PETE - PETROLEUM ENGINEERING

PETE 602 Well Stimulation

Credits 3. 3 Lecture Hours. Design and analysis of well stimulation methods, including acidizing and hydraulic fracturing; causes and solutions to low well productivity.

PETE 603 Advanced Reservoir Engineering I

Credits 3. 3 Lecture Hours. Petroleum reservoir simulation basics including solution techniques for explicit problems.

PETE 609 Enhanced Oil Recovery Processes

Credits 3. 3 Lecture Hours. Fundamentals and theory of enhanced oil recovery; polymer flooding, surfactant flooding, miscible gas flooding and steam flooding; application of fractional flow theory; strategies and displacement performance calculations. **Prerequisite:** PETE 323.

PETE 611 Application of Petroleum Reservoir Simulation

Credits 3. 3 Lecture Hours. Use of simulators to solve reservoir engineering problems too complex for classical analytical techniques. **Prerequisites:** PETE 400 and PETE 401.

PETE 612 Unconventional Oil and Gas Reservoirs

Credits 3. 3 Lecture Hours. As conventional oil and gas resources are depleted, unconventional resources, including heavy oil and gas from low-permeability sandstones, fractured shales, coal bed, and hydrates, will assume greater roles in meeting USA and world energy demands; this course emphasizes resources, geologic and geographic occurrences, recovery technology and economics of unconventional hydrocarbon resources. **Prerequisite:** Graduate classification in petroleum engineering, geology or geophysics.

PETE 613 Natural Gas Engineering

Credits 3. 3 Lecture Hours. Flow of natural gas in reservoirs and in wellbores and gathering systems; deliverability testing; production forecasting and decline curves; flow measurement and compressor sizing. **Prerequisites:** PETE 323 and PETE 324.

PETE 614 Master Graduate Student Paper Contest

Credits 0. 0 Lecture Hours. No Credit. Presentation of a technical petroleum engineering topic judged by petroleum professionals at the master graduate level department student paper contest. **Prerequisite:** Master level graduate classification.

PETE 615 Doctoral Student Paper Contest

Credits 0. 0 Lecture Hours. No Credit. Presentation of a technical petroleum engineering topic judged by petroleum professionals at the PhD graduate level department student paper contest. **Prerequisite:** PhD graduate classification.

PETE 617 Petroleum Reservoir Management

Credits 3. 3 Lecture Hours. The principles of reservoir management and application to specific reservoirs based on case studies presented in the petroleum literature.

PETE 620 Fluid Flow in Petroleum Reservoirs

Credits 3. 3 Lecture Hours. Analysis of fluid flow in bounded and unbounded reservoirs, wellbore storage, phase redistribution, finite and infinite conductivity fractures; dual-porosity systems. **Prerequisite:** PETE 323.

PETE 622 Exploration and Production Evaluation

Credits 3. 3 Lecture Hours. Selected topics in oil industry economic evaluation including offshore bidding, project ranking and selection, capital budgeting, long-term oil and gas field development projects and incremental analysis for assisted recovery and acceleration.

PETE 625 Well Control

Credits 3. 3 Lecture Hours. Theory of pressure control in drilling operations and during well kicks; abnormal pressure detection and fracture gradient determination; casing setting depth selection and advanced casing design; theory supplemented on well control simulators. **Prerequisites:** PETE 411.

PETE 627 Well Completion and Workover

Credits 3. 3 Lecture Hours. Development of design options, systems and procedures to meet deliverability, safety and integrity requirements for completions and workover equipment; overview of methods in the oil and gas industry; function and design criteria of well components. **Prerequisite:** Graduate classification.

PETE 628 Horizontal Drilling

Credits 3. 3 Lecture Hours. Changing a wellbore from vertical to horizontal; long- and short-radius horizontal wells; bottomhole assemblies for achieving and maintaining control of inclination and direction; drilling fluids; torque and drag calculations; transport of drilled solids. **Prerequisite:** PETE 411 or approval of instructor.

PETE 630 Geostatistics and Data Analytics

Credits 3. 3 Lecture Hours. Introductory and advanced concepts in geostatistics and data analytics for petroleum reservoir characterization by integrating static (cores, logs, seismic traces) and dynamic (flow, transport) data; specific topics include: data partitioning (classification), data correlation (parametric, non-parametric regression), variograms and spatial data analysis, kriging and cokriging, conditional simulation, non-Gaussian approaches (indicator methods, simulated annealing, genetic algorithms) and data driven methods (RF, SVM and GBM). **Prerequisite:** Introductory course in statistics or approval of instructor.

