83-00-degree-requirements/#82-44).

Code | Title | Credits
---|---|---
CHEM 111 | Experimental Chemistry I | 1
ECON 102 | Introductory Microeconomic Analysis and Policy | 3
EMSC 100S | Earth and Mineral Sciences First-Year Seminar | 1
MATH 230 | Calculus and Vector Analysis | 4
MATH 251 | Ordinary and Partial Differential Equations | 4
PHYS 211 | General Physics: Mechanics | 4
PHYS 212 | General Physics: Electricity and Magnetism | 4
EME 460 | Geo-resource Evaluation and Investment Analysis | 3
EMCH 210 | Statics and Strength of Materials | 5
EMCH 212 | Dynamics | 3
GEOC 1 | Physical Geology | 3
GEOC 454 | Geology of Oil and Gas | 3
PNG 490 | Introduction to Petroleum Engineering Design | 1
ENGL 202C | Effective Writing: Technical Writing | 3
PNG 420 | Applied Reservoir Analysis and Secondary Recovery | 4
PNG 425 | Principles of Well Testing and Evaluation | 3
PNG 430 | Reservoir Modeling | 3
PNG 440 | Formation Evaluation | 3
PNG 480 | Surface Production Engineering | 3
PNG 482 | Production Engineering Laboratory | 1
PNG 491 | Capstone Design in Drilling and Completions | 1
PNG 492 | Petroleum Engineering Capstone Design | 1

Prescribed Courses: Require a grade of C or better

CHEM 110 | Chemical Principles I | 3
CHEM 112 | Chemical Principles II | 3
MATH 140 | Calculus With Analytic Geometry I | 4
MATH 141 | Calculus with Analytic Geometry II | 4
PHYS 211 | General Physics: Mechanics | 4
PHYS 212 | General Physics: Electricity and Magnetism | 4
EME 301 | Thermodynamics in Energy and Mineral Engineering | 3
EME 303 | Fluid Mechanics in Energy and Mineral Engineering | 3
PNG 405 | Rock and Fluid Properties | 3
PNG 406 | Rock and Fluid Laboratory | 1
PNG 410 | Applied Reservoir Engineering | 3
PNG 450 | Drilling Engineering | 3
PNG 451 | Drilling Laboratory | 1
PNG 475 | Production and Completions Engineering | 3

Additional Courses
Select 9 credits: one course from categories A, B, and C:

A.
ENGL 15 | Rhetoric and Composition | 9
or ENGL 30 | Honors Freshman Composition

B.
PHIL 103 | Introduction to Ethics | 3
PHIL 106 | Introduction to Business Ethics | 3
PHIL 107 | Introduction to Philosophy of Technology | 3
PHIL 233 | Ethics and the Design of Technology | 3

C.
CMPSC 201 | Programming for Engineers with C++ | 3
or CMPSC 202 | Programming for Engineers with FORTRAN

Supporting Courses and Related Areas
Select 6 credits in consultation with adviser (students may apply 6 credits of ROTC)
Student Outcomes

1. Our students, at the time of their graduation, will have a working knowledge of basic math, science skills and engineering skills.

2. Our students, at the time of their graduation, will be equipped with ability to design and conduct experiments as well as to analyze and interpret data.

3. Our students, at the time of their graduation, will be ready to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

4. Our students, at the time of their graduation, will be able to function in multi-disciplinary teams.

5. Our students, at the time of their graduation, will be equipped with the necessary skills to identify, formulate and solve engineering problems.

6. Our students, at the time of their graduation, will have a thorough understanding of professional and ethical responsibilities.

7. Our students, at the time of their graduation, will be equipped with the necessary communication skills to communicate effectively.

8. Our students, at the time of their graduation, will have a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.

9. Our students, at the time of their graduation, will be instilled with the recognition of the need for, and an ability to engage in lifelong learning.

10. Our students, at the time of their graduation, will attain knowledge on contemporary issues.

11. Our students, at the time of their graduation, will have an ability to use the techniques, skills and modern engineering tools that are necessary for engineering practice.

Integrated B.S. in Petroleum and Natural Gas Engineering (PNGE) and M.S. in Energy and Mineral Engineering (EME)

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. Students should refer to the Energy and Mineral Engineering graduate program in the Graduate Program Bulletin for the IUG admission and degree requirements. (http://bulletins.psu.edu/bulletins/whitebook/graduate_degree_programs.cfm?letter=E&program=grad_eme.htm)

Course Substitutions for the Integrated B.S. in Petroleum and Natural Gas Engineering (PNGE) and M.S. in Energy and Mineral Engineering (EME)

As many as twelve of the credits required for the master’s degree may be applied to both the B.S. and M.S. degrees. A minimum of six credits counted for both the B.S. and M.S. degrees must be at the 500-level. Thesis and culminating/capstone experience credits may not be double counted. 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.

Program Educational Objectives

1. Our graduates will integrate key science and engineering principles to address the technological challenges of the petroleum and natural gas industry.

2. Our graduates will practice in a broad range of petroleum engineering fields working on teams that create innovative solutions to the most pressing problems of the petroleum and natural gas industry by implementing the ideals of ethical behavior, professionalism, and environmental sensitivity and social awareness.

3. Our graduates will be recognized as critical and independent thinkers and will assume positions of leadership in defining the social, intellectual, business and technical dimensions of the professional organizations they belong to.

