COURSE CONTENT OF B.TECH. IN PETROLEUM ENGINEERING 2017 ONWARDS

3rd SEMESTER

1. LINEAR ALGEBRA AND COMPLEX ANALYSIS (MA 201)

1. Limit, continuity and derivative of complex functions. Analytic Functions, Cauchy–Riemann Equation (Proof of sufficient condition of analyticity & C R Equations in polar form not required)-Laplace's Equation Harmonic functions, Harmonic Conjugate.
2. Geometry of Analytic functions Conformal Mapping, Circles and straight lines, extended complex plane, fixed points Special linear fractional Transformations, Cross Ratio, Cross Ratio property-Mapping of disks and half planes.
3. Definition Complex Line Integrals, First Evaluation Method, Second Evaluation Method Cauchy's Integral Theorem(without proof), Independence of path(without proof), Cauchy's Integral Theorem for Multiply Connected Domains (without proof) Cauchy's Integral Formula- Derivatives of Analytic Functions(without proof). Application of derivative of Analytical Functions Taylor and Maclaurin series (without proof), Power series as Taylor series, Practical methods(without proof) Laurent's series (without proof).
4. Singularities, Zeros, Poles, Essential singularity, Zeros of analytic functions Residue Integration Method, Formulas for Residues, Several singularities inside the contour Residue Theorem. Evaluation of Real Integrals.
5. Linear systems of Equations, Coefficient Matrix, Augmented Matrix Gauss Elimination and back substitution, Elementary row operations, Row equivalent systems, Gauss elimination-Three possible cases, Row Echelon form and Information from it. Linear independence-rank of a matrix Vector Space-Dimension-basis-vector space Solution of linear systems, Fundamental theorem of non-homogeneous linear systems (Without proof)-Homogeneous linear systems (Theory only)
6. Determination of Eigen values and Eigen vectors-Eigen space Symmetric, Skew Symmetric and Orthogonal matrices –simple properties (without proof). Basis of Eigen vectors- Similar matrices Diagonalization of a matrix- Quadratic forms-Principal axis theorem (without proof).

Text Books:

1. Erwin Kreyszig: Advanced Engineering Mathematics, 10th ed. Wiley

References:

1. Murray R Spiegel, Seymour Lipschutz, John J. Schiller&Dennis Spellman - Complex Variables, 2ed (Schaum's Outline Series), Mc Graw Hill
2. S. Ponnusamy- Foundations Of Complex Analysis, Narosa Book Distributors
3. Seymour Lipschutz&Marc Lipson - Linear algebra, 5ed (Schaum's Outline Series), Mc Graw Hill
4. Michael Artin- Algebra, Pearson.
5. Dennis g Zill&Patric D Shanahan-A first Course in Complex Analysis with Applications- Jones &Bartlet Publishers
6. B. S. Grewal. Higher Engineering Mathematics, Khanna Publishers, New Delhi.
7. Lipschutz, Linear Algebra,3e (Schaums Series) McGraw Hill Education India 2005
8. Complex variables introduction and applications-second edition-Mark.J.Owitz-Cambridge Publication

2. MECHANICAL ENGINEERING-I (ME-PE-301)

1. Engineering Materials: Alloy and alloying materials, heat treatment, composition, properties and uses of engineering materials.
2. Strength of materials: Stress and strain, Stress-strain diagram, Struss, Columns and lattice structure; Elastic constants and their relations; Thermal stresses and strains; Shear force and bending moment diagrams. Deflection of beams, Analysis of stresses in pressure vessels, Torsion of circular sections, springs.
3. Theory of machine: Degrees of freedom, Linkage, mechanism, Basic principles of governors, Flywheels and Brakes.
4. Thermodynamics: Laws of thermodynamics, P-V and T-S diagrams, air standard cycles and vapour power cycles (carnot cycle, otto cycle, diesel cycle, dual cycles, rankine cycles), Classification and application of internal combustion engines.
5. Classification, basic construction and application of different types of pumps and water turbines
6. Classification and application of Gas turbines and Compressors.
7. Production Engineering: Metal machinery: Cutting tools; tool materials, wear and machineability. Machining – drilling, grinding, boring.