PETE 633 Data Integration for Petroleum Reservoirs

Credits 3. 3 Lecture Hours. Introduction and application of techniques that can be used to incorporate dynamic reservoir behavior into stochastic reservoir characterizations; dynamic data in the form of pressure transient tests, tracer tests, multiphase production histories or interpreted 4-D seismic information. **Prerequisites:** PETE 620; STAT 601.

PETE 636 Horizontal, Multilateral and Intelligent Wells

Credits 3. 3 Lecture Hours. Advanced well architectures, primarily horizontal, multilateral and intelligent wells, all aspects of these types of wells, including well completions, reservoir flow, and wellbore flow conditions, and well deliverability; optimization of well design and field applications will be demonstrated with field cases. **Prerequisites:** PETE 662; graduate classification.

PETE 637 Streamline Simulation

Credits 3. 3 Lecture Hours. Introductory and advanced concepts in streamline simulation and its applications; theory of streamlines/streamtubes in multidimensions; topics include: streamline, streamtubes, streamfunctions, transport along streamlines, spatial discretization and material balance, time stepping and transverse fluxes, impact of cell geometry, history matching and production data integration, comparison with finite difference. **Prerequisite:** Graduate classification.

PETE 638 Production Logging

Credits 3. 3 Lecture Hours. Well logging methods concerned with problem well diagnosis and reservoir surveillance; includes fluid flow in pipes, understanding fluid dynamics in a wellbore, theoretical basis of production logging techniques, production log interpretation techniques, and operational considerations. **Prerequisite:** Graduate classification.

PETE 639 High Performance Drilling Design and Operational Practices

Credits 3. 3 Lecture Hours. Achieving differentiating drilling performance in most complex wells; includes physics of each type of performance limiter, real time operational practices, engineering redesign practices, and effective workflows to achieve the required change in engineering and operational practices. **Prerequisites:** Graduate classification, PETE 355 or PETE 661 or approval of instructor.

PETE 640 Models for Simulation of Flow and Transport of Fluids and Heat in Porous Media

Credits 4. 3 Lecture Hours. 3 Lab Hours. Design and develop numerical simulators that describe flow of reservoir fluids and transport of heat through porous media; develop multi-dimensional models capable of handling single mass components (gas, oil or water) in single phases (liquid or vapor). **Prerequisites:** PETE 603 or approval of instructor; experience in FORTRAN or another programming language; solid understanding of physical processes of flow and transport through porous media, numerical analysis and linear algebra; graduate classification.

PETE 641 Models for Simulation of Advanced Coupled Processes in Geologic Media

Credits 4. 3 Lecture Hours. 3 Lab Hours. Design and develop advanced multi-phase flow processes and complex geologic media (porous and fractured, with matrix-fracture interactions); structured and unstructured grids, multiple mass components (gas, oil and water) in multi-phase states (liquid, vapor and/or liquid-vapor), and phase changes. **Prerequisites:** PETE 640 and graduate classification; experience in FORTRAN95, C, C++ or another programming language; solid understanding of physical processes of flow and transport through porous media, numerical analysis and linear algebra.

PETE 643 Oil Field Chemistry

Credits 3. 3 Lecture Hours. The role of chemistry in well stimulation, water shut-off treatments, scale removal, mitigation, downhole corrosion issues, organic deposition, dementing, drilling fluids and various aspects of formation damage; includes problem identification as the first step in designing chemical treatment to remove formation damage. **Prerequisites:** Graduate classification.

PETE 644 CO2 Capture and Uses: Sequestration, Enhanced Oil Recovery (EOR)

Credits 3. 3 Lecture Hours. Understanding the need and potential of CO2 captures and uses, including sequestration and Enhanced Oil Recovery (CCS-EOR), the scientific, technological and economic aspects of identifying and implementing a CCS-EOR; overview of safety, environmental and legal aspects. **Prerequisites:** Graduate classification.

PETE 645 Upscaling of Geologic Models for Flow Simulation

Credits 3. 3 Lecture Hours. In-depth understanding of current approaches to upscaling of 3D geologic models for reservoir flow simulation; includes development of upscaling solvers. **Prerequisites:** Graduate classification.

PETE 648 Pressure Transient Testing

Credits 3. 3 Lecture Hours. Diffusivity equation and solutions for slightly compressible liquids; dimensionless variables; type curves; applications of solutions to buildup, drawdown, multi-rate, interference, pulse and deliverability tests; extensions to multiphase flow; analysis of hydraulically fractured wells. **Prerequisites:** PETE 324 and PETE 620.

PETE 651 Probabilistic Reserves Evaluation

Credits 3. 3 Lecture Hours. Oil and gas reserves definitions and reporting regulations; probabilistic reserves estimation methods; unconventional resources characterization; reserves valuation techniques. **Prerequisites:** Graduate classification or approval of instructor.

