

للهندسة النفطية المحتوى العلمي للمقررات الدراسية
Description of Course Content for Petroleum Engineering

PE 200 Strength of Materials (3 Units): **Prerequisite:**
GE 140

Introduction - Direct Stresses: Tensile and Compressive Stresses - Stress-Strain Relations - Hook's Law -Factor of Safety - Poisson's Ratio - Strain Energy – Resilience - Toughness -Composite Stresses - Thermal Stresses -Shear Stress and Shear Strain - Modulus of Rigidity -Shear Strain Energy - Relations Between Young's Modulus, Modulus of Rigidity, Poisson's Ratio, and Bulk Modulus of Elasticity - Bearing Stress -Thin Shells under Internal Pressure - Shearing Force and Bending Moments of Beams, Shearing Force and Bending Moment Diagrams - Moment of Inertia of Areas - Torsion: Torque, Torsion of Circular Shaft, Comparison in Torsion of Solid and Hollow Shaft - Bending Stresses - Buckling of Columns.

PE 220 Introduction to Petroleum Engineering (3 Units):
Prerequisite : ---

Origin, Chemical Composition, Migration and Accumulation of Petroleum. –Subsurface Pressures and Temperatures – Petroleum Exploration Methods –Basic Reservoir Rock Properties: Porosity, Permeability, Saturation, and Capillary Pressure – Properties of Gaseous Petroleum – Oil and Gas Reserves Calculations – Drilling Methods: Cable Tool and Rotary Drilling – Drilling Techniques: Vertical and Directional Drilling, Fishing Operations – Rotary Drilling Fluids – Well Completion Types – Well Logging – Production Methods.

PE 210 General Geology (3 Units): **Prerequisite**
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Scope of Geological Science, Origin & Parts of Earth, Theories of Earth's Genesis - Internal Processes of The Earth (Volcanic Activity, Earth's Movement & Structure) - External Processes of the Earth (Weathering– Erosion-Transportation–Sedimentation) - Earth's Crust Rock Types (Igneous–Metamorphic–Sedimentary) – Sedimentary Basins System – Sedimentary Environment (Aeolian System, Fluvial System, Deltaic) – Hydrocarbon (Accumulation and Presentation and Organic Matter), Kerogens, Timing of Transformation, Petroleum Trilogy (Source Rock, Reservoir Rock, Seal Rock), Migration, Traps.

PE 201 Fluid Mechanics (3 Units): **Prerequisite**
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Fluid Properties – Fluid Statics: Pressure at a Point, Pressure Variation in a Static Fluid, Units and Scales of Pressure Measurement, Manometers, Forces on Submerged Surfaces,

Buoyant Force, Masses of Liquids Subjected to an Acceleration – Fluid Flow Concepts and Basic Equations: Flow Characteristics, Continuity Equation, Momentum Equation, Euler's Equation of Motion along a Streamline, Bernoulli's Equation, Steady-State Energy Equation, Energy Losses – Dimensional Analysis: Dimensional Homogeneity and Dimensionless Ratios, The Π Theorem – Compressible Flow: Speed of a Sound Wave, Mach Number, Isentropic Flow, Converging-Diverging Nozzle Flow – Velocity and Flow Rate Measurements.

PE 221 Drilling & Production Machinery (3 Units): **Prerequisite**
: PE 220

I. Drilling Machinery:

The Rotary Rig and Its Components: The Rotating System, The Hoisting System, The Circulating System – Power Requirements and Ton-Miles of a Drilling Line – Drilling Techniques: Control of Hole Deviation in Vertical Drilling, Control of Hole Deviation in Directional Drilling, Fishing Operations -Well Control Equipments: Fluid Density Control, Blow Out Preventers.

II. Production Machinery:

Surface Gathering Systems – Gas Lift Valves: Types and Mechanics – Sucker Rods Pumps – Production Packers – Oil and Gas Separators.

PE 202 Engineering Thermodynamics (3 Units): **Prerequisite**
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Main Principle and Definitions - Temperature and Zeroth Law of Thermodynamics - Heat and Work – The Definitions of Process and the Path - The State of Working Fluid – Reversible and Irreversible Processes – Reversible Work - First Law of Thermodynamics - Internal Energy – Application of the First Law and No-Flow Process - Working Fluid: Liquid-Vapour, Gas, Steam Tables - Perfect Gas – Specific Heat - Reversible and Irreversible Process – Reversible No-Flow Process on (P – V) Diagram for Steam and Perfect Gas - Second Law of Thermodynamics – Heat Engine – Thermal Efficiency - Entropy - Reversible No-Flow process on (T–S) Diagram - Carnot Cycle – Constant Pressure Cycle.