Text/Reference Books -

1. R E Sonntag, C Borgnakke & G J Van Wylen, *Fundamentals of Thermodynamics*, John Wiley.
2. V. Raghavan, *Materials Science and Engineering*, Prentice Hall.
3. T. Bevan. Theory of Machines, CBS Publishers and Distributors.
4. F.P.Beer, E.Russel Johnston, J.T. Dewolf, D.F Mazurek, Mechanics of Materials, McGraw Hill.
5. A Ghosh and A K Mallik, Manufacturing Science, Wiley Eastern.
6. G Boothroyd, Fundamentals of Metal Cutting Machine Tools, Tata McGraw Hill.
7. R.W. Fox and A.T. McDonald, 1998, Introduction to Fluid Mechanics, John Wiley.

3. GEOLOGY OF PETROLEUM (PE-302)

1. Introduction to Earth Science: Earth Systems-Surface and subsurface processes, Physical geology.
2. Rock forming minerals: General properties; Classification of minerals and properties of common rock forming minerals
3. Rocks: Introduction to major rock groups; igneous, metamorphic and sedimentary, properties of rocks important in the petroleum industry
4. Stratigraphy: Principles of stratigraphy, Broad stratigraphic subdivisions and associated rock types of important coal belts and oil fields of India, Geologic map and their interpretation
5. Concepts of palaeontology; Fossils, their mode of preservation and significance as indices of age and climate; Concept of index fossils.
6. Structural Geology: Folds, faults, joints and unconformities - their nomenclature, classification and recognition, Effects of folds and fractures on strata and their importance in exploration activities.
7. Geomorphology; Interpretation of topographic maps; Attitude of planar and linear structures; Effects of topography on outcrops.
8. Forms of igneous intrusions - dyke, sill and batholith.

Text/Reference Bo**oks -**

1. *H. H., Rutley's , Elements of Mineralogy*
2. *Krishnan, M. S. Geology of India and Burma*
3. *Mahapatra G. B. A Textbook of GeologY*
4. *Raup & Stanley, Principles of PalaeontologY*
5. *Billings, M. P., Structural Geology*
6. *Tyrrel, G. W., An Introduction to Petrology*

7. *Kumar, Ravindra, Fundamentals of Historical Geology and Stratigraphy of India*

4. DRILLING ENGINEERING –I (PE-301)

1. Well Planning: Introduction to oil well drilling, Drilling planning approaches.
2. Drilling and Drill Rigs; Principles of drilling and Drilling Methods, Rig Components and Drilling Site Layout
3. Drilling Operations & Practices: Hoisting, circulation, Rotation, power plants and Power transmission,
4. Casing & Cementing:-

A. Casing Design: Design of casing string, Liner Design and Setting, Casing landing practices, Buckling criteria and Calculation of well head loads. Casing while drilling.

B. Cements & cement slurry: Objectives of cementing, oil well cements, Classification of cement, Slurry design, Slurry additives, Factors influencing cement slurry design, Cementing equipments.

C. Cementing Methods: Primary cementing, Stage cementing, Liner cementing, Plugging, Squeeze Cementing techniques in practice. Deep well cementing, Characteristics of good quality cementation. Cementing calculations.

5. Drill String: Parts, function and design.
6. Drill Bits: Classification and design criteria of drag, rotary, roller, diamond and PDC bits.
7. Coring: Core Drilling Practices or Diamond Drilling. Rig wire line system handling & storage.
8. Oil Well Fishing: Fish classification, tools and techniques.
9. Drilling Fluids:

a. Overview of Drilling Fluids, Clay chemistry and its application to drilling fluids, Types of clays, hydration, flocculation, aggregation and dispersion.

b. Classification, Types and applications of Drilling Fluids: Water based, oil based, emulsion based, polymer based, Surfactant based, Foam based and Aerated drilling fluids.

c. Drilling Fluid Characteristics: Basic functions, properties, maintenance and treatments of drilling fluids.

d. Drilling fluid calculations.

e. Rotary Drilling Hydraulics: Rheology of drilling fluids, Pressure loss calculations and Rig hydraulics.

