

BSc. Petroleum Engineering Course Contents

Mathematics I : GS111

Credits: 2

Limits, continuity, derivatives, chain rule, higher derivatives, implied differentiation, trigonometric functions, maximum, minimum, point of inflection, curve sketching, Rolle's theorem, mean value theorem. Definite and indefinite integrals: Definition, area under curve, area between two curves, volume of solids of revolution. Methods of integration by substitution, integration by parts.

Physics I : GS112

Credits: 2

Waves: wave equations, travelling waves and stationary waves: principles of superposition, Doppler Effect. Sound: Definitions, velocity of sound in air and material media and its variation. Velocity of transverse and longitudinal vibration in character of light and their spectra: absorption and scattering, dispersion, polarization of light.

Chemistry I: GS113

Credits: 3

Classifications of matter, Physical and Chemical Properties, Measurements (SI), Scientific Notation, Compounds, Atomic number, Mass number, Atomic weight, Isotopes, Molecular weights and Percent Composition, Stoichiometry, The Structure of an Atom, Periodic Table of Elements, Types of Chemical Reaction, Lewis Symbols or Diagrams, Chemical Bonds, Chemical Equilibrium, Acids and Bases, Gases Laws, Introduction in Organic Chemistry.

Engineering Drawing-I : GE114

Credits: 2

Introduction: Drawing instrument, types of lines, letters and figures, geometrical construction, dimensioning, projections, principles of first angle and third angle projection, projection applications, sectioning, section of views and hatching.

Arabic : GH116

Credits: 2

Review of Arabic courses taken in high school, including construction of Arabic sentence, spelling and punctuation.

English (I&II) :GH115 & GH125

Credits: 2&3

GH115 and GH125 are complementary courses designed to introduce the student to the basic pattern of scientific English at the introductory stage and thereafter deals with more advanced

materials. Each cover:-

- (a) Intensive reading of passage containing material the student needs with comprehension questions, contextual references, vocabulary exercises and affixation.
- (b) The study of scientific vocabulary which includes use of dictionary, spelling and affixation.
- (c) Revision and study of Basic English verb tenses, action and passive.
- (d) Description of the laboratory experiments.
- (e) Study and use of the passive voice in scientific technical English.
- (f) Eng. Form.
- (g) Compound nouns. The English noun phrases, relative clause

Mathematics II:GS121

Credits: 3

Methods of integration: By partial fractions, by successive reduction formula, transcendental function; differentiation and integration of transcendental functions. Complex numbers, partial differentiation, applications on relative maxim and minim, the method of Lagrange multiplier integration with applications.

Physics II: GS122

Credits: 3

Electrostatics: Charges and fields, the electric potential electric current, the magnetic fields electric fields in matter. Photoelectric effect, Einstein's explanation and quantum theory of the hydrogen atom, radioactive decay law derivation.

Chemistry II: GS123

Credits: 2

Laboratory Safety , Laboratory Techniques , Definition Acids , Bases and Salts , Identification of Acidic and Basic Radicals , Experiments ...

A-Acidic Radicals :

- 1- Dilute HCL acid group (Carbonate C_3^{2-} , Bicarbonate HCO_3^- , Sulphide S^{2-} , Sulphite SO_3^{2-} , Thiosulphate $S_2O_3^{2-}$, Nitrite NO_2^- and Acetate CH_3COO^-).
- 2- Concentrated H_2SO_4 acid group ((Chloride Cl^- Bromide Br^- , Iodide I^- , Nitrate NO_3^- and Oxalate $C_2O_4^{2-}$)).
- 3- Miscellaneous group ((Sulphate SO_4^{2-} , Phosphate PO_4^{3-} and Borate $B_4O_7^{2-}$)).

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law of thermodynamics and its applications, the second law of thermodynamics, the third law of thermodynamics, Chemical equilibria of homogeneous and heterogeneous systems, Phases and solutions, Phase equilibrium, the liquid state, Thermodynamics of electrochemical cells, chemical reaction kinetics, Reaction equilibria.

Electrical Engineering:GE215

Credits: 3

Kirchhoff's laws and applications, Network theorems, applied electromagnetism and magnetic circuits, self and mutual inductance, rise and fall of current in an inductive circuit, capacitance, charging and discharging of capacitors, stored energy, alternating voltages and currents, average and r.m.s. Values, phasors, complex notation, R-L-C circuits resonance, quality factor, power calculations.

Eng. Mechanics II:GE216

Credits: 3

Dynamics of particles: kinematics including rectilinear and curvilinear motion, kinetics of particles, Newton's Laws of motion, energy principles, impulse and momentum, impact. Rigid body dynamics: kinematics of motion including plan motion, motion relative to rotating frame, kinetics of rigid bodies. Introduction to mechanical vibration.