4. Our graduates will continue their lifelong learning process and participate in graduate education to remain as effective professionals in the workplace of the future.

Suggested Academic Plan

University Park Campus

The course series listed below provides only one of the many possible ways to move through this curriculum. The University may make changes in policies, procedures, educational offerings, and requirements at any time. This plan should be used in conjunction with your degree audit (accessible in LionPATH as either an Academic Requirements or What If report). Please consult with a Penn State academic adviser on a regular basis to develop and refine an academic plan that is appropriate for you.
Petroleum and Natural Gas Engineering, B.S.

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General Education Knowledge Domain

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Second Year

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Third Year

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General Education Health and Wellness (GWS) 1.5

16

Fourth Year

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<th>Course</th>
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General Education Health and Wellness (GHW) 1.5

16

Total Credits 129

* Course requires a grade of C or better for the major
† Course satisfies General Education and degree requirement
‡ Course requires a grade of C or better for General Education

University Requirements and General Education Notes:

US and IL are abbreviations used to designate courses that satisfy University Requirements (United States and International Cultures).

W, M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.

GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of ‘C’ or better.

Integrative Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

1. Students who begin their studies at non-UP locations and/or join the college after their first year should substitute CAS 100, CAS 100A, CAS 100B, or CAS 100C (GWS) for EMSC 100S (GWS). EMSC 100S Earth and Mineral Sciences First year Seminar (3) is a required course only for students who begin their studies at UP in the College of Earth and Mineral Sciences.

2. Approved Technical Electives for the PNGE program may be found at the department web site: http://www.eme.psu.edu/pnge/techelectives

Advising Notes:

To enter PNGE, students must have a cumulative GPA of 3.0 or higher, complete the entrance to major courses with a C or better, and apply to the major within 40-59 cumulative credits. Only students who are enrolled in EMSC or DUS are eligible to apply to PNGE.

Courses required for the major may be offered fall semester only, spring semester only, or both fall and spring semesters. Consult with your adviser and department to discuss your academic progress and course sequencing.

The PNGE program strongly recommends that students have summer internships, as many companies will only consider hiring PNGE graduates who have had at least one internship.

Commonwealth Campuses

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Total Credits 130

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### University Requirements and General Education Notes:

- **W**: M, X, and Y are the suffixes at the end of a course number used to designate courses that satisfy University Writing Across the Curriculum requirement.
- GWS, GQ, GHW, GN, GA, GH, and GS are abbreviations used to identify General Education program courses. General Education includes Foundations (GWS and GQ) and Knowledge Domains (GHW, GN, GA, GH, GS, and Integrative Studies). Foundations courses (GWS and GQ) require a grade of "C" or better.

Integral Studies courses are required for the General Education program. N is the suffix at the end of a course number used to designate an Inter-Domain course and Z is the suffix at the end of a course number used to designate a Linked course.

All incoming Schreyer Honors College first-year students at University Park will take ENGL/CAS 137 in the fall semester and ENGL/CAS 138 in the spring semester. These courses carry the GWS designation and replace both ENGL 30 and CAS 100. Each course is 3 credits.

1. Students who begin their studies at non-UP locations and/or join the college after their first year should substitute CAS 100, CAS 100A, CAS 100B, or CAS 100C (GWS) for EMSC 100S (GWS). EMSC 100S Earth and Mineral Sciences First Year Seminar (3) is a required course only for students who begin their studies at UP in the College of Earth and Mineral Sciences.
2. Approved Technical Electives for the PNGE major can be found at the department web site: http://www.eme.psu.edu/pnge/techelectives Students may use up to 6 credits of ROTC as technical electives.

### Advising Notes:

To enter PNGE, students must have a cumulative GPA of 3.0 or higher, complete the entrance to major courses with a C or better, and apply to the major within 40-59 cumulative credits. Only students who are enrolled in EMSC or DUS are eligible to apply to PNGE.

Courses required for the major may be offered fall semester only, spring semester only, or both fall and spring semesters. Consult with your adviser and department to discuss your academic progress and course sequencing.

The PNGE program strongly recommends that students have summer internships, as many companies will only consider hiring PNGE graduates who have had at least one internship.

### Career Paths

Graduates of this program find rewarding careers across the globe as engineers for governmental and regulatory bodies, oil and gas producing companies, and other independent and service companies in the energy sector.

### Careers

Our graduates may be candidates for careers in a wide range of industries in both the private and public sector including major oil and...
gas production companies, large and small independents and service companies and government agencies.

MORE INFORMATION (http://www.eme.psu.edu/pnge/career)

**Opportunities for Graduate Studies**
Graduates may be well suited to pursue graduate-level studies. Further study toward an M.S. or Ph.D. can lead to research, university, or management positions.

MORE INFORMATION (http://www.eme.psu.edu/academics/graduate)

**Professional Resources**
- Society of Petroleum Engineers Penn State Student Chapter (http://spepenstate.org)
- American Association of Drilling Engineers Penn State Student Chapter (http://www.eme.psu.edu/academics/student-orgs/isee)
- Positive Energy (http://spepenstate.org/positive-energy)
- International Society of Explosives Engineers Penn State Student Chapter (http://www.eme.psu.edu/academics/student-orgs/isee)

**Accreditation**
The baccalaureate program in Petroleum and Natural Gas Engineering is accredited by the Engineering Accreditation Commission of ABET, Inc., www.abet.org. (http://www.abet.org)

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