Department of Petroleum and Natural Gas Engineering

Degrees Offered

- Master of science in petroleum and natural gas engineering
- Master of science in engineering with a major in petroleum and natural gas engineering
- Doctor of philosophy in engineering with a major in petroleum and natural gas engineering

The Petroleum and Natural Gas Engineering (PNGE) graduate programs are designed for students who have already completed a basic petroleum engineering curriculum.

Degree Programs

The Department of Petroleum and Natural Gas Engineering admits students to the following degree programs: master of science in petroleum and natural gas engineering (M.S.P.N.G.E.) and petroleum and natural gas engineering major under the college of engineering and mineral resources’ interdisciplinary doctor of philosophy (Ph.D.). Students in these programs must comply with the rules and regulations as presented in the general requirements for graduate work in the College of Engineering and Mineral Resources.

Program Objectives

The objective of the Petroleum and Natural Gas Engineering (PNGE) graduate programs is to educate and train men and women who will be capable of performing at the highest levels of the petroleum and natural gas engineering profession. The programs provide students with the advanced technical knowledge and engineering skills needed by the oil and gas industry in the state, the nation, and the world. Moreover, the programs will make students competent to perform independent research and will prepare them to be the future providers of high quality education in petroleum and natural gas engineering. Graduates have the opportunity to enter all phases of the oil and natural gas industry, government agencies, and academia in meaningful and important jobs.

Student Learning Outcomes

- Graduates will have in-depth knowledge of petroleum and natural gas engineering principles and applications to function effectively in their profession or continue their education.
- Graduates will have the ability to perform independent research to solve engineering and scientific problems encountered in their profession.
- Graduates will have in-depth petroleum and natural gas scientific and engineering knowledge to provide high quality education in petroleum and natural gas engineering.

Areas of Research

- Development of the Unconventional Oil and Gas Resources
- Drilling and Completion
- Reservoir Engineering
- Formation Evaluation
- CO₂ Sequestration and Enhanced Oil Recovery
- Reservoir Simulation
- Artificial Intelligence

FACULTY

CHAIR

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

PROFESSORS

- Kashy Aminian - Ph.D. (University of Michigan)
  - Natural Gas Engineering, Reservoir Engineering
- Shahab Mohaghegh - Ph.D. (Pennsylvania State University)
  - Intelligent Systems
ASSOCIATE PROFESSOR  
• H. Ilkin Bilgesu - Ph.D., P.E. (Pennsylvania State University)  
  Drilling Engineering

ASSISTANT PROFESSOR  
• Ebrahim Fathi - Ph.D. (University of Oklahoma)  
  Unconventional Gas Recovery  
• Ali Takbiri Boroujeni - Ph.D. (Louisiana State University)  
  Enhanced Oil Recovery

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

Masters Admission  
A candidate for the M.S.P.N.G.E. program must meet the following requirements:

• B.S. degree in engineering from an ABET-accredited, or an internationally-recognized engineering program or equivalent with a grade point average (GPA) equal to, or greater than, 3.0 (on a 4.0 scale) (Applicants who cannot meet this condition may be considered for provisional admission.)
• International students must demonstrate proficiency in communicating in English (a minimum TOEFL score of 550, or IBT score of 79, or IELTS score of 6.5).
• At least three recommendation letters (One letter must be from the applicant’s academic advisor or equivalent.)

Doctoral Admission  
A candidate for the degree of Doctor of Philosophy (Ph.D.) must comply with the rules and regulations as outlined in the general requirements for graduate work in engineering and the specific requirements stated in the departmental guidelines.

A candidate for the degree of Doctor of Philosophy (Ph.D.) must meet the following requirements:

• B.S. or M.S. degree in petroleum engineering from an ABET-accredited, or an internationally-recognized petroleum engineering program or equivalent with a grade point average (GPA) equal to, or greater than, 3.0 and 3.2, respectively
• A score of at least seventy-fifth percentile for Graduate Record Examination (GRE) quantitative analysis
• International students must demonstrate proficiency in communicating in English (a minimum TOEFL Score of 550, or IBT Score of 79, or IELTS Score of 6.5).
• At least three recommendation letters (One letter must be from the applicant’s previous thesis advisor or an academic equivalent.)

Master of Science in Petroleum and Natural Gas Engineering  
A candidate for the M.S. degree in petroleum and natural gas engineering (PNGE) must comply with the rules and regulations as outlined in the general requirements for graduate work in engineering and the specific requirements stated in the departmental guidelines.

STUDY PROGRAMS  
All M.S. degree candidates are required to perform research and follow a planned program of study. The research advisor, in conjunction with the Advising and Examining Committee (AEC) — appointed with the consent of the student — 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 student with the necessary tools to carry out his/her thesis research and prepare him/her for his/her career.

The program must contain a minimum of twenty-four hours of coursework and six hours of research (PNGE 697) leading to a master’s thesis or thirty hours of coursework and three hours of research (PNGE 697) leading to a comprehensive problem report. At least sixty percent of the course credits must be from 500 through 700-level courses while the remainder can be made up of 400-level courses. All students are required to take PNGE 796 for each semester enrolled. A maximum of three credit hours each of Graduate Seminar (PNGE 796) and Independent Study (PNGE 695) can be counted towards meeting the coursework requirements.

Students who do not hold a baccalaureate degree in petroleum and natural gas engineering are required to take a set of undergraduate petroleum and natural gas engineering courses above and beyond the minimum coursework requirements.
RESEARCH PROPOSALS
M.S. students following the thesis 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.

