

Department of Petroleum & Natural Gas Engineering

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Degree Offered

- Bachelor of Science in Petroleum and Natural Gas Engineering (B.S.P.N.G.E.)

Nature of Program

Petroleum and Natural Gas Engineering is concerned with design and application aspects of the discovery, production, and transportation of oil and natural gas resources.

Professionals in this field must have a thorough understanding of the geological principles relating to the occurrence, discovery, and production of fluid hydrocarbons. The petroleum and natural gas engineer must know and be capable of applying both conventional engineering design principles as well as those pertaining specifically to the field of petroleum and natural gas engineering. These are developed in the petroleum and natural gas engineering courses in the curriculum. In addition, a strong foundation in mathematics and the sciences broadens the future engineer's professional capabilities. Because many engineers will be employed as supervisors or executives, managerial and social skills are also emphasized.

Students are offered the opportunity to enter all phases of the petroleum and natural gas industry in meaningful and important jobs, continue their education towards advanced degrees, or in some cases pursue a combination of professional employment and continued education. The petroleum and natural gas engineering program is accredited by the Engineering Accreditation Commission (EAC) of ABET, <http://www.abet.org>.

Program Learning Objectives

- The graduates will be successful in their professional careers as petroleum engineers in the energy industry, government agencies, and/or post-graduate education.
- The graduates will continue to develop professionally and serve in leadership roles.
- The graduates will be successful in demonstrating their obligations to the profession, to their employer, and to society.

The foundation for achieving program objectives is established through a rigorous curriculum that provides the students with:

- An understanding of scientific and engineering principles and the application of these principles in solving petroleum and natural gas engineering problems using modern tools
- An integrated design experience leading to a capstone design course
- A balanced and rounded education to recognize the need for developing technical communication and teamwork skills, as well as understanding the engineer's professional, ethical, and societal obligations

Student Outcomes

Upon graduation, all Bachelors of Science students in Petroleum and Natural Gas Engineering will have:

- A thorough understanding of scientific and engineering principles and their application to petroleum and natural gas engineering problems
- The ability to integrate their scientific and engineering knowledge to design and conduct experiments and interpret and analyze data
- The ability to apply scientific and engineering fundamentals to formulate solutions to petroleum and natural gas engineering problems
- The ability to use techniques, skills, and modern petroleum and natural gas engineering tools
- The ability to integrate their scientific and engineering knowledge to solve petroleum and natural gas engineering design problems
- The ability to communicate effectively
- The ability to function on multi-disciplinary teams
- Recognition of the professional and ethical responsibilities of a petroleum engineer
- An understanding of the impact of petroleum and natural gas engineering solutions in a societal and global context
- Recognition of the need to acquire the knowledge of contemporary issues
- Recognition of the need to engage in life-long learning

These outcomes are achieved by enrolling in rigorous individual courses in all basic areas of petroleum and natural gas engineering, basic science, mathematics, geology, and humanities and social sciences. The petroleum and natural gas engineering curriculum also contains significant laboratory components aimed at reinforcing the knowledge gained in the classroom. In the senior year, electives are offered in which the student may obtain

additional depth of knowledge in specific areas of petroleum and natural gas engineering technology. Each student is individually assisted in course selection by an adviser who is a member of the petroleum and natural gas engineering faculty.

Students gain practical experience and first-hand knowledge of many aspects of petroleum and natural gas engineering through close proximity to the industry in West Virginia and surrounding states. Production sites, secondary and enhanced oil recovery projects, compressor stations, gas storage fields, and corporate offices all provide excellent opportunities for our students. Additional experience is provided through modern, well-equipped laboratories within the department and the University. Students are urged to gain field experience through summer employment in the industry.

FACULTY

CHAIR

- Samuel Ameri - M.S.Pet.E., P.E. (West Virginia University)
Formation Evaluation

PROFESSORS

- Kashy Aminian - Ph.D. (University of Michigan)
Graduate Coordinator. Natural Gas Engineering, Unconventional Reservoirs
- Shahab Mohaghegh - Ph.D. (Pennsylvania State University)
Intelligent Systems, Shale Analytics

ASSOCIATE PROFESSOR

- H. Ilkin Bilgesu - Ph.D., P.E. (Pennsylvania State University)
Drilling Engineering