10. Well Problems and Solutions: Fatigue failure, Pipe sticking, Lost circulation, Sloughing shales, Swabbing, surge, gas cap drilling, Blow out and kick control.
11. Well Head Testing, Hermetical Testing.
12. Well Control, Blow Out Prevention well control equipment, Kick and Blow Out detection devices, monitoring, IWCF methods, types and gas well control devices in offshore rig.

Text/Reference Books -

1. Oil Well Drilling Engineering- H Rabia
2. Coring & Core Analysis –T Kull, J Paxnen
3. Advance Oil Well Drilling Handbook- Mitchell Raymond
4. Drilling Fluids, Mud Pumps and Condition- K V Dyke

5. CHEMISTRY OF PETROLEUM (PE-303)

1. Advance electrochemistry: Reversible and irreversible cells; Fuel cells; Reference electrodes and indicator electrodes; Ion selective electrodes; Application of electrode potentials; Potentiometric titration;
2. Corrosion and corrosion control: Principles of corrosion, methods of corrosion control, cathodic and anodic protection, corrosion inhibitors. Surface coatings, Corrosion Monitoring. Case Studies of Corrosion in Petroleum industry including metals and alloys used in Petroleum Industry.
3. Advanced surface chemistry: Interfacial phenomena; Wetting; Surface tension measurements; Electrokinetic phenomena; Zeta potential and its measurement. Adsorption: Types of adsorption isotherm, Gibb's adsorption equation, BET equation, surface area of adsorbents, Application of Adsorption on the surface of solids, adsorption of high molecular compounds.
4. Analytical techniques: UV-Vis Spectrophotometry, Atomic Absorption Spectrophotometer (AAS), IR Spectroscopy, Liquid and Gas Chromatography and Solvent extraction methods.

Text/Reference Books -

1. A Textbook of Engineering Chemistry- Shashi Chaula
2. Engineering Chemistry-Wiley (India) Publication
3. Organic Spectroscopy- William Kemp

6. PETROLEUM REFINING (PE-304)

1. Composition of Petroleum: Physical properties of Petroleum. Crude classification, Evaluation of crude oil. Refinery products - specifications, properties, test methods. Additives and their uses.
2. Refinery Equipment Design: Pipe still heater. Distillation column, Heat exchangers and condensers.
3. Petroleum Refining Process: Multi-component distillation. Coking, Cracking, Reforming, alkylation, Isomerisation, Hydro-processes.
4. Specialty Products: Lube Oil Production, Propane De-asphalting, solvent extraction, De-waxing, Hydro-finishing. Wax Production, Carbon black & Petroleum Coke Production.

Text/Reference Books -

1. Modern Petroleum Refining Processes- B. K. Bhaskar Rao
2. Petroleum Refining Engineering- W. L. Nelson
3. Petrochemical Technology Assessment- John Wiley
4. Petrochemicals – B. K. Bhaskar Rao

7. ENVIRONMENTAL SCIENCE

UNIT 1- THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES (MARKS-5)

a. Definition, scope and importance. b. Need for public awareness.

UNIT 2- NATURAL RESOURCES (MARKS-20)

Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: use and over exploitation, deforestation. Timber- extraction, mining, dams and their effects on forests and tribal people.
b) Water resources: use and over utilization of surface and ground water, floods, drought, conflicts over water, dams benefits and problems.
c) Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.
e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.

f) Land resources: land as a resources, land degradation, man- induced landslides, soil erosion and desertification.

*Role of an individual in conservation of natural resources.

*Equitable use of resources for sustainable lifestyles.