FINAL EXAMINATION
All students are required to pass a final oral examination, administered by their AEC, covering both the thesis or problem report (depending on the program selected) and related course material.

Doctor of Philosophy in Petroleum and Natural Gas Engineering
The doctor of philosophy degree is administered through the college’s interdisciplinary program; petroleum and natural gas engineering may be the major. A candidate for the degree of doctor of philosophy must comply with the rules and regulations outlined in the general requirements of the Statler College of Engineering and Mineral Resources. The research work for the doctoral dissertation must show a high degree of originality on the part of the student and must constitute an original contribution to the art and science of petroleum and natural gas engineering.

STUDY PROGRAM
Each student must conduct research and follow a planned program of study prepared by the research advisor, in consultation with the student, and approved by the student’s advisory and examining committee (AEC) - appointed with the consent of the student. The underlying principle of the planned program is to accommodate and facilitate the students such that they are well prepared for their dissertation research and their career. A minimum of fifty-four hours of coursework and thirty hours of independent research beyond a bachelor’s degree, or thirty hours of coursework and twenty-four hours of independent research beyond an M.S. degree are required. All students are required to take PNGE 796 Graduate Seminar for each semester enrolled. A maximum of three credit hours each of Graduate Seminar (PNGE 796) and Independent Study (PNGE 795) can be counted towards meeting the coursework requirements.

EXAMINATION
All students must take and pass a written qualifying examination no later than one semester after completion of eighteen credit hours toward doctoral degree. In order to be admitted to candidacy, the student must pass the candidacy exam, which is designed to evaluate the student’s overall ability to engage in high-level research. At the completion of the dissertation research, the candidate must prepare a dissertation and pass the final oral examination (defense) administered by their AEC.

COURSES
PNGE 501. Petroleum Engineering Problems. 1-3 Hours.
PR: Senior standing. Investigation of a special problem in petroleum engineering.

PNGE 532. Intro to Reservoir Simulation. 3 Hours.
PR or CONC: PNGE 434 or Consent. Partial differential equations for fluid flow in porous media and the use of finite difference equations in solving reservoir flow problems for various boundary conditions. Study of individual well pressures and fundamentals of history matching.

PNGE 533. Sndry Rcyr-Oil-Water Flooding. 3 Hours.
PR: PNGE 333. Theory of immiscible fluid displacement mechanism, evaluation and economics of water flood projects, and oil field flooding techniques. (3 hr. lec.).

PNGE 591A-Z. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

PNGE 601. Flow Fluids Porous Media. 3 Hours.
PR: PNGE 434 and MATH 261 or consent. Theoretical and practical aspects of the physical principles of hydrodynamics in porous media. (3 hr. lec.).

PNGE 632. Reservoir Simulation/Modeling. 3 Hours.
PR: PNGE 532 or consent. Application of finite-difference equations to multi-phase fluid flow in porous media in two or three dimensions with gravity and capillary pressure effects. Simulation of waterflood performance and enhanced recovery techniques.

PNGE 633. Advanced Secondary Recovery. 3 Hours.
PR: PNGE 533. Secondary recovery of oil by gas flooding, miscible fluid injection, in-situ combustion, and heat injection. (3 hr. lec.).

PNGE 634. Pressure Transient Analysis. 3 Hours.
PR: PNGE 434 or consent. Methods of analysis of pressure transient data obtained from well testing for the purpose of determining in-situ reservoir conditions including porosity, lateral extent, average reservoir pressure, and formation permeability.

PNGE 691A-Z. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

PNGE 693A-Z. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.
PNGE 695. Independent Study. 1-6 Hours.
Faculty supervised study of topics not available through regular course offerings.

PNGE 697. Research. 1-15 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U).

PNGE 701. Envrmntl-Issues-Petroleum Engr. 3 Hours.
PR: Graduate standing. Environmental impacts of petroleum exploration and production, methods to minimize or eliminate potential environmental impacts, treatment and disposal of the drilling and production wastes, and remediation methods for petroleum contaminated sites.

PNGE 710. Advanced Drilling Engineering. 3 Hours.
PR: PNGE 310. Drilling optimization, methods for estimating formation pore and fracture pressures, air drilling, application of directional drilling and deviation control, horizontal drilling, and coiled tubing applications.

PNGE 711. Advanced Productions Engr. 3 Hours.
PR: PNGE 420. Advanced well completion methods, problem well analysis, well remediation and workover planning, multi-phase flow in pipes, system approach for oil and gas wells, application of NODAL analysis, and surface and subsurface production equipment.

PNGE 734. Advanced Reservoir Engineering. 3 Hours.
PR: PNGE 434. Modeling and simulation of heterogeneous reservoirs, predicting the performance of the heterogeneous reservoirs during primary, secondary, and enhanced recovery production.

PNGE 735. Advanced Formation Evaluation. 3 Hours.
PR: PNGE 450. Advanced methods for interpreting well logs, shaly sand analysis, and production logging methods.

PNGE 770. Adv Natural Gas Engineering. 3 Hours.
PR: PNGE 470. Application of reservoir modeling, history matching, and type curves techniques to analyze and predict the performance of conventional and unconventional gas reservoirs.

PNGE 790. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of petroleum and natural gas engineering. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibility. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading may be S/U).

PNGE 791A-Z. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

PNGE 792A-Z. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

PNGE 793A-Z. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

PNGE 794A-Z. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

PNGE 795. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

PNGE 796. Graduate Seminar. 1 Hour.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

PNGE 797. Research. 1-15 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U).

PNGE 798. Dissertation. 1-6 Hours.
PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.