10F. Petroleum Engineering Course Descriptions

PETxxx Courses

PET211	Introduction to Petroleum Engineering	3 CH (2,3,0)
Course Contents	Overview of Oil and Gas Resources. International Petroleum organizations, Origin of petroleum. Basic Review of Petroleum Traps. Migration and Accumulation. Basic Functions and Components of Rig. Drilling Fluid Functions. Fundamental Drilling Operations. Completion Types. Completion Equipment. Definitions of Reserves. Reservoir Drive Mechanisms. Primary Recovery. Petroleum Fraction. Different Petroleum Products. Petroleum oilfield Safety.	
Prerequisite (s)	--	
Textbook	1. X. Shen, M. Bai, W. Standifird: "Drilling and Completion in Petroleum Engineering ", 1st ed., Taylor & Francis, 2011 2. F. Jahn, M. Cook, M Graham: "Hydrocarbon Exploration and Production", 2nd ed., Elsevier Publishing, 2008	
Lab/Computer work/Project	--	

PET212	Drilling Engineering I	3 CH (2,2,1)
Course Contents	Systems of units. Fundamentals of rock mechanics. Down hole pressure and temperature relations. Drill string design. Hosting system. Rotary drilling bits (Tricone bits, PDC bits, Diamond bits). Bit selection. Mud engineering: Functions, Types, Properties, Calculations, and Conditioning. Rig hydraulics. Mud lab Experiments.	
Prerequisite (s)	PET211	
Textbook	1. R. F. Mitchell, S. Z. Miska: "Fundamentals of Drilling Engineering", 1st ed., SPE Textbook, 2011 2. E. Fjaer, R. M. Holt, P. Horsrud, A. M. Raaen: "Petroleum Related Rock Mechanics", 2nd edition, Elsevier, 2008	
Lab/Computer work/Project	Drilling Fluids Lab Software for design	

PET241	General Geology	2 CH (2,0,0)
Course Contents	Cosmology and Earth formation. Mineralogy: different rock types. Sedimentary processes. Volcanoes. Geologic time. Plate tectonics and crustal deformation. Earthquakes. Surface processes of erosion. Weathering in different geologic environments.	
Prerequisite (s)	--	
Textbook	1. E. J. Tarbuck, F. K. Lutgens, D. G. Tasa: "Earth: An Introduction to Physical Geology", 13th ed., Pearson Publication, 2019 2. A. Parriaux: "Geology-Basics for Engineers", 2nd ed. Taylor & Francis, 2018	
Lab/Computer work/Project	--	

PET242	Structural Geology & Sedimentology	3 CH (2,2,0)
Course Contents	Introduction to structures formed by brittle and ductile deformation. Structures in terms of geometrical, kinematical, mechanical analysis. Stereo net practice, stress and strain analysis, fractures and faults, folding, diapirism, shear zones, deformation mechanisms. Analysis and interpretation of seismic, Sea floor image, Well logs, Characteristics of the elements of reservoirs and emphasizing internal architecture as related to reservoir performance. Geologic control on reservoir equality. New concepts in understanding transport and depositional processes. Geologic modeling and petroleum systems.	
Prerequisite (s)	PET241	
Textbook	1. D. D. Pollard, R. C. Fletcher: "Fundamentals of Structural Geology", Cambridge University Press, 2005 2. G. Shanmugam: "Deep-Water Processes and Facies Models Implications for Sandstone Petroleum Reservoirs", 1st ed., Elsevier, 2006 3. R. M. Slatt: "Stratigraphic Reservoir Characterization for Petroleum Geologists, Geophysicists, and Engineers", 2nd ed., Elsevier, 2013	
Lab/Computer	--	

PET314	Drilling Engineering II	3 CH (2,2,1)
Course Contents	Pore pressure. Fracture gradient. Casing seat selection. Casing design. Cementing. Well completion. Factors affecting rate of penetration. Hole problems. Directional holes. Fishing. Offshore drilling.	
Prerequisite (s)	PET212	
Textbook	1. R. F. Mitchell, S. Z. Miska: "Fundamentals of Drilling Engineering", 1st ed., SPE Textbook, 2011 2. M. E. Hossain, M. R. Islam: "Drilling Engineering Problems and Solutions "1st ed., Wiley, 2018	
Lab/Computer work/Project	Cementing Lab Software for design	