UNIT 3- ECOSYSTEMS (MARKS-15)

a. Concept of an ecosystem. b. Structure and function of an ecosystem. C. Producers, consumers and decomposers. d. Energy flow in the ecosystem. E. Ecological succession. F. Food chains, food web, and ecological pyramids. g. Introduction, types, characteristics features, structure and function of the ecosystem:

a) Forest ecosystem.

b) Grassland ecosystem.

c) Desert ecosystem.

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

e) Ecological Energetics.

UNIT 4-BIODIVERSITY AND ITS CONSERVATION (MARKS-15)

a. Introduction-Definition; genetic, species and ecosystem diversity. B. Biogeographical classification of India. C. Value of biodiversity; consumptive use ,productive use, social, ethical, aesthetic and option values .d. Hot-spots of biodiversity-India. E. Threats to biodiversity; habits loss, poaching of wildlife, man-wild life conflicts. F. Endangered and endemic species. g. Conservation of biodiversity; In-situ Ex-situ conservation of biodiversity.

UNIT 5-ENVIRONMENTAL POLLUTION (MARKS-15) 5

A. Definition, causes, effects, and control measures of :

a) Air pollution b) Water pollution c) Soil pollution d) Noise pollution e) Thermal pollution f) Nuclear hazards

B. Solid waste management: causes, effects ,and control measure of urban and industrial waste-biodegradable and non-biodegradable waste.

C. Role of an individual in prevention of pollution.

D. Disaster management: Floods, earthquake, cyclone and landslides.

E. Environmental pollution issues in hydrocarbon industries in different stages.

F. Oil Spill Management.

G. Bio-remedial Techniques, produced water management.

UNIT 6- SOCIAL ISSUES AND THE ENVIRONMENT (MARKS-12)

a. From Unsustainable to Sustainable development. b. Water conservation, rain water harvesting, watershed management. c. Resettlement and rehabilitation of people, its problems and concerns. d. Environmental ethics. e. Climate change, global warming, acid rain , ozone layer depletion, nuclear accidents and holocaust. f. Waste land reclamation. g. Consumerism and waste products. h. Environmental Legislation. i. Public awareness.

UNIT 7- HUMAN POPULATION AND THE ENVIRONMENT (MARKS-8)

a. Population growth, variation among nations. b. Population explosion-Family welfare programme. c. Environment and human health and hygiene (including Sanitation and HIV/AIDS) etc. d. Role of Information Technology in Environment and Human Health.

b. Environmental clearance, forest clearance, NBWL clearance, hazardous waste management, E-waste management.

UNIT 8-FIELD WORK (MARKS-10)

a. Visit to a local area to document environmental asset-river /forest/grassland/hill/mountain. B. visit to a local polluted site-Urban/rural/industrial/agricultural. c. Study of common plants, insects, birds and fishes. d. study of simple ecosystems-ponds, river, hillslopes, etc.

4th SEMESTER

1. PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS (MA-204)

1. Discrete random variables and Discrete Probability Distribution. Discrete Random Variables, Probability distribution function, Cumulative distribution function. Mean and Variance of Discrete Probability Distribution. Binomial Distribution-Mean and variance. Poisson Approximation to the Binomial Distribution. Poisson distribution-Mean and variance.Continuous Random variables and Continuous Probability Distribution. Continuous Random Variable, Probability density function, Cumulative density function, Mean and variance. Normal Distribution, Mean and variance (without proof). Uniform Distribution.Mean and variance. Exponential Distribution, Mean and variance.
2. Fourier transforms. Laplace Transforms.Fourier Integrals. Fourier integral theorem (without proof). Fourier Transform and inverse transform. Fourier Sine & Cosine Transform, inverse transform. Laplace Transforms, linearity, first shifting Theorem. Transform of derivative and Integral, Inverse Laplace transform, Solution of ordinary differential equation using Laplace transform. Unit step function, second shifting theorem. Convolution Theorem (without proof). Differentiation and Integration of transforms.
3. Numerical methods-solution of Algebraic and transcendental Equations, Interpolation.Solution Of equations by Iteration, Newton- Raphson Method. Interpolation of Unequal intervals-Lagrange's Interpolation formula. Interpolation of Equal intervals-Newton's forward difference formula, Newton's backward difference formula. Numerical solution of system of Equations.Solution to linear System- Gauss Elimination, Gauss Seidal Iteration Method. Numeric Integration-Trapezoidal Rule, Simpson's 1/3 Rule. Numerical solution of first order ODE-Euler method, Runge-Kutta Method (fourth order).