Computer programming-I:GS217

Credits: 2

Introduction to Digital Computer Organization. Programming language. Computer approaches to problem solution, Flow diagram, FORTRAN language. Fixed and floating point. Arithmetic statement. FORTRAN statement. Control statement. GO TO. Computed GO TO. IF statement. Call exit. Pause. Stop. End. Array. Subscripted variables. Dimension statement. Repeated operations. DO Statement and loop. Continue. Do implied list in input/and output statement.

Mathematics IV: GS221

Credits: 3

Vector analysis, div, grad, curl, Green's, Gauss's and Stokes theorems and their applications. Linear algebra, matrices and their applications. N-Euclidean space, vector spaces. Matrices, algebra of matrices, rank of a matrix, linear transformation, system of linear equations, equivalent and similar matrices, Eigen values and Eigen vectors.

Statistics: GE222

Credits:2

Probability: Concept of a random experiment and a sample space; addition and multiplication laws of probability; conditional probability and independence, Bayes theorem and its application. Random variables and their probability distribution Binomial, poisson, Normal. Gamma, Exponential, Uniform

of the Earth(Weathering- Erosion -Transportation – 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.

Computer Programming-II:GS227

Credits: 2

Function and subprograms. Library functions. Function and subroutine call- Return. Equivalence and Common statement. Engineering oriented exercises and programming debugging.

Numerical Analysis:GE311

Credits: 3

Solution of Non-Laminar Equation : Bisection Method - Alternative Methods – Newton-Raphson Method – Solution of Linear System Equations : Gauss – Elimination Method – Gauss- Jordan Method - Gauss- Siedel Method , Interpolation : Newton' s Forward Difference – Newton's Backward Difference –Sterling Control Difference – Lagrangian Interpolation : Numerical Differentiation – Numerical Integration – Trapezoidal Rule – Simpsons Rule – Solution of Ordinary Differential Equations : Euler's Method – Modified Method – Rung Kutta Method – Second Order and Fourth Order – Linear Regression and Method of Least Squares – Non –Linear Regrssion – Errors

. Organic Chemistry:GS312

Credits: 3

Principles of Organic Chemistry , Classification of Organic Compounds , Saturated and unsaturated and Unsaturated Compounds , Hydrocarbons ; Aromatic Compounds ; alcohol ; Ethers; Aldehydes Phenols ; Ketones ; Carboxylic Acids ; Esters ; Amines ; Industrial Application of Organic Compounds.

Applied Fluid Mech:GE313

Credits: 3

General Energy Equation , Reynolds Number , Laminar Flow and Turbulent Flow , Energy Losses due to Friction , Minor Losses , Series Pipe Line Systems , Parallel Pipe Line Systems , Pump Selection and Application , Open Channel Flow Measurement , Agitation and Mixing Power Requirements For Mixing.

Heat Transfer:GE314

Credits: 3

Steady state heat conduction in one and two dimensions including extended surfaces; illustration of method of solution for two dimensions problems; unsteady state conduction in solids; lumped heat capacity approach; illustration of method of solution for selected geometry's and boundary conditions; dimensional analysis in relation to for heat transfer coefficient inside and across pipes;

natural and forced convection; boiling condensation double pipe and shell and tube heat exchangers; heat transfer by radiation.

Oil Field Equipment :PTE315

Credits: 3

Students are taught drilling and production equipment and their corrosion. In the first part the students are introduced with components and working principles of equipment which are used in the process of oil well drilling: derrick and its components, hoisting system, rotating system, circulation system, casing, roller bits, fishing tools, and well controlling system. Second part covers the principle and components of production equipment: Subsurface and surface equipments of fluid separations; fluid separation, oil skimmers and heater treated. The third part cover preliminary corrosion of the oil field equipments: inspection, evaluation of different design parameters of equipments such as; horsepower of rotary, slush pump and drawwork , mud circulation cycle time. Drilling lines required length, oil and gas capacities of fluid separators, spacing of kick off valves and others.

Structure Geology :PTE316

Credits: 3

Definition of Geological Structure and their Importance – Studying of Primary Geologic Structures and their Significant – Mechanical Properties of Rocks Under Stresses and Factors Controlling their Behavior – 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.

Survey & Topography :PTE317

Credits: 3

Basic Map (Topographic map) -Preparation for Countries and Small Site – Discussion of Different Elements – Uses of the Basic Map – Calculation of Area and Volumes Uses and Application of Plan meter and Measuring disc – Location of Points and Traverses – Transferring to Map & (Vise Versa) by Using Prismatic Compass – Topography 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 Geodetically Range Finder – Leveling – Instruments and Methods of Field work – Calculation And Drawing – Barometric Surveying.