PET321	Production Optimization and Well Performance	3 CH (2,2,0)
Course Contents	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 (s)	PET211	
Textbook	1. H. D. Beggs: "Production Optimization Using Nodal Analysis", 2nd ed., Oil & Gas Consultants Intl., 2002 2. Dowell –Schlumberger, "Well performance Manual", 1998 3. Kermit E. Brown, and H. D. Beggs: "Technology of Artificial lift Methods" Vol. 1, PennWell Books, 1980	
Lab/Computer	--	

PET322	Artificial Lift Technology	3 CH (2,2,0)
Course Contents	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 (s)	PET321	
Textbook	1. N. K. Mitra, A. Kumar: "Principle of Artificial lift", Allied Publishers Pvt, Ltd., 2012 2. Kermit E. Brown, and H. D. Beggs: "Technology of Artificial lift Methods" Vol. 1,	

	PennWell Books, 1980
Lab/Computer	--

PET324	**Well Completion and Workover**	**3 CH (2,2,0)**
Course Contents	Fundamentals and applications of completion and workover operations: Various completion designs, Reservoir and mechanical considerations, Basic tubing design, Subsurface equipment, Completion and workover fluids, Perforating, stimulation, Sand control and remedial cementing. Horizontal well completion technology. Completion and workover problem solving, and demonstration of the design and operation of basic completion and control equipment.	
Prerequisite (s)	PET314	
Textbook	1. J. Beilarby: "Well Completion Design" 1st ed., Elsevier Science,2009 2. W. Renpu: "Advanced Well Completion Engineering", 3rd ed., Gulf Professional Publishing (imprint of Elsevier), 2011	
Lab/Computer	--	

PET331	**Reservoir Rock and Fluids Properties**	**3 CH (2,2,1)**
Course Contents	Basic petrophysical properties of reservoir rocks: Porosity, Permeability, Fluid saturation, Electrical conductivity, Capillary pressure, and Relative permeability. Laboratory measurement of the reservoir rock characteristics mentioned above. 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. Principles of miscibility.	
Prerequisite (s)	PET211	
Textbook	1. D. Tiab, E. C. Donaldson: "Petro physics: Theory and Practice of Measuring Reservoir Rock and Fluid Transport Properties", 3rd ed., Gulf Professional Publishing, 2012 2. W. D. McCain: "The Properties of Petroleum Fluids", 2nd ed., PennWell Publishing Company, 1990	
Lab/Computer work/Project	Porosity Lab Measurements Permeability Lab Measurements Relative Lab Measurements Capillary pressure Lab Measurements Wettability Capillary pressure Lab Measurements PVT Lab Phase behaviors of the petroleum fluids PVT Lab Types of reservoir fluids.	

PET332	**Petroleum Reservoir Engineering**	**3 CH (2,2,0)**
Course Contents	Quantitative study of oil production by natural forces, Gas cap, Water influx, Solution gas, etc. Material balance equations, study of gas, and black oil reservoirs. Predictive calculations of oil recovery from different reservoir types. Principles of immiscible displacement.	
Prerequisite (s)	PET331	
Textbook	1. T. Ahmed and P. D. McKinney: "Advanced Reservoir Engineering", Gulf Professional Publishing (imprint of Elsevier), 2005 2. B.C. Craft and M.F. Hawkins: "Applied Petroleum Reservoir Engineering", 2nd ed., Revised by R. Terry, Prentice Hall PTR, 1991 3. L.P. Dake: "Fundamentals of Reservoir Engineering", Elsevier Science B.V., 1998	
Lab/Computer	--	