PETE 652 Deterministic Reserves Evaluation

Credits 3. 3 Lecture Hours. Oil and gas reserves definitions and reporting regulations; deterministic estimation methods; unconventional resources characterization; reserves valuation techniques. **Prerequisites:** Graduate classification or approval of instructor.

PETE 655 Finite Element Method for Geomechanics

Credits 3. 3 Lecture Hours. Formulation of the 2D and 3D finite element method; development of a simple finite element computer program; linear and non-linear constitutive relation for soft and hard rocks; applications to porous flow and geomechanics problems; code the finite element computer programs and practice to solve geomechanics problems, reservoir flow, reservoir compaction, subsidence, borehole breakout and casing stability problems. **Prerequisites:** Computer language such as Fortran, C, C#, C++, or Matlab.

PETE 656 Advanced Numerical Methods for Reservoir Simulation

Credits 3. 3 Lecture Hours. Numerical simulation of flow in porous media based on numerical methods for partial differential equations; supplemented by published papers and research topics; development of a reservoir simulator. **Prerequisites:** Graduate classification; basic reservoir simulation or equivalent course; linear algebra and matrix computations or equivalent course; advanced calculus or equivalent course; programming experience.

PETE 657/CSCE 657 High Performance Computing for Earth Science and Petroleum Engineering

Credits 3. 3 Lecture Hours. Numerical simulation of problems in Earth Sciences and Petroleum Engineering using high performance computing (HPC); development of a parallel reservoir simulator. **Prerequisite:** Graduate classification. **Cross Listing:** CSCE 657/PETE 657.

PETE 658 Energy and Sustainability

Credits 3. 3 Lecture Hours. Overview of energy resources and use with emphasis on long-term sustainability; considers fossil, nuclear, and alternative energy sources, electricity and transportation, energy conversions, energy efficiency, energy security, energy policy, and environmental impact. **Prerequisites:** PHYS 201, PHYS 202 or equivalent, CHEM 107 or equivalent.

PETE 659 Rock Mechanics Related to Hydraulic Fracturing

Credits 3. 3 Lecture Hours. Fundamentals of rock mechanics; calculation of displacements and stresses of opening fractures; evaluation of stress shadow effects; investigation of local stress reorientation and fracture interaction; analysis of near-tip stresses; determination of fracture propagation direction; summary of hydraulic fracturing treatments and modeling in unconventional reservoirs. **Prerequisite:** Graduate classification.

PETE 660 Technical Writing and Presentations for Petroleum Engineers

Credits 3. 3 Lecture Hours. Planning, drafting and editing reports, proposals, correspondence, technical papers and procedures for workplace and academic applications; research and citation guidelines; working with templates; effective figures, graphs and tables; presentation design and practice.

PETE 661 Drilling Engineering

Credits 3. 3 Lecture Hours. Introduction to drilling systems: wellbore hydraulics; identification and solution of drilling problems; well cementing; drilling of directional and horizontal wells; wellbore surveying abnormal pore pressure, fracture gradients, well control; offshore drilling, underbalanced drilling.

PETE 662 Production Engineering

Credits 3. 3 Lecture Hours. Development of fundamental skills for the design and evaluation of well completions, monitoring and management of the producing well, selection and design of article lift methods, modeling and design of surface facilities.

PETE 663 Formation Evaluation and the Analysis of Reservoir Performance

Credits 3. 3 Lecture Hours. Current methodologies used in geological description/analysis, formation evaluation (the analysis/interpretation of well log data), and the analysis of well performance data (the design/analysis/interpretation of well test and production data); specifically, the assessment of field performance data and the optimization of hydrocarbon recovery by analysis/interpretation/integration of geologic, well log, and well performance data. **Prerequisite:** Approval of instructor or graduate classification.

PETE 664 Petroleum Project Evaluation and Management

Credits 3. 3 Lecture Hours. Introduction to oil industry economics, including reserves estimation and classification-, building and using reservoir models, developing and using reservoir management processes, managing new and mature fields, and investment ranking and selections.

PETE 665 Petroleum Reservoir Engineering

Credits 3. 3 Lecture Hours. Reservoir description techniques using petrophysical and fluid properties; engineering methods to determine fluids in place, identify production-drive mechanisms, and forecast reservoir performance; implementation of pressure-maintenance schemes and secondary recovery. **Prerequisite:** Approval of instructor or graduate classification.

PETE 667 Petroleum Engineering Reserves and Evaluation

Credits 3. 3 Lecture Hours. Estimation and valuation of hydrocarbon reserves and resources, with emphasis on probabilistic methods, technically challenging reservoirs, and unconventional resources. **Prerequisite:** PETE 664, approval of instructor.