ASSISTANT PROFESSOR

- Ming Gu - Ph.D. (University of Texas)
Rock Mechanics
- Mehrdad Zamirian - Ph.D. (West Virginia University)
Property Evaluation
- Ali Takbiri Borujeni - Ph.D. (Louisiana State University)
Fracturing
- Ebrahim Fathi - Ph.D. (University of Oklahoma)
Phase Behavior

ADJUNCT PROFESSORS

- Alan Brannon - Ph.D. (West Virginia University)
Natural Gas Engineering
- Pramod Thakur - Ph.D. (Pennsylvania State University)
Coalbed Methane

[Click here to view the Suggested Plan of Study \(p. 4\)](#)

Curriculum in Petroleum and Natural Gas Engineering

GENERAL EDUCATION FOUNDATIONS

Please use this link to view a list of courses that meet each GEF requirement. (<http://registrar.wvu.edu/gef>)

NOTE: Some major requirements will fulfill specific GEF requirements. Please see the curriculum requirements listed below for details on which GEFs you will need to select.

General Education Foundations

F1 - Composition & Rhetoric		3-6
ENGL 101 & ENGL 102 or ENGL 103	Introduction to Composition and Rhetoric and Composition, Rhetoric, and Research Accelerated Academic Writing	
F2A/F2B - Science & Technology		4-6
F3 - Math & Quantitative Skills		3-4
F4 - Society & Connections		3
F5 - Human Inquiry & the Past		3

F6 - The Arts & Creativity	3
F7 - Global Studies & Diversity	3
F8 - Focus (may be satisfied by completion of a minor, double major, or dual degree)	9
Total Hours	31-37

Please note that not all of the GEF courses are offered at all campuses. Students should consult with their advisor or academic department regarding the GEF course offerings available at their campus.

Curriculum Requirements

To receive a degree of bachelor of science in petroleum and natural gas engineering, a student must meet the University's undergraduate degree requirements, take all of the courses indicated below, earn a grade of C- or better in all petroleum and natural gas engineering courses, and attain a grade point average of 2.25 or better in all petroleum and natural gas engineering courses, in all WVU courses, and overall. If a petroleum and natural gas engineering course is repeated, only the last grade received is used to compute the major grade point average, and the course credit hours are counted only once. This requirement assures that the student has demonstrated overall competence in the major.

Freshman Engineering Requirements

ENGR 101	Engineering Problem Solving 1	2
Engineering Problem Solving:		3
CHE 102	Introduction to Chemical Engineering	
ENGR 102	Engineering Problem-Solving 2	
ENGR 103	Introduction to Nanotechnology Design	
MAE 102	Introduction to Mechanical and Aerospace Engineering Design	
ENGR 191	First-Year Seminar	1

Non-Petroleum & Natural Gas Engineering Core

CHEM 115	Fundamentals of Chemistry (GEF 2B)	4
CHEM 116	Fundamentals of Chemistry (GEF 8)	4
ECON 201	Principles of Microeconomics (GEF 4)	3
ECON 202	Principles of Macroeconomics	3
GEOL 101	Planet Earth	3
GEOL 373	Introduction to Petroleum Geology	3
Calculus I (GEF 3):		4
MATH 155	Calculus 1 (Minimum grade of C- is required)	
MATH 153 & MATH 154	Calculus 1a with Precalculus and Calculus 1b with Precalculus (Minimum grade of C- is required)	
MATH 156	Calculus 2 (GEF 8 - Minimum grade of C- is required)	4
MATH 251	Multivariable Calculus (Minimum grade of C- is required)	4
MATH 261	Elementary Differential Equations	4
PHYS 111	General Physics (GEF 8)	4
PHYS 112	General Physics	4
STAT 215	Introduction to Probability and Statistics	3
or IENG 213	Engineering Statistics	
EE 221	Introduction to Electrical Engineering	3
MAE 241	Statics	3
MAE 243	Mechanics of Materials	3
MAE 320	Thermodynamics	3
MAE 331	Fluid Mechanics	3

Petroleum & Natural Gas Engineering Core Requirements (Minimum grade of C- required)

Minimum GPA of 2.25 required in all petroleum and natural gas courses

PNGE 200	Introduction to Petroleum Engineering	3
PNGE 310	Drilling Engineering	4
PNGE 312	Drilling Fluids Laboratory	1
PNGE 332	Petroleum Properties and Phase Behavior (Fulfills Writing and Communications Skills Requirement)	3
PNGE 333	Basic Reservoir Engineering	3
PNGE 400	Petroleum Engineering Ethics	1