PET333	Formation Evaluation with Well Logging	3 CH (2,2,1)
Course Contents	Introduction to formation evaluation, coring and core analysis, drilling fluid and cuttings analysis, mud logging, well logging and other evaluation methods. Theory and interpretation of conventional well logs, electric resistivity of rocks, measurements zones and environments, open hole logging; spontaneous potential log, gamma ray logs, resistivity logs; conventional electric tools, focused current and induction devices, sonic log, density logs, and neutron logs.	
Prerequisite (s)	PET331	
Textbook	1. T. Darling: "Well Logging and Formation Evaluation", Gulf Professional Publishing, 2005 2. G. Asquith, D. Krygowski: "Basic Well Log Analysis", 2nd ed., AAPG Publications, 2006 3. Z. Bassouni: "Theory, Measurement and Interpretation of Well Logs", 2nd ed., SPE Textbooks, 1994	
Lab/Computer work/Project	Software lab for well log interpretation and formation evaluation	

PET343	Petroleum Geology and Exploration	3 CH (2,2,0)
Course Contents	Fundamentals of petroleum geology. Source rock and reservoir, trap types. Generation, migration and accumulation of petroleum. Effects of sedimentary environments on reservoir rock properties. Mapping and geological correlations. Concepts and Geo-statistics. Geotectonic effects on frac. Geophysical tools integrated with geology. Correlation principles and exercise, sequence stratigraphy primer and applications, principle of exploration and exploitation and examples. Exploration methods; seismic, gravity, magnetism. Appraisal methods, reservoir mapping and volumetric. Unconventional resources. Outline of the importance of oil and gas deposits in Egypt.	
Prerequisite (s)	PET242	
Textbook	1. R. C. Selley: "Elements of Petroleum Geology", 3rd ed, Elsevier Academic Press, 2015 2. R. M. Slatt: "Stratigraphic Reservoir Characterization for Petroleum Geologists, Geophysicists, and Engineers", 2nd ed., Elsevier, 2013	
Lab/Computer	--	

PET351	Petroleum Refining and Petrochemical Engineering	3 CH (2,2,0)
Course Contents	Distillation Columns. Crude oil fractionation. Basic petroleum fractions from AD/AV complex, Refinery Gases. Gasoline and Naphtha Specification and uses. Aviation Turbine Fuel. Kerosene, Fuel, and Asphalt specifications and uses. Wax distillates production. Manufacture of lubricating oils, and Grease. Complex refinery schemes: dehydration, desulphurization, Cracking, reforming Operations. Raw materials of petrochemical industries. Preparation of gaseous hydrocarbons, fractionation of gases. Preparation of liquid hydrocarbons. Separation of paraffin's, aromatics, xylenes. Syntheses and reactions of H2-CO2 mixture. Production of methanol, alcohols, ammonia, sulfur and sulfuric acid. Production of detergents, plastics and resins, synthetic rubber, and industrial fibers. Natural and properties of polymers.	
Prerequisite (s)	EMP251	
Textbook	1. J. H. Gary, G. E. Handwerk, M. J.: Kaiser: "Petroleum Refining: Technology and Economics", 5th ed., CRC Press, 2007 2. W. L. Nelson: "Petroleum Refinery Engineering", McGraw-Hill, New York, 1969	
Lab/Computer	--	

PET352	Natural Gas Engineering and Processing	3 CH (2,2,0)
Course Contents	Gas reserves: Estimation, Deliverability, and Future production performance prediction. Deliverability testing of gas wells: Isochronal, Flow after flow, Drawdown and buildup. Gas field development and underground storage. Gas production metering gauging and transmission. Properties of Natural Gases and Condensate Systems. Separation and Processing. Glycol Dehydration. Petrochemicals: Overview, Introduction, Process Topology, Manufacture of Methanol from Synthesis Gas, Formaldehyde and Chloromethane.	
Prerequisite (s)	--	
Textbook	1. H. D. Beggs: "Gas Production Operations", Oil & Gas Consultants Int, 1984 2. S. Mokhatab, W. A. Poe, J. Y. Mak:" Handbook of Natural Gas Transmission and Processing", 4th ed., Gulf Professional Publishing (imprint of Elsevier), 2019	
Lab/Computer	--	

