PGE - Petroleum and Geosystems Engineering

Petroleum and Geosystems Engineering: PGE

Lower-Division Courses

PGE 301. Engineering, Energy, and the Environment.

Enrollment limited to beginning students in petroleum and geosystems engineering. Introduction to the field of petroleum engineering. Overview of energy supply and demand. Studies subsurface engineering and engineering problem-solving methods, with an emphasis on fossil energy exploitation and geologic CO2 storage. Includes aspects of basic petroleum geology. Two lecture hours and three laboratory hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Credit with a grade of at least C- or registration for Geological Sciences 401 or 303.

PGE 311. Numerical Methods and Programming.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Introduction to computer programming and mathematical equations typically encountered in petroleum and geosystems engineering; methods to visualize data and solve engineering and mathematical equations with numerical methods; and applications of computers to general problem solving. Three lecture hours a week for one semester Petroleum and Geosystems Engineering 310 and 311 may not both be counted. Offered on the letter-grade basis only. Prerequisite: Physics 303K with a grade of at least C-, Physics 105M or 103M with a grade of at least C-, and credit with a grade of at least C- or registration for Mathematics 427J.

PGE 312. Physical and Chemical Behavior of Fluids I.

Principles of organic chemistry; phase behavior; properties of hydrocarbon gases and liquids and oil field waters; overview of laboratory phase behavior measurements; material balance calculations. Three lecture hours a week for one semester. Petroleum and Geosystems Engineering 312 and 427 may not both be counted. Offered on the letter-grade basis only. Prerequisite: Chemistry 302 with a grade of at least C-.

PGE 119S, 219S, 319S, 419S, 519S, 619S, 719S, 819S, 919S. Topics in Petroleum and Geosystems Engineering.

Used to record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office. Credit is recorded as assigned by the study abroad adviser in the Department of Petroleum and Geosystems Engineering. University credit is awarded for work in an exchange program; it may be counted as coursework taken in residence. Transfer credit is awarded for work in an affiliated studies program. May be repeated for credit when the topics vary. Offered on the letter-grade basis only.

Upper-Division Courses

PGE 421K. Physical and Chemical Behavior of Fluids II.

Applications of thermodynamics and physical chemistry to petroleum and geosystems engineering. Three lecture hours and three laboratory hours a week for one semester. Prerequisite: Petroleum and Geosystems Engineering 326.

PGE 322K. Transport Phenomena in Geosystems.

Applications of mass, heat, and momentum balances to fluid flow problems; shell balances; non-Newtonian fluids; transport processes through permeable media. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Engineering Mechanics 306, and Mathematics 427J or 427K with a grade of at least C- in each.

PGE 323K. Reservoir Engineering I: Primary Recovery.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Classification of subsurface reservoirs by type and recovery mechanism; reserve estimates based on material balance; steady-state and transient fluid flow in permeable reservoir rocks as applied to subsurface engineering problems. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: The following with a grade of at least C-: Petroleum and Geosystems Engineering 311 (or 310), 326, and 427; and credit with a grade of at least C- or registration in Petroleum and Geosystems Engineering 322K and 424.

PGE 323L. Reservoir Engineering II: Secondary and Tertiary Recovery.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Introduction to reservoir displacement processes; water and gas injection; enhanced recovery. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Credit with a grade of at least C- for Mathematics 427J or 427K, Petroleum and Geosystems Engineering 311 (or 310), 322K, 323K, and 424.

PGE 323M. Reservoir Engineering III: Numerical Simulation.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Mathematical equations governing fluid flow in reservoirs; numerical methods to solve the equations; numerical reservoir simulation; treatment of wells; history matching; a simulation project performed using a commercial simulator. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Petroleum and Geosystems Engineering 323L with a grade of at least C-.

PGE 424. Petrophysics.

Properties of rocks; measurement and interpretation of petrophysical properties; application of petrophysics to subsurface engineering problems; interaction of resident fluids with rocks. Extensive written reporting. Three lecture hours and three laboratory hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Geological Sciences 416M or 316P, Petroleum and Geosystems Engineering 333T and Physics 303L with a grade of at least C- and credit or registration with at least a C- for Petroleum and Geosystems Engineering 322K.

PGE 326. Thermodynamics and Phase Behavior.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Basics of phase behavior, classical thermodynamics in terms of material and energy balances, and applications to changes of state of petroleum fluids. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: The following with a grade of at least C-: Chemistry 302, Physics 303K, Physics 105M or 103M, and Mathematics 408D or 408M.

PGE 427. Properties of Petroleum Fluids.

Restricted to students admitted to major sequence in geosystems engineering and hydrogeology or petroleum engineering. Principles of organic chemistry, phase behavior of multicomponent mixtures, properties of hydrocarbon gases and liquids and oil field waters, overview of laboratory phase behavior measurements, and material balance

calculations. Three lecture hours and three laboratory hours a week for one semester. Petroleum and Geosystems Engineering 312 and 427 may not both be counted. Offered on the letter-grade basis only. Prerequisite: Chemistry 302 and Petroleum and Geosystems Engineering 326 with a grade of at least C- in each.