PETE 668 RSVR Non-PETE Assets - Geothermal Energy, Compressed Gas Energy Storage, Carbon Sequestration

Credits 4. 4 Lecture Hours. Basic principles of thermodynamics, fluid flow through porous and fractured media heat flow and transport in geologic formations, applications in fundamentals of petroleum reservoir engineering and several aspects of subsurface processes involving conventional and unconventional reservoirs; geothermal energy, storage of compressed hydrogen as a fuel from any number of sources with an additional power generation component during decompression and recovery from the storage facility, air storage for power generation, and carbon sequestration; development of necessary theoretical and mathematical basis of the physics governing the various processes of flow, thermodynamic, and geochemical, for use by an advanced simulator to develop and analyze several realistic problems of increasing complexity involving system design and production. **Prerequisites:** Graduate classification or approval of instructor.

PETE 669 Subsurface Engineering for Sustainable Energy

Credits 3. 3 Lecture Hours. Broad perspective on how the subsurface can be engineered for sustainable energy solutions; evolving energy mix and decarbonization strategies, geothermal energy, carbon capture and storage, and subsurface gas storage; subsurface storage value chain, resource and capacity estimation, unconventional storage systems characterization, site selection criteria, subsurface storage monitoring. **Prerequisites:** Graduate classification; engineering and geoscience majors; approval of instructor.

PETE 678 Resource Shale Petrophysics

Credits 3. 3 Lecture Hours. Petrophysical properties of resources shale including strength, deformation, fluid flow, thermal and electrical properties as a function of the subsurface temperature, in-situ stress, pore fluid pressure, and chemical environment. **Prerequisite:** Graduate classification.

PETE 679 Unconventional Reservoir Methods and Analysis

Credits 3. 3 Lecture Hours. Exploration of the latest practices in the use of unconventional reservoirs, reservoir characterization, horizontal drilling and completion optimization methodologies; focus on practices for reservoir engineering and production analysis techniques.

PETE 680 Applied Rock and Fracture Mechanics for Unconventional Reservoirs

Credits 3. 3 Lecture Hours. Introduction of key rock and fracture mechanics concepts for unconventional reservoirs and discussion of the layered nature of mudstones and its effect on their mechanical behavior and response to hydraulic fracturing treatments; presentation of problem in field techniques, laboratory measurements and engineering analyses for solving rock and fracture mechanics, and discussion of how these are used together to construct predictive models and solve practical problems of rock failure and hydraulic fracture propagation; demonstrations of rock testing and hydraulic fracture experiments. **Prerequisite:** MATH 152, PHYS 206, or graduate classification.

PETE 681 Seminar

Credits 0. 0 Lecture Hours. Presentations by experts in petroleum technologies.

PETE 684 Professional Internship

Credits 1 to 4. 1 to 4 Other Hours. Training under the supervision of practicing professional engineers in settings appropriate to the student's professional objectives. May be taken four times for credit. **Prerequisite:** Graduate classification and one semester of graduate work completed.

PETE 685 Directed Studies

Credits 1 to 12. 1 to 12 Other Hours. Students undertake and complete limited investigations not within their thesis research and not covered in established curricula. **Prerequisites:** Graduate classification; approval of instructor.

PETE 686 Petroleum Data Analytics and Machine Learning

Credits 3. 3 Lecture Hours. Data analytics suitable for petroleum engineers and geoscientists; emphasis on implementation of data-driven methods on certain types of subsurface data; creation of data-driven workflows and application to subsurface data generated during petroleum engineering and geoscience operations; study of case studies with an emphasis on the use of supervised learning, classification and regression, unsupervised learning, transformations, clustering and feature extraction, and neural networks using open-source Python computational platforms; exploration of the basics of machine learning, data science and data analysis and their applications to petroleum engineering and geoscience. **Prerequisite:** PETE 301 or GEOP 361, or equivalent; graduate classification; or approval of instructor.

PETE 687 Machine Learning for Petroleum Engineers Using Python

Credits 3. 3 Lecture Hours. Introduction to machine learning; use of Python programming to apply various machine learning algorithms to petroleum engineering problems; practical exercises to get hands-on experience building models with Python; introduction to deep learning; use of Tensorflow and PyTorch (two open-source Python libraries) for deep learning applications. **Prerequisites:** Graduate classification or approval of instructor.

PETE 689 Special Topics in…

Credits 1 to 4. 1 to 4 Other Hours. Special topics in an identified area of petroleum engineering. May be repeated for credit.

PETE 691 Research

Credits 1 to 23. 1 to 23 Other Hours. Advanced work on some special problem within field of petroleum engineering; thesis course.

PETE 692 Professional Study

Credits 1 to 12. 1 to 12 Other Hours. Approved professional study or project. May be taken more than once but not to exceed 6 hours of credit towards a degree.