PTE 211 Sedimentology (2 Units): **Prerequisite**
: PE 210

Definitions of Sedimentary Rock – Nature and Origin of Sedimentary Rocks - Economic Value of Sedimentary Rocks - Textures of Sedimentary Rocks and their Importance - Classification of Sedimentary Rocks - Environments of Depositions - Relation of Sedimentary Rocks with Hydrocarbons Generation and Accumulation – Sedimentary Basins (Rift Type Basin, Stable Area Basins, Passive Margin Basins, Mobile Basins).

EE 201 Fundamentals of Electrical Engineering (3 Units) **Prerequisite: GS 121 & GS 131**

System of Units – Types of circuits and circuit elements – Ohms law – Kirchoffs laws – Nodal analysis – Mech analysis – Thevenins and Nortons theorems – Inductance and Capacitance – The Sinusoidal forcing function – The phasor Concept – Sinusoidal Steady State response – Phasor Diagrams – Impedance – Admittance – Instantaneous , average, apparent, and Complex powers.

PE 322 Drilling and Oil Well Design (3 Units): **Prerequisite**
: PE 221

Factors Affecting the Penetration Rate – Rheological Classification of Fluids – Pipe Flow of Newtonian Liquids – Annular Flow of Newtonian Liquids – Pipe Flow of Bingham Plastics – Annular Flow of Bingham Plastics – Rotary Drilling Hydraulics – Casing String (Function of Casing, Types of Casing String, Classification of Casing) – Selection of Casing Sizes – Design of a Combination String – Rotary Drilling Techniques (Vertical Drilling , Directional Drilling) – Cost of Drilling – Drilling Problems.

PE 312 Structural Geology (3 Units): **Prerequisite**
: PE 211

Definition of Geological Structures and their Importance - Studying of Primary Geologic Structures and their Significant - Mechanical Properties of Rocks Under Stresses and Factors Controlling their Behaviour - Studying of Secondary Structure (Folds – Faults - and Joint and Cleavages) - Classification of Different Type of Folds, Faults and Joints - Appearance of Different Structures on Maps - Studying of Unconformities Surfaces and their Significances - The Earth Movement in the Light of Plate Tectonic Theory - Examples of Major Structures Feature of Libya.

PE 350 Reservoir Rock Properties (3 Units): **Prerequisite**
: PE 220

I. Fundamental Properties of Fluid-Permeated Rocks: Porosity: Types and Measurement of Porosity in Laboratory – Permeability: Types and Measurement of Permeability in Laboratory – Permeability of Combination Layers – Fluid Saturations and their Measurements in Laboratory – Electrical Conductivity of Fluid-Saturated Rocks, Resistivity Relations.

II. Properties of Porous Media Containing Multiple Fluid Saturations: Fundamentals of Surface and Capillary Forces – Water Saturation from Capillary Pressure data – Calculation of Wettability – Effective and Relative Permeability.

PE 351 Reservoir Fluids Properties (3 Units): **Prerequisite**
: PE 220

Fundamentals of the Behavior of Hydrocarbon Fluids – Single Component System – Binary System – Multi Components Systems – Classification of Crude Oils and Natural Gases According to Their Phase Diagrams – Properties of the Gaseous State (Ideal Gas Laws, Behavior of Natural Gases, Properties of Natural Gases) – Properties of Hydrocarbon Liquids – Properties of Two Phase Hydrocarbon Systems (Oil Formation Volume Factor,

Bubble Point Pressure, Solution Gas Oil Ratio, Flash PV Test, Differential Oil Formation Factor and Gas in Solution) – Equilibrium Relations – Physical Properties of Formation Water.

PE 330 Oil Well Completion (3 Units): **Prerequisite**
: PE 322

Oil Well Cementing - Completion Operation - Completion Fluids – Perforating Operations - Water and Gas Coning - Well Completion Program and Control - Sand Control - Completion Efficiency – Formation Damage – Well Stimulation Techniques for Removing the damage and Improving the Flow Efficiency: Hydraulic Fracturing and Acidizing.

PE 313 Petroleum Geology (3 Units): **Prerequisite**
: PE 312

Origin of Petroleum - Theories of Organic & In-Organic Origin - The Present Theory - Occurrence of Petroleum - Surface Occurrence - The Kerogen and the Type of its Occur - Formation of Petroleum - Sapropel and Sapropelite (Source Rock) - Migration of Petroleum: Primary & Secondary Migration - The Reservoir Rock: Sandstone & Carbonates - Oil Traps: Stratigraphic, Structural & Combined Traps - Accumulation of Petroleum - Study of Some Productive Oil Fields in Libya, its Depositional Basin, Source Rock, Reservoir, Migration & Accumulation of Oil.

