

# PETROLEUM ENGINEERING (PET ENG)

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## **PET ENG 1120 Introduction to Subsurface Energy and Carbon Storage** (LEC 1.0)

This course provides an overview of oil and gas upstream activities, a brief introduction to geothermal energy and carbon storage in geological reservoirs.

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## **PET ENG 2000 Special Problems** (IND 1.0-3.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

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## **PET ENG 2001 Special Topics** (IND 1.0-3.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

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## **PET ENG 2002 Cooperative Work Training** (IND 1.0-3.0)

On-the-job experience gained through cooperative education with industry, with credit arranged through departmental cooperative advisor. Grade received depends on quality of reports submitted and work supervisor's evaluation.

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## **PET ENG 2510 Properties Of Hydrocarbon Fluids** (LEC 3.0)

Physical properties of petroleum fluids; chemical components of petroleum fluids. Elementary phase behavior; calculations of the physical properties of gases, liquids, and gas-liquid mixtures in equilibrium. Prerequisite: Chem 1310.

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## **PET ENG 3000 Special Problems** (IND 1.0-3.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

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## **PET ENG 3001 Special Topics** (LAB 0.0 and LEC 0.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

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## **PET ENG 3320 Petrophysics** (LAB 1.0 and LEC 2.0)

Properties of petroleum reservoir rocks, including lithology, porosity, absolute permeability, pore surface area, relative and effective permeability, fluid saturations, rock wettability, capillary characteristics, acoustic properties, and electrical properties. Darcy's law for single phase linear horizontal, tilted and radial flow. Prerequisites: Preceded or accompanied by Physics 1135.

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## **PET ENG 3330 Well Logging** (LAB 1.0 and LEC 2.0)

An introduction to the electrical, nuclear, and acoustic properties of rocks; theory and interpretation of conventional well logs. Prerequisites: Physics 2135 or 2111; Pet Eng 3320.

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## **PET ENG 3520 Petroleum Reservoir Engineering** (LEC 3.0)

Properties of reservoir formations and fluids; reservoir volumetrics, reservoir statics, reservoir dynamics. Darcy's law and the mechanics of single and multiphase fluid flow through reservoir rock, capillary phenomena, material balance, reservoir drive mechanisms. Prerequisite: Accompanied or preceded by Pet Eng 2510, Pet Eng 3320.

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## **PET ENG 3529 Petroleum Reservoir Laboratory** (LAB 1.0)

Core analysis determination of intensive properties of crude oil and its products; equipment and methods used to obtain petroleum reservoir information. Prerequisite: Accompanied or preceded by Pet Eng 3520.

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## **PET ENG 4000 Special Problems Special Problems Special Problems** (IND 0.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

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## **PET ENG 4001 Special Topics** (LAB 1.0 and LEC 2.0)

Problems or readings on specific subjects or projects in the department. Consent of instructor required.

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## **PET ENG 4010 Ethics and Professionalism** (LEC 1.0)

Topics related to Ethics and Professionalism. Lifelong learning, teamwork and discussion of current events. (Course cannot be used for graduate credit). Prerequisite: Senior standing in Pet Eng.

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## **PET ENG 4097 Capstone Design** (LEC 3.0)

Senior capstone design project(s) based on industry data. Application of reservoir engineering: drilling and production engineering principles to evaluate and solve an industry problem such as a new field development, evaluation of an existing reservoir asset, or analysis of field re-development. Prerequisites: Pet Eng 3520 and senior standing.

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## **PET ENG 4099 Undergraduate Research** (IND 0.0-6.0)

Designed for the undergraduate student who wishes to engage in research. Not for graduate credit. Not more than six credit hours allowed for graduation credit. Subject and credit to be arranged with the instructor.

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## **PET ENG 4109 Field Studies** (LAB 1.0)

Field trip, which studies different aspects of petroleum engineering like reservoirs, caprocks and traps, drilling rigs, petroleum production facilities, refineries and petroleum engineering research facilities. This course takes the students for one week to petroleum operations and geological outcrops in Oklahoma and Texas to expose students to field work.

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## **PET ENG 4111 Fundamental Digital Applications In Petroleum Engineering** (LEC 3.0)

Applications of Windows-based Visual Basic solutions to engineering problems including selected topics in fluid flow, PVT behavior, matrices in engineering solutions, translating curves to computer solutions, predictor-corrector material balance solutions, and graphical display of results. Prerequisite: Junior Standing.