PNGE 405	Multidisciplinary Team Project	1
PNGE 420	Production Engineering	3
PNGE 432	Petroleum Reservoir Engineering Laboratory	1
PNGE 434	Applied Reservoir Engineering	3
PNGE 441	Oil and Gas Property Evaluation	3
PNGE 450	Formation Evaluation	3
PNGE 470	Natural Gas Engineering	4
PNGE 480	Petroleum Engineering Design	3
Professional Elective - select two of the following:		6
PNGE 415	Well Control	
PNGE 460	Well Stimulation Design	
PNGE 471	Natural Gas Production and Storage	
PNGE 501	Petroleum Engineering Problems	
PNGE 532	Introduction to Reservoir Simulation	
Additional GEF Elective (2-7)		3
GEF Electives 1, 5, 6, 7		15
Total Hours		128

Suggested Plan of Study

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 B.S.P.N.G.E. degree program that completes degree requirements in four years is as follows.

First Year

Fall	Hours Spring	Hours
MATH 155 (GEF 3)	4 MATH 156 (GEF 8)	4
ENGR 101	2 ENGR 102	3
ENGR 191	1 PHYS 111 (GEF 8)	4
CHEM 115 (GEF 2B)	4 CHEM 116 (GEF 8)	4
ENGL 101 (GEF 1)	3 GEF Elective 6	3
GEF Elective 5	3	
	17	18

Second Year

Fall	Hours Spring	Hours
PHYS 112	4 MATH 261	4
MATH 251	4 MAE 243	3
MAE 241	3 MAE 331	3
ENGL 102 (GEF 1)	3 IENG 213 or STAT 215	3
GEOL 101	3 PNGE 200	3
	17	16

Third Year

Fall	Hours Spring	Hours
PNGE 332	3 PNGE 310	4
EE 221	3 PNGE 312	1
ECON 201 (GEF 4)	3 PNGE 333	3
MAE 320	3 ECON 202	3
GEF Elective 7	3 GEOL 373	3
	Additional GEF Course	3
	15	17

Fourth Year

Fall	Hours Spring	Hours
PNGE 420	3 PNGE 400	1
PNGE 434	3 PNGE 405	1

PNGE 441	3 PNGE 432	1
PNGE 450	3 PNGE 480	3
PNGE 470	4 Two Professional Electives	6
		<hr/>
		16
		<hr/>
		12

Total credit hours: 128

Major Learning Outcomes

PETROLEUM & NATURAL GAS ENGINEERING

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PNGE 200. Introduction to Petroleum Engineering. 3 Hours.

PR: Sophomore standing. Introduction; origin, migration, and accumulation of petroleum; reservoir fluids properties; properties of reservoir rocks; exploration; drilling technology; reservoir engineering; well completions; production engineering. Open to all students.

PNGE 293. Special Topics. 1-6 Hours.

PR: Consent. Investigation of topics not covered in regularly scheduled courses.

PNGE 297. Research. 1-6 Hours.

Independent Research projects.

PNGE 300. Transport Phenomena in Petroleum Engineering. 3 Hours.

PR: MAE 241. Introduction to fluid flow in pipes, two-phase flow, rotary drilling hydraulics, primary cementing jobs, flow calculations, flow measuring devices, fluid machinery, dimensional analysis, and heat transfer.

PNGE 310. Drilling Engineering. 4 Hours.

PR: GEOL 101 and MAE 331. Rock properties, functions and design considerations of rotating system, hoisting system, and circulation system; drilling fluids calculations and selections; hydraulic programs; drilling optimization; casing string design; cementing programs; and pressure control.

PNGE 312. Drilling Fluids Laboratory. 1 Hour.

PR or Conc: PNGE 310. Topics include clay hydration, viscosity of water-based fluids, mud weight control, filtration studies, thinning agents, chemical contaminants, lime muds, polymer muds, rheological models, and liquid and solid determination.

PNGE 332. Petroleum Properties and Phase Behavior. 3 Hours.

PR: PNGE 200 and CHEM 116 and (ENGL 102 or ENGL 103). Theoretical and applied phase behavior of hydrocarbon system and hydrocarbon fluids. Applications to petroleum reservoirs and production engineering design. (2 hr. lec., 3 hr. lab.).

PNGE 333. Basic Reservoir Engineering. 3 Hours.