PE 360 Fluid Flow in Porous Media (3 Units): **Prerequisite : PE 350**
& PE 351

Darcy's Law – Classification of Fluid Flow System: Linear, Radial, Spherical – Steady-State Linear Flow: Incompressible Fluids, Gases – Linear Flow in Beds in Series and in Parallel – Poiseuille's Law for Capillary Flow – Flow through Fractures – Steady-State Radial Flow: Incompressible Fluids, Gases – Permeability Variation in Radial Flow – Unsteady-State Radial Flow: Diffusivity Equation, Exponential Integral Solution and its Applications – Radial Flow in Bounded Drainage Areas – Water Influx: Hydraulic Analogs of Water Influx, Water Influx from Solutions of the Diffusivity Equation, General Material Balance Equation, Water Influx from Material Balance Equation, Simultaneous Calculation of Initial Oil in Place and Water Influx from Material Balance Equation.

PE 380 Storage and Transportation of Petroleum (3 Units): **Prerequisite**
: PE 201

Design of Oil Pipelines: Major & Minor Pressure Drop, Optimum Pipe Size, Hydraulic Gradient Curves - Mechanical Design - Pressure Drop Using Monographs – pumping stations arrangement - Design of Gas Transmission Pipelines: Pressure Drop, Pipe Line Storage Capacity, Optimum Pipe Diameter, Gas Hydrate - Two-Phase (Liquid & Gas) Flow: Type of Flow, Pressure Drop, Correlations for Multiphase Flow - Petroleum Storage Tanks: Optimum Tank Proportions, Mechanical Design - Pressure Vessel Design: Optimum Proportions, Mechanical Design, Wind Effect, Spherical Tanks.

PE 304 Surveying (3 Units): **Prerequisite**
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Basic Map (Topographic map) - Preparation for Countries and Small Site - Discussion of their Different Elements - Uses of the Basic Map - Calculation of Area and Volumes - Uses and Application of Planimeter and Measuring disc - Location of Points and Traverses - Transferring to Map & (Vice Versa), by Using Prismatic Compass - Topographic and Geologic Surveying by Means of Brunton Compass - Tachometric Surveying , Basic Concept and Methods of Field Work , Measurements and Calculation - Surveying Using Alidad Telescope, Invar Rod , and Geodetical Range Finder - Leveling – Instruments and Methods of Field Work, Calculation and Drawing - Barometric Surveying.

PE 440 Petroleum Production Engineering I (3 Units): **Prerequisite**
: PE 330

Outline of Oil and Gas Production Methods - Production–Rate Decline Curves – The Performance of Productive Formations: Productivity Index and Inflow Performance Relationships - Factors Influencing Shape of IPR - Predicting the Shape of IPR for Depletion - Drive Reservoir - Vertical Lift Performance: Flow Regimes in Vertical Two – Phase Flow Pressure - Distribution Curves - The pressure–Rate–Depth Grid - Slippage and Flow Resistance: Optimum GLR - Effect of Tubing Size and Depth - The Flowing Well Including: Choke Performance, Down–Hole and Flow-Line Chokes - Effects of Changes in Choke Size, Static Pressure, the Producing GLR on Well Efficiency - The Heading Cycle – Water and Gas Coning Problems and Proposed Solutions.

PE 423 Drilling Fluids (3 Units): **Prerequisite**
: PE 322

Introduction and Review to the System of Units - Subsurface Pressure Control with Definitions to Some Criteria - Review to Some Fluid Flow Fundamentals - Drilling Fluid Functions - Types of Drilling Fluids - Drilling Fluid Properties and Methods of Measurements - Drilling Fluid Calculations - Drilling Fluid Contaminations and Treatments - Drilling Fluid Properties Affecting Penetration Rate - Hole Problems Related to Drilling Fluids - Mud Conditioning Equipment and their Layout - Air or Gas Drilling.

PE 461 Applied Reservoir Engineering (3 Units): **Prerequisite**
: PE 360

Petroleum Reservoirs – Estimation of Hydrocarbon Volume Volumetrically – Gas Reservoirs (Estimation Gas in Place by Material Balance Equation) – Oil Reservoirs (Estimation Oil in Place by Material Balance Equation) – The Material Balance Equation as a Straight Line Equation – Estimation of Original Oil in Place by the Material Balance Equation as a Straight Line Equation – Predicting Reservoir Performance – Tarner Method – Muskat Method – Estimation Recovery Factor (Reserves) – Actual Example (Oil Reservoir).