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## **PET ENG 4210 Drilling and Well Integrity** (LAB 1.0 and LEC 2.0)

This course covers drilling fluids, including mixing and analysis of rheological properties; pressure loss calculations; casing design; well cementing; pore pressure and geomechanical considerations in drilling; completion equipment; and completion design. Prerequisite: Preceded or accompanied by Civ Eng 2200.

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**PET ENG 4211 Advanced Drilling Technology** (LEC 3.0)

In-depth study of directional well planning and drilling. The course covers the bottom hole assemblies and operational techniques used in drill directional drilling as well as the limiting factors and hole problems related to horizontal wells. Prerequisites: Pet Eng 4210.

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**PET ENG 4311 Reservoir Characterization** (LEC 3.0)

The integration and extrapolation of Geologic, Geophysical, and Petroleum Engineering data for flow model construction. Prerequisites: Pet Eng 3520 and Pet Eng 3330.

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**PET ENG 4410 Production Engineering** (LAB 1.0 and LEC 2.0)

Introduction to the producing wellbore system; inflow performance relationships, effect of formation damage on well flow, nodal systems analysis; perforating methods and their effect on inflow; stimulation treatments to enhance well performance. Introduction to well completions, diagnostics and well servicing. Overview of production systems. Prerequisite: Preceded or accompanied by Pet Eng 3520.

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**PET ENG 4421 Artificial Lift** (LEC 3.0)

This course is a study of artificial lift methods used to produce liquids (oil/water) from wellbores. Methods covered include sucker rod (piston) pumps, electric submersible pumps, gas lift, hydraulic lift and plunger lift. Prerequisite: Pet Eng 4410.

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**PET ENG 4431 Well Completion Design** (LEC 3.0)

An overview of the hardware, fluids and processes employed in completing oil and gas wells. Examination of types of well completions and considerations in their design. Introduction to downhole mechanics and tubing movement and stress calculations. Prerequisite: Pet Eng 4410.

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**PET ENG 4441 Well Stimulation** (LEC 3.0)

This course reviews fundamentals of hydraulic fracturing and builds on the basic theory through the use of STIMPLAN software and hands on industry examples. The course teaches the methods used to plan, execute and evaluate hydraulic fracturing treatments. Students may not earn credit for both Pet Eng 4441 and Pet Eng 6441. Prerequisites: Pet Eng 3520 and Pet Eng 3330.

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**PET ENG 4511 Applied Petroleum Reservoir Engineering** (LEC 3.0)

Quantitative study of oil production by natural forces, gas cap, water influx, solution gas, etc.; material balance equations, study of gas, non-retrograde gas condensate, and black oil reservoirs. Predictive calculations of oil recovery from different reservoir types. Prerequisites: Pet Eng 3520.

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**PET ENG 4520 Well Test Analysis** (LAB 1.0 and LEC 2.0)

Causes of low well productivity; analysis of pressure buildup tests, drawdown tests, multi-rate tests, injection well fall off tests, and open flow potential tests; design of well testing procedures. Prerequisite: Pet Eng 3520.

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**PET ENG 4531 Natural Gas Engineering** (LEC 3.0)

This course will cover basic and fundamental knowledge for a future natural gas engineer, including natural gas properties, natural gas underground storage estimates, natural gas exploration/drilling/and completion, natural gas productivity and deliverability estimates, natural gas related processing after it reaches the surface. Prerequisite: Pet Eng 2510.

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**PET ENG 4590 Subsurface Energy Economics** (LEC 3.0)

Uncertainty in the estimation of oil and gas reserves; tangible and intangible investment costs; depreciation; evaluation of producing properties; federal income tax considerations; chance factor and risk determination. Petroleum economic evaluation software is introduced. Prerequisites: Pet Eng 3520, Econ 1100, or Econ 1200.

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**PET ENG 4611 Secondary Recovery Of Petroleum** (LEC 3.0)

Oil recovery by water injection. Effects of wettability, capillary pressure, relative permeability, mobility ratio on displacement, sweep, and recovery efficiencies. Piston-like and Buckley-Leverett models. Fractional flow and frontal advance equation. Oil recovery prediction methods for linear and pattern waterfloods in single and multi-layered reservoirs. Prerequisites: Pet Eng 3520.

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**PET ENG 4621 Fundamentals Of Petroleum Reservoir Simulation** (LEC 3.0)

An introduction to petroleum reservoir simulation. Fundamentals of finite difference approximation of the partial differential equations of flow through porous media. Discussion of various simulation schemes, data handling, boundary conditions. Use of a dry gas and black oil simulators. Prerequisite: Pet Eng 3520.