PGE 430. Drilling and Well Completions.

Elements of rock mechanics, drilling fluids, factors affecting rate of penetration, and well completions, including casing and tubing design. Three lecture hours and one and one-half laboratory hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Engineering Mechanics 319 with a grade of at least C-, credit with a grade of at least C- or registration for Petroleum and Geosystems Engineering 322K.

PGE 333T. Engineering Communication.

Advanced technical communication skills, with emphasis on writing strategies for technical documents, oral presentations, and visual aids. Three lecture hours a week for one semester. Only one of the following may be counted: Aerospace Engineering 333T, Biomedical Engineering 333T, Communication 333T, Civil Engineering 333T, Chemical Engineering 333T, Electrical and Computer Engineering 333T, Electrical Engineering 333T, Engineering Studies 333T, Mechanical Engineering 333T, Petroleum and Geosystems Engineering 333T. Prerequisite: Rhetoric and Writing 306 with a grade of at least C-.

PGE 334. Reservoir Geomechanics.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Basic stress and strain analysis; pore pressure and in situ stress estimation and measurement; deformation mechanisms in rock; rock fracture description and analysis; wellbore stresses and failure; wellbore stability analysis; fault stability analysis; depletion-induced reservoir deformation; and hydraulic fracturing. Emphasis on applications to petroleum engineering. Two lecture hours and three laboratory hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Engineering Mechanics 319 and Petroleum and Geosystems Engineering 301 and 424 with a grade of at least C- in each.

PGE 338. Geostatistics and Data Analysis.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Explore basic frequentist and Bayesian probability and statistics, confidence and significance models, multivariate and spatial correlated features, feature engineering, spatial debiasing and estimation, stochastic simulation, uncertainty modeling, basic machine learning, and optimum decision making in the presence of uncertainty. Examine applications to spatial problems such as geology and subsurface resource development. Three lecture hours a week for one semester. Petroleum and Geosystems Engineering 337 and 338 may not both be counted. Offered on the letter-grade basis only. Prerequisite: The following coursework with a grade of at least C- in each: Mathematics 408D or 408M and Petroleum and Geosystems Engineering 311 (or 310).

PGE 358. Principles of Formation Evaluation.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Integrated petrophysical interpretation of well logs, core laboratory measurements, and geological data for static, dynamic, and geophysical appraisal of subsurface rock formations. Three lecture hours per week for one semester. Petroleum and Geosystems Engineering 358 and 368 may not both be counted. Offered on the letter-grade basis only. Prerequisite: Credit for Geological Sciences 416M or 316P, Physics 303L, Physics 105N or 103N, and Petroleum and Geosystems Engineering 424 with a grade of at least C-.

PGE 361. Advanced Reservoir Engineering.

Secondary recovery methods; computer simulation of reservoir performance; applications to field problems. Three lecture hours a week for one semester. Prerequisite: Petroleum and Geosystems Engineering 326 and 323K.

PGE 362. Production Technology and Design.

Restricted to petroleum engineering majors. Analysis, specification, and characteristics of production systems; inflow performance; wellbore and tubing hydraulics; and artificial lift. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Petroleum and Geosystems Engineering 430 with a grade of at least C-.

PGE 363. Petroleum Leasing Regulations and Practices.

Restricted to petroleum engineering majors. Domestic and worldwide regulations associated with petroleum leasing, including offshore areas, and environmental provisions concerning petroleum exploration and production. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Credit with a grade of at least C- or registration for Petroleum and Geosystems Engineering 365.

PGE 364. Natural Gas Engineering.

Production, transportation, and storage of gas; metering and gauging; performance of wells; estimation of gas reserves; prevention of waste and utilization of natural gas. Three lecture hours a week for one semester. Prerequisite: For petroleum engineering majors, Petroleum and Geosystems Engineering 326, 323K, and 362; for others, upper-division standing and consent of instructor.

PGE 365. Resource Economics and Valuation.

Restricted to petroleum engineering majors. Derivation of profitability criteria for earth resource investments, project analysis in terms of the interrelation of technical and economic factors, investment analysis in the presence of uncertainty, and project planning. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Petroleum and Geosystems Engineering 311 (or 310) and 323K with a grade of at least C-.

PGE 368. Fundamentals of Well Logging.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Principles, applications, and interpretation of well logs as used in exploration and evaluation of subsurface formations. Three lecture hours a week for one semester. Petroleum and Geosystems Engineering 358 and 368 may not both be counted. Offered on the letter-grade basis only. Prerequisite: Credit for Geological Sciences 416M or 316P, Physics 303L, and 103N and Petroleum and Geosystems Engineering 424 with a grade of at least C-.

PGE 371. Energy Finance.