PE 485 Petroleum Refining Engineering (3 Units): **Prerequisite**
: PE 220

Introduction - Composition of Crude Oil, its Classification and Evaluation Methods - Preparation of Crude to Refine - Type of Refinery - Crude Oil as Source of Petrochemical

Industry - Distillation Processes – Petroleum Processing Equipment - Processing of Hydrocarbon Gases - Thermal and Catalytic Processes - Lubricate Oil Production and its Additives.

PE 415 Applied Geophysics (3 Units): **Prerequisite**
: PE 313

Introduction – Role of Applied Geophysics in Field of Oil and Gas Exploration - Magnetic Method: Basic Concepts, Field Work , Results and Interpretation - Gravity Method: Basic Concepts, Field Work , Results and Interpretation - Seismic(Refraction Method): Basic Concepts, Field Work , Results and Interpretation - Seismic(Reflection Method): Basic Concepts, Field Work , Results and Interpretation - Seismology(Induce Tremors): Relation to Oil Production, Basic Concepts, Field Work, Results and Interpretation - Resistivity Method: Basic Concepts, Field Work , Results and Interpretation -Radioactive method: Basic Concepts, Field Work, Results and Interpretation – Geothermal: principle of the Method, Source of Temperature, Measurements and Interpretation - Application of Geophysical Method to Problems in Petroleum Engineering.

PE 441 Petroleum Production Engineering II (3 Units): **Prerequisite**
: PE 440

Major Methods of Artificial Lift - Gas Lift: Gas Lift Valve Characteristics, Type of Gas Lift Installations, Factors to Consider in the Design of Continuous Flow Gas Lift Installations, Determination of the Gas Injection Point, Spacing of Gas lift Valves, Determination of the Flow Rate Possible by Gas Lift, Compressor Horse Power Requirements - Different Types of Pumping System: Hydraulic Pumps, Jet Pumps, Plunger Lift, Beam Pumping, Electrical Submersible Centrifugal Pumps, Components of the Submersible Pumping System, Types of Electrical Pumping Installations - Planning for and Comparison of Different Artificial Lift Methods - Surface Production Facilities: Fluid Separators, Heater Treaters and Oil Skimmers.

PE 431 Well Logging (3 Units): **Prerequisite**
: PE 330

The basic of Resistivity Equation - Formation Temperature – Archie’s Formula - Spontaneous Potential: The SP Log, SSP and SP curves, Inflection Point, Recording of Potential Drop, Uses of SP Log, , Factors Affecting SP Curve - Resistivity Logs: Devices, Measurement, Normal Devices – Focused Tools – Induction Tools: Measurement, Calculation of Water Saturation - Sonic logs: Interpretation, Theory of Propagation, Type of Sonic Measurements, Generation of the Signals, Signal Path - Analysis of the logs: Pattern Recognition, Quick Look Technique, R_w Computation Method, Chart Method, Comparison - Nuclear logs: Introduction, Sources, Devices, Dual Spaced - Density Log: Log Pad Content, Porosity Determination - Shaly Formation Neutron Logging: Tools, Measurements, Corrections, Neutron Density Pattern, Cross plotting N-O for Shale - Gamma Ray Properties – Radio Element Depositum - Gamma Ray Curves Characteristics – Use of Gamma Ray to Determine V. Shale.

PE 470 Computer Applications (3 Units): **Prerequisite**
: GS 226

Review of Used Programming Language and Computer Structure - Curve Fitting Program (Least Square Method) - Interpolation and Extrapolation Program - Application of Computer in Drilling Engineering - Application of Computer in Reservoir Engineering - Application of computer in Natural gas Engineering - The Use of Decline Curve Analysis by Computer - Miscellaneous Applications - Software Applications.

PE 486 Field Processing of Natural Gas (2 Units): **Prerequisite**
: PE 351

Introduction - General Review of Ideal and Real Gas Laws - Calculations of GFVF(Bg) , μ_g and Cg - Gas Wells Deliverability Tests - Liquid Removal From Gas Wells - Well Head and Bottom Hole Pressures - Gas Liquid Separation and Separators - Dehydration of Natural Gas - Sweetening of Natural Gas - Underground Storage of Natural Gas.

PE 445 Oil Well Testing (3 Units): **Prerequisite**
: PE 360

Drill Stem Testing Steps & Reading the Test - DST Test and its Analysis - Pressure Buildup & Drawdown Tests and their Usage for Calculating Reservoir Characteristics - Average Reservoir Pressure - Gas Well Testing – Use of Typical Kind Curve.