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**PET ENG 4631 Applied Reservoir Simulation** (LAB 1.0 and LEC 2.0)

Simulation of reservoir problems using field and individual well models to determine well spacing, production effects of secondary and enhanced recovery processes, future rate predictions and recovery, coning effects, and more. The lab focuses on learning computer simulation models, including practice using the software and data analyses techniques. Prerequisite: Pet Eng 3520.

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**PET ENG 4710 Finite Element Analysis with Applications in Petroleum Engineering** (LAB 1.0 and LEC 2.0)

This course introduces finite element analysis (FEA) methods and applications of FEA in subsurface engineering. The course is intended to provide a fundamental understanding of FEA software and experience in creating meshes for petroleum reservoirs or other subsurface features. Prerequisites: Pet Eng 3520, Geology 3310, and Math 3304.

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**PET ENG 4720 Reservoir Geomechanics** (LAB 1.0 and LEC 2.0)

This course introduces the work process necessary to create the Mechanical Earth Model's principal components, formation in situ stress and strength. 1-D modeling methods are reviewed and extended to 3-D, and the integration of MEM with well design is shown. An MEM model will be created and compared to actual field results. Prerequisites: Pet Eng 3330 and Geology 3310.

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**PET ENG 4811 Offshore Petroleum Technology** (LEC 3.0)

An introduction to the development of oil and gas fields offshore, including offshore leasing, drilling, well completions, production facilities, pipelines, and servicing. Subsea systems, and deepwater developments are also included. This course is suitable for mechanical, electrical and civil engineering students interested in ultimately working offshore. Prerequisites: Pet Eng 3520.

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**PET ENG 4821 Environmental Petroleum Applications** (LEC 3.0)

This course is a study of environmental protection and regulatory compliance in the oil and gas industry. The impact of various environmental laws on drilling and production operations will be covered. Oilfield and related wastes and their handling are described. Federal, state and local regulatory agencies are introduced, and their role in permitting and compliance monitoring is presented. Legal and ethical responsibilities are discussed. Prerequisite: Chem 1310.

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**PET ENG 5000 Special Problems** (IND 0.0-6.0)

Problems or readings on specific subjects of projects in the department. Consent of instructor required.

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**PET ENG 5001 Special Topics** (LEC 0.0-6.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

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**PET ENG 5010 Seminar** (RSD 0.0-6.0)

Discussion of current topics.

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**PET ENG 5040 Oral Examination** (IND 0.0)

After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

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**PET ENG 5050 Carbon Storage** (LEC 3.0)

This course provides an overview of CO<sub>2</sub> storage in subsurface from fundamental to applications. The topics include importance of store CO<sub>2</sub> in subsurface, CO<sub>2</sub> phase behavior, geologic reservoir storage, CO<sub>2</sub> enhanced oil recovery, CO<sub>2</sub> leakage monitoring and control, and field case studies.

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**PET ENG 5085 Internship** (IND 0.0-15)

Students working toward a doctor of engineering degree will select, with the advice of their committees, appropriate problems for preparation of a dissertation. The problem selected and internship plan must conform to the purpose of providing a high level engineering experience consistent with the intent of the doctor of engineering degree.

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**PET ENG 5099 Research** (IND 0.0-12)

Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

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**PET ENG 5801 Petroleum Data Analytics** (LAB 1.0 and LEC 2.0)

This course provides a general introduction to fundamental data analytics methods including basic statistical analysis, regression analyses and their applications in petroleum engineering, and their implementation using python, the most popular interpreted computer language. Prerequisites: Comp Sci 1500 and at least Junior standing.

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**PET ENG 6000 Special Problems** (IND 0.0-6.0)

Problems or readings on specific subjects of projects in the department. Consent of instructor required.

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**PET ENG 6001 Special Topics** (LAB 1.0 and LEC 0.0)

This course is designed to give the department an opportunity to test a new course. Variable title.

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**PET ENG 6010 Seminar** (IND 0.0-6.0)

Discussion of current topics.

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**PET ENG 6040 Oral Examination** (IND 0.0)

After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

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**PET ENG 6050 Continuous Registration** (IND 1.0)

Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.

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**PET ENG 6085 Internship** (IND 0.0-15)

Students working toward a doctor of engineering degree will select, with the advice of their committees, appropriate problems for preparation of a dissertation. The problem selected and internship plan must conform to the purpose of providing a high level engineering experience consistent with the intent of the doctor of engineering degree.