PR: PHYS 112 and MAE 331. Basic properties of petroleum reservoir rocks. Fluid flow through porous materials. Evaluation of oil and gas reserves.

PNGE 400. Petroleum Engineering Ethics. 1 Hour.

PR: PNGE 450 or consent. Introduction to petroleum and natural engineering ethics and moral issues concerning safety in engineering practice as well as those arising for engineers employed by corporations. Professionalism and professional registration.

PNGE 405. Multidisciplinary Team Project. 1 Hour.

PR: PNGE 434 and PNGE 470. Introduction to the need to seek input from other professionals, incorporate constraints imposed by other disciplines in solving petroleum and natural gas engineering design problems, and working with other professionals in a multi-disciplinary team.

PNGE 415. Well Control. 3 Hours.

PR: PNGE 310. Methods, techniques, equipment, and engineering calculations used in the control of oil and natural gas wells during drilling operations. Practical applications with rig floor simulator.

PNGE 420. Production Engineering. 3 Hours.

PR: PNGE 310 and PNGE 332. Well completion, performance of Productive formulation, drill stem tests, completion of wells, flowing wells, gas lift methods and equipment, pumping installation design, well stimulation, emulsions, treating, gathering, and storage of oil and gas, field automation. (3 hr. lec.).

PNGE 432. Petroleum Reservoir Engineering Laboratory. 1 Hour.

PR or Conc: PNGE 333. Laboratory evaluation of basic and special petroleum reservoir rock properties. (3 Hr. lab.).

PNGE 434. Applied Reservoir Engineering. 3 Hours.

PR: MATH 261 and PNGE 333 and PR or Conc: STAT 215 or IENG 213. Application of reservoir engineering data to calculation of recovery potentials and prediction of reservoir performance under a variety of production methods to effect maximum conservation.

PNGE 441. Oil and Gas Property Evaluation. 3 Hours.

PR: PNGE 333 and PR or Conc: PNGE 420 or consent. Reserve estimation decline analysis, petroleum property evaluation, including interest calculations, cost estimation and tax evaluation. Overview investment decision analysis and computer applications in property evaluation.

PNGE 450. Formation Evaluation. 3 Hours.

PR: PNGE 310 and PR or Conc: EE 221 or consent. Various well logging methods and related calculations with exercises in interpretation of data from actual well logs.

PNGE 460. Well Stimulation Design. 3 Hours.

PR: (MAE 243 and PNGE 420 and PNGE 333) or consent. Fundamentals of well stimulation and treatment design and their applications to low permeability formations.

PNGE 470. Natural Gas Engineering. 4 Hours.

PR: PNGE 333 and PR or Conc: MAE 320. Natural gas properties, compression, transmission, processing, and application of reservoir engineering principles to predict the performance and design of gas, gas-condensate, and storage reservoirs. Includes a laboratory devoted to gas measurements. (3 hr. lec, 3 hr. lab.).

PNGE 471. Natural Gas Production and Storage. 3 Hours.

PR: PNGE 470. Development of gas and gas-condensate reservoirs; design and development of gas storage fields in depleted gas, gas-condensate, oil reservoirs and aquifers.

PNGE 480. Petroleum Engineering Design. 3 Hours.

PR: PNGE 420 and PNGE 434 and PNGE 441 and PR or Conc: PNGE 450. Comprehensive problems in design involving systems in oil and gas production, field processing, transportation, and storage.

PNGE 490. Teaching Practicum. 1-3 Hours.

PR: Consent. Teaching practice as a tutor or assistant.

PNGE 491. Professional Field Experience. 1-18 Hours.

PR: Consent. (May be repeated up to a maximum of 18 Hours.) Prearranged experiential learning program, to be planned, supervised, and evaluated for credit by faculty and field supervisors. Involves temporary placement with public or private enterprise for professional competence development.

PNGE 493. Special Topics. 1-6 Hours.

PR: Consent. Investigation of topics not covered in regularly scheduled courses.

PNGE 494. Seminar. 1-3 Hours.

PR: Consent. Presentation and discussion of topics of mutual concern to students and faculty.

PNGE 495. Independent Study. 1-6 Hours.

Faculty supervised study of topics not available through regular course offerings.

PNGE 496. Senior Thesis. 1-3 Hours.

PR: Consent.

PNGE 497. Research. 1-6 Hours.

Independent research projects.

PNGE 498. Honors. 1-3 Hours.

PR: Students in Honors Program and consent by the honors director. Independent reading, study or research.