PE 562 Enhanced Oil Recovery (3 Units): **Prerequisite**
: PE 461

Outline of EOR Methods and Common Factors Affecting them - Fluid Distribution and the Theory of Frontal Displacement – Buckley - Leverette Theory - Injection Well Location - Water Injection: Water Injection Performance Calculations for Homogenous and Stratified Formations - Gas Injection: Gas Injection Performance Calculations - Miscible Drive: High Pressure Dry Gas Injection - Enriched Gas Injection – Liquefied Petroleum Gases – Alcohol Slug Injection – Carbon Dioxide Injection - Chemical Flooding: Surfactant Injection, Polymer Flooding, Caustic Flooding, the Use of Micro Emulsions - Thermal Recovery Methods: Hot Water Injection, Steam Injection, Cyclic Steam Injection, In-Situ Combustion(Forward and Reverse Combustion).

PE 524 Drilling Technology (3 Units): **Prerequisite**
: PE 423

Drilling Technology of Horizontal Wells (Equipment Used, Hydraulics, Casing Design, Cementing, Completion) – Problems of Horizontal Drilling- Well Testing in Horizontal Wells -Production from Horizontal Wells – Off Shore Drilling.

PE 552 Geological Characterization of Oil and Gas Reservoirs (3 Units):
Prerequisite : PE 431 &445

Review of Petroleum Reservoir Geology – Geological Depositional Environments – Classification of Reservoir Heterogeneity – Introduction to Various Forms of Data for

Reservoir Modelling – Core data (Core Data, Well Log Data, Well Test Data, Geophysical Data) – Impact of Reservoir Heterogeneity on the Flow Response Observed at Wells.

PE 571 Petroleum Engineering Economics (2 Units): **Prerequisite**
: PE 461

Introduction - Interest: Simple Interest, Compound Interest, Continuous Interest - Present Day Value and Discount Annuities - Depreciation: Type of Depreciation, Methods for Calculating Depreciation, Straight Line Method, Declining Balance Method, Sum of the Year Digits Method - Capital Investment - Estimation of the Total Production Cost - Petroleum Engineering Economics.

PE 506 Safety and Loss Prevention (2 Units): **Prerequisite**
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Introduction - Type of Hazards and Hazardous Materials - Hazards Dealing with Oil Industry - Safety Equipment - Factors Enhance Safety: Training, equipment, periodic inspection, etc. - Environment Pollution from Oil Industry - Accidents – Reports.

PE 563 Réservoir Simulation (3 Units): **Prerequisite**
: PE 461

Reservoir Simulation , What , Why and How - Single and Multiphase Flow in Porous Media in 3-D for Steady and Unsteady Cases - Finite Difference Method for solving Diffusivity Equation - Simulator Classification - Data Preparation - History Matching(Model Verification) - Application of Reservoir Models in Field Development.

PE 564 Réservoir Management (2 Units): **Prerequisite : PE 440**
& PE 461

Exploration Background – Reservoir Engineering Activities – Possible Technical Solutions – Economic Analysis – Decision Criteria.

Elective Courses:

PE 506 Corrosion in Oil Industry (3 Units): **Prerequisite**
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Introduction: Direct and Indirect Corrosion Losses - Electrochemical – Mechanism – Metallic Passivity – Corrosion Rate Expression - Economic Consideration: Net Present Value Method & its Application in Corrosion Control - Corrosion Forms: Uniform Attack, Galvanic Corrosion, Erosion Corrosion - Stress Corrosion: Forms, Mechanisms, Factors Affect, Prevention and Control - Cathodic & Anodic Protection – Isolation & Coating – Metals of Constructer: Stainless Steel , Copper, Aluminum, Lead, Nickel, Titanium, Tantalum - Corrosion Inhibitors: Mechanics & Applications – Corrosion Charts.

PE 587 Fuel & Combustion (3 Units):**Prerequisite**

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Introduction - Heating Value – Combustion Calculations – Heat Loss in Fuel Gas – Flame Temperature – Stack Draft Calculation – Stack Height & Diameter - Classification of steam - Shifting Reaction to CH₄ production – Fuel: Solid Fuels: Content, Classifications - Liquid & Gas Fuels: Refinery Processing of Crude Oil - Natural Gas: Liquefied Natural Gas - Secondary Fuels: Conversion Processes: Cracking and Reforming - Fuel & Energy: Electricity from Combustion – Solar Energy - Atomic Energy – Wind energy – Tide energy – Energy by Non-Combustion Processes.