Reservoir Rock Properties:PTE321

Credits:3

Concepts and applications of rock properties which are fundamental to engineering analysis of petroleum reservoir. Such as porosity, Permeability, fluid saturation and electrical conductivity,

These terms are used in calculations of relation permeability, relative permeability ratio, pore size and fluid saturation for multifluid system calculation. The capillary pressure characteristics of the reservoir rock, displacement pressure, wet ability, free water level. The measurement and use of these various factor are discussed.

Reservoir Fluid Properties:PTE322

Credits: 3

Changes of state: Behaviour of pure component, binary and multi-component systems. Properties of hydrocarbon gases: The equation of state for gases, PVT . correlations for reservoir fluids. The properties of reservoir liquids. The coefficient of isothermal compressibility of liquids. Estimation of FVF at pressure below and above the bubble – point pressure. Estimation of oil viscosity . Gas-Liquid Equilibria. Calculation of the bubble – point pressure . Equilibrium Ratio Correlation , flash vaporization, differential vaporization. Gas Solubility . Properties of oil field waters. Gas hydrates.

Res.R & F .Porp. Lab:PTE323

Credits: 3

Calculation of the Original Oil in Place by Using Geological Contour , Isobaths ,Isoporosity and Isosaturation Map, Covering Procedure and apparatus for Measuring the Petro physical Core Rock Properties :Porosity Permeability , Fluid Saturation , Capillary Pressure ,Relative Permeability , and Rock Electrical Resistivity ,Reservoir Fluid Properties ,Viscosity ,Density, and Copressibility.

Safety & Inviior :GE324

Credits: 3

Safety Principles and Importance , Accident Causes and Consequences , Hazard , Fire and Explosion , Contaminant and Control Hazards Environmental issues.

Drilling Engineering :PTE325

Credits: 3

Theory and practice in rotary drilling processes, mechanical properties of rock, bit selection, drilling cost evaluation, well planning, optimizing of bit weight, bit nozzle diameter, and rotary speed; pore pressure and fracture pressure gradient determination. Function properties of drilling fluids, the mathematical modelling of the flow behaviour of drilling fluids. Rotary drilling hydraulics; well control, casing design and cementing.

Drilling Fluids Laboratory :PTE326

Credits: 3

Physical, chemical, and rheological properties of the drilling fluids. Lab tests, distribution, pressures vs. time analysis, flow and pressure test.

Petroleum Geology :PTE327

Credits: 3

Origin of Petroleum – Theories of Organic & In-Organic – The Present Theory – Occurrence of Petroleum – Surface Occurrence – The Kerogen and the Type of its Occurrence – 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.

Petroleum Production I :PTE411

Credits: 3

Production aspects of naturally flowing oil well. The performance of such wells is determined through understanding of multiphase flow of fluids through the various components that comprise a production system, starting from the reservoir and ending at the separator. Derivation, applications and limitations of the inflow performance relationships, vertical lift performance correlations, horizontal flow performance correlation, deviated flow performance correlations, and surface choke performance equations are presented and discussed.

Fluid Flow through Porous :PTE412

Credits: 3

Darcy's Law – Classification of Fluid Flow System : Linear, Radial Spherical – Steady – State 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 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.

Well Logging :PTE413

Credits: 3

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 Log : Interpretation, Theory of Propagation, Type of Sonic Measurement – Generation of the Signals – Signal Path – Analysis of Log : Pattern Recognition – Quick Look Technique – R_w Computation Method – Chart Method – Comparison – Nuclear logs : introduction – Source – Devices – Dual Spaced – Density Log : Log Pad Content - Porosity Determination – Shaly

Formation Neutron Logging : Tools – Measurement - 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.

Well Completion :PTE414

Credits:3

Concepts, purpose of completion. Secondary cementing squeezes liner and Plug back cementing. Completion fluids. Equipments: down hole and surface , tubular , strings. Perforation, sand control , fluids displacement, well bringing in , swabbing, stimulation, acidizing, fracturing, workover: cause, problems, remedies. Workover planning.

Materials Engineering :PTE415

Credits: 3

Classification of Materials – Crystal Structures , Defects in Crystal Structure - Solidification – Properties of Materials , Metallic Materials : Carbon and Low – alloy Steels , High alloy Steels , Nickel and alloys , Aluminium and alloy ; Special Metals , Titanium , Tantalum and Zirconium - Phase and Alloy Fabrication Techniques for Metals and Alloys . Polymeric Materials – Ceramics- Composite Materials – Conductors , Semi Conductors – Organic and Metallic Coating – Materials Selection.