Text Books -

1. Miller and Freund's "Probability and statistics for Engineers"-Pearson-Eighth Edition.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.

Reference Books-

1. V. Sundarapandian, "Probability, Statistics and Queuing theory", PHI Learning, 2009.
2. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics"-Sixth Edition.

3. Jay L. Devore, "Probability and Statistics for Engineering and Science"-Eight Edition.
4. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers"-Sixth Edition-Mc Graw Hill.

2. MECHANICAL ENGINEERING –II (ME-PE-401)

1. Fluid Mechanics: Properties of fluids; Classification; Ideal fluid, Newtonian and Non-Newtonian fluids; Newton's law of viscosity, Fluid Statics: fluid pressure and its measurement, Fluid Kinetics: Continuity equation; types of flow. Fluid dynamics: One dimensional equation of motion; Bernoulli's equation; application, Application of Bernoulli's equation; venturimeter. Principle of Turbomachinary.

2. Introduction to tribology, Metal casting and joining, Jigs and fixtures, ; principle of oil hydraulics, components of hydraulic system, Friction and wear, types of lubrication and construction, operation and maintenance of oil pumps, valves,

3. Introduction to Steam Boilers and steam engines, IC engines and its various subsystems like Fuel System, Cooling System, exhaust system, Lubrication system and recent trends.

4. Design of machine elements: factor of safety, design of shafts and keys, springs helical springs), rigid and flexible couplings, universal (Hooke's) joints, flanged joints, Oldham coupling, clutches and breaks belt

5. Introduction to Heat Transfer.

Text/Reference Books-

1. F. M. White, Fluid Mechanics, McGraw-Hill.
2. P K Nag, Powerplant Engineering, Tata McGraw Hill.
3. J. E. Shigley, Mechanical Engineering Design, McGraw Hill.
4. H I H Saravanamuttoo, G F C Rogers and H. Cohen, Gas Turbine Theory, Pearson.
5. T D Eastop and McConkey, Applied Thermodynamics for Engineering Technologists, Pearson.
6. C R Fergusan and A T Kirkpatrick, Internal Combustion Engines, John Wiley & Sons.
7. M.N. Ozisik, Heat Transfer – A basic approach, McGraw Hill.

3. DRILLING ENGINEERING- II (PE-401)

1. Directional Drilling: Objectives, Types of deflection tools, tool orientation, Directional well profiles, Well path deflection & correction. Directional Drilling Problems and Their Remedies.

2. Down Hole Motors: Positive displacement motors and Turbo-drills - motor description, Power calculation and applications. Auto-track and verti-track system. Rotary Steerable motors, Geo-steering tools. Horizontal
3. Well Drilling: Horizontal well objectives and selection, Different profiles, Slant Hole Drilling: Objectives and selections, Well profiles and applications. Down the Hole Well Surveying: Well surveying objectives, surveying methods, Surveying Analysis methods and calculations for well coordinates.
4. Measurements While Drilling: Objectives of MWD/ LWD, MWD tools, Telemetry system and data interpretation.
5. Special Methods of Drilling : Aerated drilling, Under-balanced drilling, Overbalanced drilling, HPHT Drilling, Variable pressure regime, Plasma drilling, Electrical Drilling, Top drive drilling, Re-entry drilling, Jet Drilling, Extended reach drilling, Multilateral drilling, Slim hole drilling, coil tubing operation, redial drilling.
6. Drilling economics. Computer Application in Drilling.