Restricted to petroleum engineering majors. Fundamentals of finance as applied to the petroleum industry, including petroleum project financing techniques, investigating sources of capital, and methods used to evaluate an oil company's financial performance. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Credit with a grade of at least C- or registration for Petroleum and Geosystems Engineering 365.

PGE 372. Advanced Drilling and Well Completions.

Applications of geomechanics in wellbore and near-wellbore problems encountered in drilling and completing high-pressure, high-temperature wells on land and water locations. Three lecture hours a week for one semester. Petroleum and Geosystems Engineering 372 and 379 (Topic: Advanced Drilling and Well Completions) may not both be counted.

Prerequisite: Petroleum and Geosystems Engineering 430 and 334 with a grade of at least C-.

PGE 373L. Geosystems Engineering Design and Analysis.

Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Team-oriented design projects involving the application of geologic and engineering methods to the solution of subsurface problems, using field case histories. Projects are selected for each student based on his or her petroleum engineering technical area option. The equivalent of three lecture hours a week for one semester, with additional hours to be arranged. Offered on the letter-grade basis only. Prerequisite: The following with a grade of at least C- in each: Petroleum and Geosystems Engineering 323K, 323L, 362, and 358 or 368.

PGE 176, 276, 376. Special Problems in Petroleum and Geosystems Engineering.

Independent investigation of an advanced subject in petroleum and geosystems engineering, for superior students only. Conference course. Prerequisite: Admission to an appropriate major sequence in engineering and written consent of instructor.

PGE 377. Deepwater Operations.

Restricted to students admitted to major sequence in geosystems engineering and hydrogeology or petroleum engineering. Overview of various technical, logistical, and managerial elements that are functionally integrated in deepwater operations, with emphasis on applications in the Gulf of Mexico. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Petroleum and Geosystems Engineering 323K, 430, 334, and 362.

PGE 378. Applied Reservoir Characterization.

Restricted to petroleum engineering and geosystems engineering and hydrogeology majors. Reservoir modeling using software tools for statistical analysis of reservoir data; variogram analysis and modeling; spatial interpolation (kriging); tools for data integration in kriging; stochastic simulation of rock-types (lithology), pay thickness/porosity, and permeability; inputting geological models into flow simulation; uncertainty assessment. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Geological Sciences 416M or 316P with at least a C-, and Petroleum and Geosystems Engineering 310, 337, and 323M with a grade of at least C-.

PGE 379. Studies in Petroleum and Geosystems Engineering.

Special courses or seminars on recent developments in engineering. Three lecture hours a week for one semester. May be repeated for credit when the topics vary. Offered on the letter-grade basis only. Prerequisite: Admission to an appropriate major sequence in engineering or consent of instructor; additional prerequisites vary with the topic.

Topic 3: Geothermal and Sustainable Energy Resources. Explore energy resources including geothermal, solar thermal, and biomass. Examine the foundations of these energy resources and the engineering approaches to recovering them. Build on basic knowledge in thermodynamics, flow through porous media, and chemistry. Petroleum and Geosystems Engineering 379 (Topic: Geotherml/ Sustainble Energy Res) and 379 (Topic 3) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing and consent of instructor.

Topic 4: Carbon Capture and Storage. Explore carbon dioxide emission into the atmosphere; carbon dioxide capture from industrial sources; and the utilization, underground storage, and monitoring of carbon dioxide. Petroleum and Geosystems Engineering 379 (Topic: Carbon Capture & Storage) and 379 (Topic 4) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing and consent of instructor.

Topic 5: Energy and the Environment. Examine current and potential energy sources and how these might impact the earth's environment. Explore the consequences of energy production in terms of the environmental impact. Discuss carbon, water, and land footprints. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing.

Topic 7: Small Scale Fluid Flow. Examine the physics of fluid flow at the microscale in the context of pore-scale transport in subsurface systems and microfluidic models of subsurface systems. Review geological sediment deposition and how that motivates the appropriate microscopic length-scales. Explore equations of mass and momentum conservation for incompressible fluids. Develop simplifications towards the small-scale slow-flow limit to describe transport through pores and cover techniques in microfluidics and micromodels development. Petroleum and Geosystems Engineering 379 (Topic: Small Scale Fluid Flow) and 379 (Topic 7) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing.

Topic 8: Oil, Gas, and Mineral Law. Explore basic oil and gas law concepts, the forms generally used in oil and gas transactions and the type of regulation commonly applied to the oil and gas industry with a focus on Texas oil and gas law and regulation. Petroleum and Geosystems Engineering 379 (Topic: Oil, Gas, and Mineral Law) and 379 (Topic 8) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing.

Topic 9: Subsurface Machine Learning. Explore fundamental probability and statistics; inference and prediction; and model training, testing, tuning, and validation. Examine workflows for integrating many features; workflows for anomaly detection, spatiotemporal prediction, and uncertainty integration. Communicate results within a project team to impact subsurface decision making. Three lecture hours a week for one semester. Petroleum and Geosystems Engineering 379 (Topic: Subsurface Machine Learning) and 379 (Topic 9) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Mathematics 408D or 408M with a grade of at least C-.