Petroleum Production II :PTE421

Credits: 3

Methods normally used in oil wells subjected to artificial lift. Methods: Such as gas lift, electric submersible pumps and sucker rod pump are considered in details as far as description and function of equipments, design calculation involved and limitations of application are concerned. Attention is given to Libyan oil field.

Corrosion I :PTE422

Credits: 3

Introduction , Corrosion Principles , Thermodynamic and Kinetic of Electrochemical Cells , Electrode Kinetics , Mass Transfer Phenomena , Types of Corrosion , Modern Theory of Corrosion ; Principles , Modern Theory of Corrosion ; Applications , Prevention , Materials Selection.

Applied Reservoir Engineering :PTE423

Credits: 3

Hydrocarbon reservoirs classification, reservoir fluid systems. Hydrocarbon in place evaluation by volumetric methods: oil, gas , gas condensates. HC reservoirs evaluation by other methods . Material balance equations and HC reservoirs evaluation by this method. Mechanisms and drives of reservoir production. Future performance. Fluid properties. Water influx , aquifers evaluation . Historical performance , depletion performance , performance prediction . Libyan reservoirs, applicability of MB.

Transient Pressure Analysis :PTE424

Credits: 3

Salutation to diffusivity equation, le of superposition, pressure build up test, pressure drawdown test: multi rate test: analysis of well test using type curves: analysis of well test using derivatives.

Geophysics & Pet . Explo :PTE425

Credits:3

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

Project Seminar :PTE511

Credits: 3

Students or group of students has to make technical preparation , literature surveying and investigation concerning one of technical matters m the field of petroleum engineering which should be defined at the beginning of the semester jointly by the instructor and the students. The students or the group , at the end, have to make presentation of their work within a session attended by his classmates , some other instructor from the PE department and some interested guests from the oil industry. Then the course instructor would evaluate the students according to their work presentation and their participation in the similar seminar by their classmates.

Natural Gas Engineering :PTE512

Credits: 3

Properties of natural gas condensate systems, their P-V-T relation . Evaluation of original gas in place by volumetric methods . Gas material balance method and it' s application. Flow of gas in porous medium and well . Gas well deliverability tests . Gas separation , treatment , dehydration , gathering , transportation, and measurements . Storage : underground storage , liquefied natural gases . Gas fields development and their feasibility . Libyan gas field .

Petroleum Economics :PTE513

Credits: 3

Economical and technical aspects necessary for the evaluation of a petroleum property with special emphasis on application to the oil industry in Libya . Field development stages . Technical evaluation . original oil in place, reservoir types decline curves . Economical aspects : Libyan oil laws and agreements . Net profit. Present worth , profit parameters , feasibility study , optional analysis. Field development decision-making . Influencing factor. Risk , ventures. oil

market and prices . Government oil policy. Financing , capital for oil projects . Technical and scientific developments, technology transfers.

Enhanced Oil Recovery :PTE514

Credits:3

Review the oil production categories , study the factors that affect the selection and efficiency of any EOR process , Water and gas injection and performance calculation Types of miscibility, conditions and factor affecting the miscibility. Calculation and Estimation of the MMP . Natural gas injection, mechanics, and types of gas injection : high-pressure lean gas , liquefied petroleum gases , enriched gas , carbon dioxide. Chemical flooding : mechanics . Types of chemical flooding : surfactant , polymer , alkaline . Thermal flooding : mechanics .Types of thermal flooding : Hot water ,steam injection, in-situ combustion. Factors affecting engineering design of any EOR process.

Project : PTE521

Credits: 3

Student has to prepare and present a complete study on one of the oil subjects defined by the department research council . The study should be either a laboratory study , or theoretical study using the available data and means from Libyan fields . The project aims to enable the student to depend on himself in doing investigation and tackling problems , through data surveying , searching , gathering , analysis , drawing conclusion . or on practical bases : lab or field work , finally student has to present this report and discuss it in front of committee composed from department teaching staff members.

Petroleum Refining Engineering : PTE522

Credits: 3

Introduction – Composition of Crude Oil , it's Classification and Evaluation Methods – Preparation of Crude to Refine – Type of Refinery – Crude Oil as Source of Petrochemical Industry – Distillation Processes – Petroleum Processing Equipments - Processing of Hydrocarbon Gases – Thermal and Catalytic Processes – Lubricate Oil Production and it's Additives.

Reservoir Simulation :PTE426

Credits: 3

Solving petroleum engineering problems using programming languages such as Visual Basic, C Language and C++ Language . Formulation short software to solve different petroleum design problems. Introduction to reservoir simulation mathematical Modeling and techniques