Text/Reference Books -

1. Drilling Technology in Non-Technical Language- Steve Devereux
2. Measurement While Drilling Reprint No-40- SPE
3. Directional drilling and Deviation control Technology- French Oil and Gas Industry
4. Special Drilling Operations, Drilling Technology, Segment III- David J. Morris

4. PRODUCTION ENGINEERING –I (PE-402)

1. Characteristics of crude oil and natural gas, classification of crude and its physicochemical properties.
2. Introduction to oil & gas field development.
3. Well equipments: Christmas tree, valves, hangers, flow control devices, packers, tubular and flow lines.
4. Introduction to Processing in oil fields: GGS/CTF - layout, sequential treatment, separation, storage and transportation of petroleum.
5. Well Completion: Systems, types and applications. Perforating Oil & Gas Wells - Conventional and Unconventional techniques viz. through tubing and tubing conveyed underbalanced perforating techniques; Bullet & Shaped Charge perforation; Perforating Gun types; type, size and orientation of perforation holes. Down-hole equipment selection, servicing, installation & testing, smart wells- intelligent completions.

6. Well activation: Displacement, compressor application, application of nitrogen, swabbing, use of artificial lift.
7. Introduction to PI & IPR of wells: Drawdown and Productivity Index, Importance of knowing IPR, shape of IPR curve.
8. Artificial Lift Technology: Basic principles and descriptions of Artificial lift methods: Gas Lift - continuous and intermittent, chamber lift, plunger lift/sucker rod pumping, hydraulic pumping – piston & jet type. Design of Continuous Flow gas lifts system (pressure operated valves). Design of Intermittent Flow gas lifts system (Pressure operated valves), Sucker rod pumping system, Electrical submersible pumping system.
9. Well Stimulation Techniques- Design & Selection: Matrix acidizing, Fracture acidizing, Hydraulic fracturing, Wave technology & Microbial stimulation.
10. Introduction to well servicing - objectives and applications; Production problems.

Text/Reference Books -

1. Dictionary of Petroleum Exploration, Drilling & Production- Norman J, Hyne
2. Oil and Gas Production in Non Technical Language- Martin S.
3. Petroleum Engineering Handbook Vol-1- John R. Fanc, Editor Larry W, Lake-Editor in Chief
4. Analysis for Well Completion, Oil and Gas Production- Mark Longley
5. Petroleum Engineering Handbook-Howard B. Bradley
6. Applied Petroleum Reservoir Engineering- Craft and Hawkins

5. RESERVOIR ENGINEERING-I (PE-403)

1. Fundamentals of petroleum, petroleum reservoir and reservoir engineering.
2. Classification of petroleum reservoir.
3. Reservoir Rock Properties : Porosity; Permeability- combination of permeability in parallel and series beds, porosity permeability relationship, effective and relative permeability; fluid saturation and significance; wettability, capillary pressure, surface tension/interfacial tension characteristics and uses.
4. Reservoir Fluids Sampling and Properties, PVT properties, different correlations and laboratory measurements.
5. Phase behavior of hydrocarbon system.
6. Reservoir Drives: Reservoir drive mechanics and recovery factors.
7. Generalized MBE, drive indices, performance prediction of depletion, Gas-cap, Water and combination drive; reservoir pressure maintenance.
8. Reserve estimation: resource & reserve concept, estimation of petroleum reserve, latest reserve classification.

Text/Reference Books -

1. Reservoir Engineering Handbook- Tarek Ahmed
2. Advanced Reservoir Engineering- Tarek Ahmed, Paul D. Mcinney
3. Phase Behavior of Petroleum Reservoir Fluid- Pederson, Chrisgtensen
4. Estimation and Classification of Reserves of Crude oil, Natural Gas & Condensate- Chapman Corrnquist
5. Fundamental of Reservoir Engineering- L. P. Dake
6. Applied Petroleum Reservoir Engineering- Craft and Hawkins