Topic 10: Artificial Lift. Restricted to geosystems engineering and hydrogeology and petroleum engineering majors. Life of a well, well testing, gas and plunger lift, progressive cavity pumps, electric submersible pumps, and beam lift. Petroleum and Geosystems Engineering 379 (Topic: Artificial Lift) and 379 (Topic 10) may not both be counted. May be used to fulfill the technical elective requirement for the Bachelor of Science in Petroleum Engineering degree. Offered on the letter-grade basis only. Additional prerequisite: Petroleum and Geosystems Engineering 430 and 362 with a grade of at least C-.

Topic 11: Facilities Management. Restricted to geosystems engineering and hydrogeology or petroleum engineering majors. Petroleum fluid characteristics, process control, separators, metering, produced water, tanks, gas processing, gas compression, and liquid pumps. Petroleum and Geosystems Engineering 379 (Topic: Oil and Gas Production Facilities Design) and 379 (Topic 11) may not both be counted. May be used to fulfill the technical elective requirement for the Bachelor of Science in Petroleum Engineering degree. Offered on the letter-grade basis only. Additional prerequisite: Petroleum and Geosystems Engineering 362 with a grade of at least C-.

Topic 12: Blowout Prevention and Control. Background in hydrostatics, hydrodynamics, hydraulics, geomechanics, mechanical systems, and procedures as they apply to well control. Petroleum and Geosystems Engineering 379 (Topic: Blowout Prevention and Control) and 379 (Topic 12) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing and Petroleum and Geosystems Engineering 430 with at least a C-.

Topic 13: Fundamentals of Enhanced Oil Recovery Techniques. Overview of the fundamental displacement concepts of chemical, miscible, and thermal enhanced oil recovery methods. Also includes

the concept of phase behavior in each process. Petroleum and Geosystems Engineering 379 (Topic: Fundamentals of Enhanced Oil Recovery Techniques) and 379 (Topic 13) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing and Petroleum and Geosystems Engineering 323L (or 323) with a grade of at least C-.

Topic 14: High Performance Computational Engineering. An introduction to the UNIX environment in a scientific computing context, including instruction in several import UNIX applications to improve user productivity. Examine the differences between various parallelization styles of computing and develop a basic working understanding of how to utilize the application programming interfaces (APIs) in scientific applications. Three lecture hours a week for one semester. Petroleum and Geosystems Engineering 379 (Topic: High Performance Comp Eng) and 379 (Topic 14) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing; Mathematics 408D or 408M and Petroleum and Geosystems Engineering 310 with a grade of at least C-.

Topic 15: E4: The Earth, Natural Resources, and Sustainability. Application of logic, common sense, the fundamental laws of mass and energy conservation, as well as more advanced thermodynamics to evaluate overall efficencies of major human energy supply schemes such as fossil, nuclear, solar, wind, and biomass to define and quantify the irreversible linear processes and sustainable/unsustainable cycles. Petroleum and Geosystems Engineering 379 (Topic: E4: Earth, Environment, Energy) and 379 (Topic 15) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing; and credit with a grade of at least C- in each of the following: Chemistry 302, Mathematics 408C or 308K, Physics 303K, Petroleum and Geosystems Engineering 310, and 326.

Topic 16: Hydraulic Fracture Design and Evaluation. Overview of Formation evaluation; elasticity; in situ stress calculation and measurement; fracture initiation; basic equations of fracture mechanics; 2-and-3-dimensional fracture models; fluid rheology; proppant settling; pipe friction/surface pressure calculations; treatment pressure analysis; fracture diagnostics; fracturing from horizontal and deviated wells; and treatment design and completions. Petroleum and Geosystems Engineering 379 (Topic: Hydraulic Fracture Design and Evaluation) and 379 (Topic 16) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing and Petroleum and Geosystems Engineering 334 (or 432) with a grade of at least C.

Topic 17: Applied Subsurface Geology. Principles and techniques for subsurface geologic interpretation, including subsurface mapping; construction of cross-sections; core description and analysis; stratigraphic interpretation of well logs; and stratigraphic and facies interpretation of seismic data. Petroleum and Geosystems Engineering 379 (Topic: Applied Subsurface Geology) and 379 (Topic 17) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Geology 416M or 316P with a grade of at least C-.

Topic 18: Wellbore Mechanics and Managed Pressure Drilling. Operational topics will draw from drilling fluids engineering; drilling system engineering; rig and wellbore hydraulics; ROP parameters and drilling optimizations; wellbore stability; fracture and pore pressure gradients; mud weight windows; in-situ and near-wellbore stress states; lost circulation; pressure control; pipe sticking; and other situations common to drilling operations. Petroleum and Geosystems Engineering 379 (Topic: Wellbore Mechanics and Managed Pressure Drilling) and 379 (Topic 18) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing and Petroleum and Geosystems Engineering 430.