PET361	Economics and Agreements	3 CH (2,2,0)
Course Contents	Introduction to the economic yardsticks. Economic analysis process for petroleum projects and the sensitivity analyses concept. Cashflow model and its components together with the net percent value consideration. Worldwide petroleum legislation such as Royalty, tax system, Production sharing, contracts, Concession Agreement, etc. Types of risks encountered in the petroleum industry and risk analysis. Introduction to E&P decision evaluation technique.	
Prerequisite (s)	--	
Textbook	1. H. K., Abdel-Aal, M. A. Alsahlawi: "Petroleum Economics and Engineering" 3rd ed., Taylor and Francis, 2013	
Lab/Computer	--	

PET415	Advanced Drilling Technology	3 CH (2,2,0)
Course Contents	Directional well planning and bottom hole assemblies. Hole problems and wellbore stability in deviated wells. Computer aided drilling optimization and drill bit selection for directional wells. Horizontal well drilling: reasons, types, design of well path, BHA design, drilling problems associated with horizontal wells. Optimized torque and drag during drilling horizontal wells. Instrumentation and mechanical aspects of steerable motors and their effect. Applications of coiled tubing and new equipment in horizontal drilling. Case histories of horizontal well drilling worldwide.	
Prerequisite (s)	PET314	
Textbook	1. R. Samuel, D. Gao: "Horizontal Drilling Engineering - Theory, Methods and Applications", Sigma Quadrant Publisher, 2014 2. M. E. Hossain, M. R. Islam: "Drilling Engineering Problems and Solutions "1st ed., Wiley, 2018 3. Drilling Manuals from Different Oil & Gas Companies Such as: Shell and ENI.	
Lab/Computer	--	

PET425	Surface Production Operations	3 CH (2,2,0)
Course Contents	Oil and Gas Gathering Systems: Onshore and Offshore Production Facility, Choosing a Process, Crude Oil Characteristics. Crude Oil Emulsion Problems: Theories of Emulsion, Emulsion Treatment Process and Equipment. Separation of Oil and Gas: Types of Separators and Capacities, Separator Design, Sizing and Selection. Oil Treatment Facilities: Desalting Units, Crude Oil Stabilization and Measurements, Classifications and Fraction of Crudes. Transportation of Crude Oil: Introduction, Pipelines, Pipeline Installation, Pipeline Maintenance, Chemical Treatment, Use of Pigs, Corrosion Control.	

Prerequisite (s)	PET321
Textbook	1. M. Stewart, K. E. Arnold: "Surface Production Operations", 3rd ed., Elsevier Science & Technology, 2011
Lab/Computer	--

PET433	**Well Testing Analysis**	**3 CH (2,2,0)**
Course Contents	Introduction to well testing, well test objectives, and overview of the diffusivity equation for well test analysis. Pressure buildup tests (PBU), PBU test analysis and design, fault detection, determination of average reservoir pressure. Draw down and reservoir limits test, design and implementation. Type curve matching and pressure derivatives. Multiple well testing; interference testing and pulse testing. Injection well testing; injectivity test; falloff test, step-rate test. Drill stem test. Design of well testing procedures analysis software.	
Prerequisite (s)	PET332	
Textbook	1. J. Lee: "Well Testing", SPE Textbook, 1982 2. D. Bourdet: "Well Test Analysis", Elsevier Science & Technology, 2002 3. T. Ahmed and P. D. McKinney: "Advanced Reservoir Engineering", Gulf Professional Publishing (imprint of Elsevier), 2005	
Lab/Computer	--	