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**PET ENG 6099 Research** (IND 0.0-12)

Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

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**PET ENG 6100 Advanced Professional Geoscience Skills** (LEC 3.0)

Communication of complex research topics in the geosciences is required for successful post-doctoral career advancement in both academic and non-academic career paths. Best practices for developing and proposing scientific ideas in the geosciences will be critiqued weekly. Assessment of research proposals presentations includes peer-and self-evaluation. Prerequisites: Doctoral Graduate Standing. (Co-listed with Geology 6100).

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**PET ENG 6211 Advanced Directional Drilling and MWD** (LEC 3.0)

In-depth study of directional well planning and drilling. The course covers the bottom hole assemblies and operational techniques used in directional drilling as well as the limiting factors and hole problems related to horizontal wells. Advanced research topics and well design in directional drilling. Prerequisites: Pet Eng 4210.

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**PET ENG 6231 Drilling Optimization** (LEC 3.0)

Optimization of the drilling process based on geomechanical model of the subsurface. Topics include drilling hydraulics, drilling bits, selection of operational parameters and analysis of drilling time and cost. Prerequisite: Pet Eng 4210.

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**PET ENG 6431 Advanced Well Completion Design** (LEC 3.0)

Overview of hardware, fluids and processes employed in completing oil and gas wells. Types of well completions and design considerations. Downhole mechanics, tubing movement and stress calculations. Advanced concepts in well completion design and review of well completions literature. Prerequisites: Pet Eng 4410.

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**PET ENG 6441 Advanced Well Stimulation** (LEC 3.0)

This course builds on the basic theory and fundamentals of hydraulic fracturing through the use of STIMPLAN software and hands on industry examples. The course teaches the methods used to plan, execute and evaluate hydraulic fracturing treatments. An advanced exercise and a research assignment are required. Students may not earn credit for both Pet Eng 4441 and Pet Eng 6441. Prerequisites: Pet Eng 3520 and Pet Eng 3310.

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**PET ENG 6521 Advanced Well Test Analysis** (LAB 1.0 and LEC 2.0)

Pressure transient analysis equations, well test analysis for fractured wells, horizontal wells, injection wells, and other special situations. Introduction to rate transient analysis. Prerequisites: Pet Eng 3520 and Pet Eng 4520.

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**PET ENG 6541 Advanced Reservoir Engineering I** (LEC 3.0)

Advanced study of producing mechanisms. Prerequisites: Pet Eng 5631 and Pet Eng 4520.

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**PET ENG 6551 Advanced Reservoir Engineering II** (LEC 3.0)

Flow through porous media: derivations and solutions for steady, semi-steady, and transient flow of single and multiple phase flow through porous media. Prerequisite: Pet Eng 3520.

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**PET ENG 6621 Advanced Applied Reservoir Simulation** (LAB 1.0 and LEC 2.0)

Advanced simulation of reservoir problems using field and individual well models to determine well spacing, production effects of secondary and enhanced recovery processes, future rate predictions and recovery, coning effects, and more. The lab focuses on learning advanced computer simulations and pre- and post-processing techniques for big datasets. Prerequisite: Pet Eng 4621 or equivalent.

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**PET ENG 6631 A Survey Of Improved Recovery Processes** (LEC 3.0)

An overview of current advanced recovery methods including secondary and tertiary processes. An explanation of the primary energy mechanism and requirements of these methods and an analysis of laboratory results and their subsequent field applications. Prerequisite: Pet Eng 4611.

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**PET ENG 6711 Geodynamics** (LEC 3.0)

The applications of continuum physics to geological and petroleum engineering problems. Topics include plate tectonics, stress and strain in solids, elasticity and flexure, heat transfer, gravity, fluid mechanics, rock rheology, faulting, and flow in porous media. Prerequisites: Math 2222 and Geology 3310. (Co-listed with Geology 6211).

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**PET ENG 6801 Advanced Petroleum Data Analytics** (LAB 1.0 and LEC 2.0)

This course advances the general introduction to fundamental data analytics methods with their applications in engineering disciplines, including basic statistical analysis, regression analyses, artificial intelligence methods and their implementation using python, the most popular interpreted computer coding language. Prerequisites: Graduate standing with some coding experience.

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**PET ENG 6811 Advanced Offshore Petroleum Technology** (LEC 3.0)

A study of factors affecting offshore structural design and operation. Focus is on mobile offshore drilling units (MODUs). Subsea well systems and offshore pipelines are covered. Advanced topics in system design. Prerequisites: Pet Eng 4210, Civ Eng 3330, Civ Eng 2210.

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