Topic 19: Advanced Well Construction. Focus on advanced topics in drilling fluids, cementing, hydraulics, managed pressure and dual gradient drilling, advanced well control and casing design, complex well design (DW, HPHT, Arctic), and well completions. Petroleum and Geosystems Engineering 379 (Topic: Advanced Well Construction) and 379 (Topic 19) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing and Chemistry 302, Mathematics 408D, Petroleum and Geosystems Engineering 326, 430, Physics 303K, 103M.

Topic 20: Drilling Engineering and Operations Management. Restricted to non-petroleum engineering majors. A broad overview of the key elements of today's drilling engineering discipline, including an understanding of rigs and rig equipment, familiarity with drilling fluids, cementing, directional drilling techniques etc., up to understanding of casing design, well control and the application of new & emerging drilling and completion technologies. Petroleum and Geosystems Engineering 379 (Topic: Drilling Engineering and Operations Management) and 379 (Topic: 20) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Mathematics 408D, Physics 303K, 103N, and Petroleum and Geosystems Engineering 326 with a grade of at least C-.

Topic 21: Wellbore to Reservoir Geomechanics. Applications from offshore to unconventionals. Applications of fluid flow/geomechanics concepts at wellbore, near-wellbore and reservoir scales; vertical, inclined, and horizontal wells; drilling, completion, production and reservoir applications; sandstones, shales, carbonates Petroleum and Geosystems Engineering 379 (Topic: Wellbore Reservoir Geomech) and 379 (Topic 21) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: PGE 323K, PGE 430 and PGE 362 with a grade of at least C-; registration or grade of at least C- in PGE 334.

Topic 22: Global Carbon Monitoring Systems. Review technologies that help us monitor the pulse of the planet. Learn about systems that directly measure carbon dioxide and methane emissions from both natural sources like wetlands and permafrost and human-made sources like agriculture and fossil fuels. Study how modern technologies - drones, satellites, aerial systems - are revolutionizing the way we measure carbon emission from energy production and use. Petroleum and Geosystems Engineering 379 (Topic: Global Carbon Monitoring Sys) and 379 (Topic 22) may not both be counted. Offered on the letter-grade basis only. Additional prerequisite: Upper-division standing and consent of instructor.

PGE 679H. Undergraduate Honors Thesis.

Research performed during two consecutive semesters under the supervision of an engineering faculty member; topics are selected jointly by the student and the faculty member with approval by the director of the Engineering Honors Program. The student makes an oral presentation and writes a thesis. Individual instruction for two semesters. Students pursuing both the Bachelor of Arts, Plan II, and a bachelor's degree in engineering may use this course to fulfill the thesis requirement for the Bachelor of Arts, Plan II. Prerequisite: For 679HA, enrollment in the Engineering Honors Program; for 679HB, Petroleum and Geosystems Engineering 679HA and enrollment in the Engineering Honors Program.

Graduate Courses

PGE 380, 680. Advanced Petroleum Laboratory for Master's Degree Candidates.

For each semester hour of credit earned, the equivalent of one class hour a week for one semester. May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Graduate standing and twelve semester hours of upper-division coursework in petroleum and geosystems engineering.

PGE 381. Drilling Engineering.

Not open to students who have a degree in petroleum engineering. Basic drilling terminology and advanced drilling engineering topics. Three lecture hours a week for one semester. Required for students pursuing the doctoral degree in petroleum engineering. Prerequisite: Graduate standing in petroleum engineering.

PGE 381K. Engineering Analysis.

Application of classical methods of mathematical analysis to problems frequently encountered in engineering applications. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

PGE 381L. Advanced Petrophysics.

Measurement, interpretation, and analysis of petrophysical properties of petroleum reservoir rocks. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

PGE 381M. Transport Phenomena.

Three lecture hours a week for one semester. Prerequisite: Graduate standing in computational and applied mathematics, engineering, or geological sciences.

PGE 382. Basic Geological Concepts for Engineers.

Basic geological principles for students with little or no geological background. Three lecture hours a week for one semester. Prerequisite: Graduate standing in petroleum or civil engineering.

PGE 382K. Theory and Application of Reservoir Transients.

Mathematical development and application of multiple pressure transients in well and reservoir systems. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

PGE 382L. Numerical Methods in Petroleum and Geosystems Engineering.

The use of numerical methods and computers in the solution of petroleum and geosystems engineering problems. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

PGE 383. Special Topics in Petroleum and Geosystems Engineering.

Recent literature on petroleum production practice and petroleum and geosystems engineering problems. Three lecture hours a week for one semester. May be repeated for credit when the topics vary. Prerequisite: Graduate standing in computational and applied mathematics, engineering, or geological sciences. Students seeking to enroll in any seminar must present technical prerequisites satisfactory to the instructor.