PET434	**Reservoir Simulation**	**3 CH (2,2,1)**
Course Contents	Introduction to petroleum reservoir simulation. 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. Simulation of actual reservoir problems using both field and individual well models to determine well spacing, production effects of secondary and enhanced recovery processes. Future rate predictions and recovery, coning effects. Relative permeability adjustments and other history matching techniques.	
Prerequisite (s)	PET332	
Textbook	1. J. H. Abou-Kassem, S. M. F. Ali, M. R. Islam: "Petroleum Reservoir Simulation: A Basic Approach", Gulf Publishing Company, 2006 2. M. R. Islam, M. E. Hossain, S. H. Mousavizadegan, S. Mustafiz, J. H. Abou-Kassem: "Advanced Petroleum Reservoir Simulation: Towards Developing Reservoir Emulators" 2nd ed., Wiley, 2016	
Lab/Computer work/Project	Software lab for using reservoir simulators to build reservoir models and applications	

PET435	**Enhanced Oil Recovery**	**3 CH (2,2,0)**
Course Contents	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 methods for liner pattern and pattern water floods in single and multi-layered reservoir. Enhanced oil production methods: Chemical (Polymer, Surfactant, and alkaline flooding), Gas miscible displacement, and Thermal recovery for heavy oil.	
Prerequisite (s)	PET332	
Textbook	1. J. J. Sheng: "Modern Chemical Enhanced Oil Recovery, Theory and Practice", Gulf Professional Publishing (an imprint of Elsevier) 2011. 2. E. C. Donaldson, G. V. Chilingarian, T. F. Yen: "Enhanced Oil Recovery II, Processes and Operations," Elsevier science Publishers, 1989	

	3. H. K. Van Poollen, et al.: "Fundamentals of Enhanced Oil Recovery," Penn Well Publishing company, 1980
Lab/Computer	--

PET436	**Reservoir Characterization**	**3 CH (2,2,0)**
Course Contents	Principles and techniques of petroleum reservoir characterization. Subsurface data from geological and engineering sources. Univariate and bivariate characterization Estimation techniques. Reserve estimation methods.	
Prerequisite (s)	PET332	
Textbook	1. R. A. Schatzinger, J. F. Jordan: "Reservoir Characterization: Recent Advances", AAPG Publications, 1999 2. F. Amenzadeh: "Reservoir Characterization: Fundamentals and Applications", Scrivener Publishing LLC, 2022	
Lab/Computer work/Project	--	

PET471	**Digital Applications in Petroleum Engineering**	**3 CH (2,2,0)**
Course Contents	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 (s)	--	
Textbook	As advised	
Lab/Computer	--	

PET472	**Greenhouse Technology and Emission Reduction**	**3 CH (2,2,0)**
Course Contents	Technologies employed to reduce CO2, CH4, and soot emissions from energy utilization, Advantages and limitations of technologies applied to reduce energy emissions, Efficient use of energy, Catalytic conversion, Greenhouse challenges, Emerging greener technologies, Capture and storage of CO2, Emissions from nuclear power, Reforming, Sulphur and Sulphur scrubbers, Climate changes and greenhouse gases.	
Prerequisite (s)	--	
Textbook	As advised	
Lab/Computer	--	

PET473	**Energy Plant Engineering and Maintenance**	**3 CH (2,2,0)**
Course Contents	Introduction to Plant Engineering in industrial application. Definition of Modern maintenance and its objectives. Maintenance Types and Strategies used in Modern Industries. Economic consideration in Plant Engineering and Maintenance. Condition Based Maintenance (CBM). Computer Maintenance Management Systems (CMMS). Plant engineering utilities, energy and power systems, Material handling and storage. Environmental control: Waste disposal, Pollution control. Industrial maintenance: Corrective and predictive maintenance, piping, Spare parts inventory control.	
Prerequisite (s)	--	

Textbook	B. S. Dhillon: "Engineering Maintenance: A Modern Approach", CRC Press, 2002
Lab/Computer	--