Topic 2: Advanced Drilling Fluids.
Topic 5: Thermal Recovery.
Topic 10: Numerical Solution of Time-Dependent Problems.
Topic 12: Near Wellbore Problems.
Topic 16: Topics in Computational Methods.
Topic 17: Naturally Fractured Reservoirs.
Topic 20: Geostatistics.
Topic 24: Natural Gas Engineering.
Topic 27: Rock Mechanics: Drilling, Completing, and Producing Applications.
Topic 28: Macroeconomics of Petroleum.
Topic 30: Fundamentals of Subsurface Environmental Engineering.
Topic 32: Hydraulic Fracture Design and Evaluation.
Topic 33: Advanced Drilling and Well Completion.
Topic 35: Advanced Production Engineering.
Topic 36: Advanced Numerical Methods.
Topic 38: Chromatographic Transport and Geochemical Modeling.
Topic 39: Design and Analysis of Pumping Systems.
Topic 41: Energy Finance.
Topic 46: International Petroleum Concessions and Agreements.
Topic 50: Reservoir Applications of Foam.
Topic 55: Pore-Level Petrophysics. Geological and mathematical investigation of pore-scale basis for transport phenomena and petrophysical properties of sedimentary rocks. Additional prerequisite: Petroleum and Geosystems Engineering 381L or consent of instructor.

Topic 56: Stochastic Methods for Reservoir Modeling. Spatial interpolation and stochastic simulation techniques for reservoir characterization.
Topic 57: Deepwater Operations. Overview of various technical, logistical, and managerial elements that are functionally integrated in deepwater operations, with emphasis on applications in the Gulf of Mexico.
Topic 58: Applied Reservoir Characterization. Reservoir modeling using software tools for statistical analysis of reservoir data; variogram analysis and modeling; spatial interpolation (kriging); tools for data integration in kriging; stochastic simulation of rock types (lithology), pay thickness/porosity, and permeability; inputting geological models into flow simulation; uncertainty assessment.
Topic 59: Oil and Gas Production Facilities Design. Applied theory relating to field processing of hydrocarbons and water, including hydrocarbon and gas separation, gas sweetening and dehydration, gas compression, fluid metering, process control, corrosion, and safety systems. Additional prerequisite: Petroleum and Geosystems Engineering 381M and 384, or consent of instructor.
Topic 60: Energy and Earth Resource Economics. Same as Energy and Earth Resources 396 (Topic 1: Energy and Earth Resource Economics). Theoretical and applied topics in natural resource economics, including project analysis, production theory, industrial organization, markets and regulation, and environmental economics.
Topic 61: Project Management. Overview of project management theory and practice in the natural resource sector, with a focus on exploration and production of energy resources.
Topic 62: Energy and the Environment. A survey course covering current and potential energy sources, what the energy supply mix will be in the future, and how this might impact the environment.
Topic 63: Subsurface Machine Learning. Explore the theory and practice of data analytics and machine learning for subsurface resource modeling. Examine fundamental probability and statistics; data preparation and feature engineering, inference (clustering, multidimensional scaling) and prediction (regression, naive Bayes, decision trees, random forest, support vector machines and artificial neural nets); and model selection, training, testing, tuning, and validation. Three lecture hours a week for one semester. Petroleum and Geosystems Engineering 383 (Topic: Subsurface Machine Learning) and 383 (Topic 63) may not both be counted.
Topic 64: High Performance Computing for Engineers. Explore an introduction to the UNIX environment in a high-performance scientific computing context. Examine several import UNIX applications that can help users be more productive. Discuss the basic differences between various parallelization styles of computing, as well as how to utilize the application programming interfaces (APIs) in scientific applications. Three lecture hours a week for one semester Petroleum and Geosystems Engineering 383 (Topic: High Performance Comp Engr) and 383 (Topic 64) may not both be counted.
Topic 65: Formation Evaluation of Unconventional Reservoirs. Explore advanced formation evaluation of unconventional reservoirs through experimental and computational/analytical methods and workflows. Discuss the rock physics of unconventional reservoirs. Examine multi-physics and multi-scale formation data (well logs, core data, and geological information) to construct hydrocarbon reservoir models amenable to production forecast and improved development

of available reserves in unconventional reservoirs. Petroleum and Geosystems Engineering 383 (Topic: Formatn Eval Uncnvtl Rsrvrs) and 383 (Topic 65) may not both be counted.

Topic 66: Data Analytics and Geostatistics. Explore subsurface data analytics and geostatistics, from fundamental probability and statistics, univariate and multivariate analysis, representative sampling, spatial characterization and modeling, and uncertainty management to decision-making in the presence of uncertainty.

Topic 67: Applied Subsurface Geology. Explore subsurface geology as a window into stratigraphy, depositional environments, depositional processes, tectonic influences, and other knowledge that can be applied to petroleum systems. Examine principles and techniques for subsurface geologic interpretation through inquiry-based, hands-on activities using petroleum-industry datasets. Petroleum and Geosystems Engineering 383 (Topic: Applied Subsurface Geology) and 383 (Topic 67) may not both be counted.

Topic 68: Digital Rock Physics. Examine current modalities used in imaging porous medium structure, transport within, or its deformation. Discuss the analysis and visualization of 2D or 3D images, quantifying properties of interest (such as porosity, tortuosity, areas or permeability) as well as the associated uncertainty. Delve into a combination of advanced image analysis algorithms, scientific visualization, and computation (based on the images). Explore digital rock physics: the images, their analysis, and using them in simulation of petrophysical properties of interest. Petroleum and Geosystems Engineering 383 (Topic: Digital Rock Petrophysics) and 383 (Topic 68) may not both be counted.

Topic 69: Geothermal and Sustainable Energy Resources. Explore energy resources including geothermal, solar thermal, and biomass. Examine the foundations of these energy resources and the engineering approaches to recovering them. Build on basic knowledge in thermodynamics, flow through porous media, and chemistry. Petroleum and Geosystems Engineering 383 (Topic: Geotherml/ Sustainble Energy Res) and 383 (Topic 69) may not both be counted.

Topic 70: Advanced Geomechanics. Examine the fundamentals of theoretical geomechanics and its application to problems in petroleum engineering. Explore the mechanics of porous solids and saturated porous solids, mechanical properties of real reservoir geomaterials, plane strain solutions for typical applications and numerical solutions for particular problems, and thermo-hydro-mechanical coupled processes. Apply this knowledge to understand the deformational behavior of various geomaterials found in petroleum engineering, to recognize situations in which geomechanical effects are important, and to choose the proper tools to solve geomechanical problems. Petroleum and Geosystems Engineering 383 (Topic: Advanced Geomechanics) and 383 (Topic 70) may not both be counted.

Topic 71: Artificial Lift. Explore the life of a well, well testing, gas and plunger lift, progressive cavity pumps, electric submersible pumps, and beam lift. Petroleum and Geosystems Engineering 383 (Topic: Artificial Lift) and 383 (Topic 71) may not both be counted.

Topic 72: Carbon Capture and Storage. Explore carbon dioxide emission into the atmosphere; carbon dioxide capture from industrial sources; and the utilization, underground storage, and monitoring of carbon dioxide. Petroleum and Geosystems Engineering 383 (Topic: Carbon Capture & Storage) and 383 (Topic 72) may not both be counted.

Topic 73: Finite Element Methods. Explore the basic concepts of the finite element method for two-point boundary value problems, elliptic and parabolic partial differential equations, and linear and nonlinear solvers. Examine the development of the method: weak formulations, approximating spaces, and construction and solution of linear systems. Petroleum and Geosystems Engineering 383 (Topic: Finite Element Methods) and 383 (Topic 73) may not both be counted.

Topic 74: Writing Technical Papers. Explore how to write technical papers, theses, and dissertations. Practice writing and editing technical works. Petroleum and Geosystems Engineering 383 (Topic: Writing Technical Paper in PGE) and 383 (Topic 74) may not both be counted.

Topic 75: Inverse Problems in Geophysics and Petroleum Engineering. Explore the basics of multi-parameter linear and nonlinear inversion of noisy measurements. Discuss inversion methods including deterministic, stochastic approaches, and machine-learning approaches. Examine examples of application from the fields of subsurface geophysics and petroleum engineering.

Topic 76: Decision Analysis. Explore the principles and application of techniques for the logical illumination of complex decision problems within any context. Examine utility theory, probability as a statement of belief, risk preference, value of information and control, probability assessment, influence diagrams, risk sharing and scaling, and life and death decision making. Discuss the principles and fundamental concepts for the normative theory of decision making under uncertainty. Develop a language, set of theories, and tools to transform complex decisions into ones where the course of action is clear. Petroleum and Geosystems Engineering 383 (Topic: Decision Analysis) and 383 (Topic 76) may not both be counted.

Topic 77: Small-Scale Fluid Flow. Examine the physics of fluid flow at the microscale in the context of pore-scale transport in subsurface systems and microfluidic models of subsurface systems. Review geological sediment deposition and how that motivates the appropriate microscopic length-scales. Explore equations of mass and momentum conservation for incompressible fluids. Develop simplifications towards the small-scale slow-flow limit to describe transport through pores and cover techniques in microfluidics and micromodels development. Petroleum and Geosystems Engineering 383 (Topic: Small-Scale Fluid Flow) and 383 (Topic 77) may not both be counted.

Topic 79: Global Carbon Monitoring Systems. Review technologies that help us monitor the pulse of the planet. Learn about systems that directly measure carbon dioxide and methane emissions from both natural sources like wetlands and permafrost and human-made sources like agriculture and fossil fuels. Study how modern technologies - drones, satellites, aerial systems - are revolutionizing the way we measure carbon emission from energy production and use. Petroleum and Geosystems Engineering 383 (Topic: Global Carbon Monitoring Sys) and 383 (Topic 79) may not both be counted.