PET474	**Geo-Energy Storage Systems**	**3 CH (2,2,0)**
Course Contents	Subsurface geological formations as storge systems for energy considerations. Geothermal energy recovery from abandoned petroleum wells. Technical factors: wellbore integrity, heat recovery technologies, subsurface influences on deep wellbore heat extraction. Practical consideration: heat exchangers, working fluids, thermal conductivity, corrosion, scaling, and remote operations. Challenges and opportunities: political motivation, regulations, environmental impacts, and economics. CO2 injection and storage/sequestration in subsurface geological formations: trapping mechanisms, petrophysical changes, monitoring techniques, environmental issues and economic considerations. CO2 injection for enhanced oil recovery.	
Prerequisite (s)	--	
Textbook	As advised	
Lab/Computer	--	

PET475	**Energy and Unconventional Resources**	**3 CH (2,2,0)**
Course Contents	Introduction to energy demand. Non-conventional energy resources and key performance characteristics. Comparison between conventional and unconventional resources. Unconventional oil and gas resources: Heavy oil, Low-permeability reservoirs, Coal bed methane, Gas hydrates. Classification of unconventional resources, geologic significance, geographic occurrences, petrophysical properties and formation evaluation, and recovery technology. Methods for hydrocarbon recovery: well drilling, well stimulation, hydraulic fracturing, and the overall geomechanical framework. Various methods for recovery and more advanced methods for improved oil recovery.	
Prerequisite (s)	--	
Textbook	1. C. Ngo: "Energy Resources, Technologies & The Environment", Institution of Engineering and Technology, 2010 2. Y. Z. Ma and S. A. Holditch: "Unconventional Oil and Gas Resources Handbook Evaluation and Development", Gulf Professional Publishing (an imprint of Elsevier), 2016 3. M. R. Islam: "Unconventional Gas Reservoirs: Evaluation, Appraisal and Development" Gulf Professional Publishing (an imprint of Elsevier), 2015	
Lab/Computer	--	

PET476	**Petroleum and Sustainability**	**3 CH (2,2,0)**
Course Contents	Introduction to the role of petroleum engineering in sustainability. Sustainable Developments Goals (SDGs) and relation to the oil and gas industry. Fundamentals and applications related to environmental sustainability and emerging energy resources. Environmental aspects of produced water disposal, mitigation of greenhouse gas emissions, reducing surface footprint, elimination spills, and applying environmentally friendly materials. Well integrity. Optimized field development and management. Energy efficiency and conservation.	
Prerequisite (s)	--	
Textbook	As advised	
Lab/Computer	--	

PET477	Selected Topics in Sustainable Energy	3 CH (2,2,0)
Course Contents	Selected topics in sustainability in energy. Problems or readings on specific subjects or projects in sustainability. Students will investigate cutting edge research in sustainable energy including experimental studies, current policies and international sustainability issues. Field study including assessment, evaluation, feasibility and economic studies will be required.	
Prerequisite (s)	--	
Textbook	As advised	
Lab/Computer	--	

PET478	Environmental Engineering and Safety	3 CH (2,2,0)
Course Contents	Energy use and energy patterns in modern society. Resource estimates. Engineering analysis of energy systems. Managing carbon emissions. Environmental impact and protection, Environmental remediation technologies. Introduction to the principles of safety and environment element for the upstream sector of petroleum industry. Fundamentals of safety measures, actions, performance and lost time incidents and awareness. Incident command system (ICS). Environmental Impact Assessment (EIA) waste disposal management system.	
Prerequisite (s)	--	
Textbook	1. M. L. Davis, D. A. Cornwell: "Introduction to Environmental Engineering", 6th ed., McGraw-Hill Education, 2023 2. D. Ghosh, D: "Safety in Petroleum Industries" Taylor and Francis, 2021	
Lab/Computer	--	

PET498	Graduation Project 1	2 CH (1,0,3)
Course Contents	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.	
Prerequisite (s)	Approval	
Textbook	All Petroleum Engineering References delivered previously by FUE	
Lab/Computer	--	

PET499	Graduation Project 2	3 CH (1,0,6)
Course Contents	An engineering assignment requires the student to demonstrate initiative and assume responsibility. Students can propose their own project. A project report is required at the end of the tenth semester.	
Prerequisite (s)	PET498	
Textbook	All Petroleum Engineering References delivered previously by FUE	
Lab/Computer	--	