PGE 384. Advanced Thermodynamics and Phase Behavior.

Thermodynamic study of pressure/volume/temperature/composition relationships in oil and gas mixtures. Three lecture hours a week for one semester. May be repeated for credit. Prerequisite: Graduate standing in petroleum engineering and twelve semester hours of upper-division coursework in petroleum and geosystems engineering.

PGE 385K. Advanced Multi-Well Formation Evaluation.

Advanced concepts in formation evaluation for the estimation of static and dynamic petrophysical properties of rocks from well logs, core data, and geological information. Multi-well data sets, seismic amplitude data, and regional geological studies are used to construct hydrocarbon reservoir models amenable to production forecast and improved development of available reserves. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Graduate standing and a course in fundamentals of well logging.

PGE 385M. Advanced Well-Logging and Correlation.

Advanced well-logging for the geologist and engineer, involving working problems with suites of well logs to cover advanced mapping and logging techniques. Three lecture hours a week for one semester. Offered on the letter-grade basis only. Prerequisite: Graduate standing,

Geological Sciences 383, and three semester hours of coursework in fundamentals of well logging.

PGE 386K. Advanced Fluid Flow in Porous Media.

The hydrodynamic equations governing the steady state flow of homogeneous fluids in porous media and their application to petroleum and geosystems engineering problems. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

PGE 387. Secondary Recovery of Petroleum.

Recovery by gas injection and water flooding. Three lecture hours a week for one semester. Prerequisite: Graduate standing in petroleum engineering and twelve semester hours of upper-division coursework in petroleum and geosystems engineering.

PGE 387K. Fundamentals of Enhanced Oil Recovery I.

Recent innovations in the recovery of petroleum by injecting fluids miscible with the oil or by application of heat to the reservoir. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

PGE 387L. Fundamentals of Enhanced Oil Recovery II.

Basic concepts and principles of chemical flooding methods of enhanced oil recovery, which include polymer flooding, surfactant-polymer flooding (SP), alkaline-sufactant-polymer flooding (ASP), chemical imbibitions by wettability alteration methods and surfactant-gas (SG) methods, and also some comparisons with other EOR methods such as miscible gas flooding when appropriate and as time permits. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

PGE 388. Advanced Reservoir Engineering.

Basic concepts of reservoir engineering, with applications to the production of hydrocarbons from both gas and oil reservoirs. Examines the governing equations for flow in permeable media, as well as concepts such as streamline flow; pseudo-steady-state flow, fractional flow, and both immiscible and miscible flow. Uses black oil and compositional reservoir simulators. Three lecture hours a week for one semester. Prerequisite: Graduate standing in computational and applied mathematics, engineering, or geological sciences. Students must present technical prerequisites satisfactory to the instructor.

PGE 389. Economic Analysis in the Petroleum Industry.

Engineering justification for capital outlay in the petroleum industry. Three lecture hours a week for one semester. Prerequisite: Graduate standing in engineering or geological sciences.

PGE 290, 390, 690, 990. Advanced Laboratory for Doctoral Candidates.

For each semester hour of credit earned, the equivalent of one class hour a week for one semester. May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Graduate standing in petroleum engineering.

PGE 392K. Numerical Simulation of Reservoirs.

Development and application of reservoir simulator models to primary and secondary recovery processes in reservoir engineering. Three lecture hours a week for one semester. Prerequisite: Graduate standing.

PGE 193, 293, 393. Research Seminar.

For each semester hour of credit earned, the equivalent of one lecture hour a week for one semester. May be repeated for credit when the topics vary. Offered on the credit/no credit basis only. Prerequisite: Graduate standing.

PGE 397M. Graduate Research Internship.

For students holding Master of Science degrees from other institutions who wish to pursue Doctor of Philosophy degrees at the University of Texas at Austin. The equivalent of three lecture hours a week for one semester. Offered on the credit/no credit basis only. Prerequisite: Graduate standing and consent of the graduate adviser and the dean of the Cockrell School of Engineering.

PGE 698. Thesis.

The equivalent of three lecture hours a week for two semesters. Offered on the credit/no credit basis only. Prerequisite: For 698A, graduate standing in petroleum engineering and consent of the graduate adviser; for 698B, Petroleum and Geosystems Engineering 698A.

PGE 398R. Master's Report.

Preparation of a report to fulfill the requirement for the master's degree under the report option. The equivalent of three lecture hours a week for one semester. Offered on the credit/no credit basis only. Prerequisite: Graduate standing in petroleum engineering and consent of the graduate adviser.

PGE 399W, 699W, 999W. Dissertation.

May be repeated for credit. Offered on the credit/no credit basis only. Prerequisite: Admission to candidacy for the doctoral degree.

Professional Courses