6. MICROPROCESSOR AND THEIR APPLICATIONS (ECE-PE-401)

1. Intel microprocessor 8085 CPU architecture, Instruction set of 8085. Assembly language of 8085, Addressing modes and different arithmetic, logical, data transfer and other instructions with simple programs, counter and time delays, BCD arithmetic. 16-bit operations, Stack and subroutines. Interrupt structure and serial I/O, Timing diagrams of different instructions, Memory and I/O interface. Introduction to 8086 CPU, Addressing modes of 8086, Assembly language programs, Interfacing memory and I/O devices, DOS routines, Minimum and Maximum modes of 8086. Interfacing different peripherals: 8155, 8255 PPI, 8254, Chips to 8085 and 8086. A/D and D/A interface to microprocessor.
2. Principle of Control Systems: Open loop and closed loop control systems; Devices for measurement and control of variables: density, flow, level, pressure, pH, temperature etc. Application of microprocessor in designing control systems.

Text/Reference Books -

1. Microprocessor architecture programming and application with 8085- Ramesh S. Goankar
2. 8051 Microcontroller and embedded system- Ali Mazidi and Janice Gillispie Mazidi

7. CORPORATE COMMUNICATION & SOFT SKILL DEVELOPMENT (HU-401)

1. Communication skills (What is communication skills? Necessity of skills in the corporate sector, The flows of communication, Barriers of communication, LSRW skills, Verbal and non-verbal communication)

2. Workplace etiquette (Team management, Grooming and dress code, How to address people in the corporate sectors, Mock interviews, Problem solving aptitude and handling conflicts, Management of time in a corporate sector-notes making)

3. Job Interviews (Pre-interview preparation techniques, Resume writing, Practice through mock interviews and group discussions, Problem solving and practicing through potential interview questions)

4. Presentation Skills (How to make an effective power point presentation, Breaking down Laskowski's acronym on 'AUDIENCE' in a presentation, Techniques of organising materials and points in a seminar report, Actual practice of presenting a report and evaluation)

5. Group Discussion (GD)- (Relevance and purpose of group discussion, mechanism of group discussion, Importance of subject knowledge in a GD, Range of topics in a GD and Strategies for an effective GD)

6. Business Writing (How to make business drafts, e-mails by avoiding mistakes in grammar, punctuation, spelling, wordiness and jargons; how to make technical reports and business letters effectively)

7. English Pronunciation and conversation (Role playing, Practicing through GDs and mock interviews, Reading aloud, Critical reviewing of a current topic orally)

8. Vocabulary Test (Prefixes, Suffixes, Homonyms, Homophones, Synonyms, Antonyms, Words often confused, One word substitution, Foreign terms and expressions, Idioms and phrases, Abbreviations and acronyms)

Text/Reference Books -

1. Effective Technical Communication : M. Ashraf Rizvi; Tata McGraw Hills.

2. Professional Communication Skills: A.K.Jain, Prabir S.R.Bhatia; S.Chand and Co.

3. Communicative English for Engineers and Professionals: Nitin Bhatnagar & Mamta Bhatnagar; Pearson Education ltd.

4. A Communicative Grammar of English: Leech, Geoffrey & Svartvik; Pearson

5th SEMESTER

1. MATHEMATICS-V (MA-501)

1. Conservation of mass; incompressibility; the continuity equation; stream functions;
2. Newton's laws applied to fluids; ideal fluids; the concept of pressure in fluids; Euler's equations of motion; simple hydrostatics; fluids in solid-body rotation; example of swinging bucket;
3. Energy equation; (steady) Bernoulli's theorem; simple pipe flows; examples of problems solvable using just Bernoulli's theorem and conservation of mass;
4. Introduction to vorticity; vorticity equation; the Rankine vortex (simple model of a tornado); Kelvin's circulation theorem; Helmholtz's laws; idea of vortex stretching (bath-tub vortices); irrotational flow; persistence of irrotational flow; extension of Bernoulli's theorem to unsteady irrotational case; example of expanding/ contracting gas bubble; example of steady flow past a cylinder and past a sphere;
5. Special solutions of the Navier-Stokes Equations, Navier-Stokes Equations in a Rotating Frame, Ekman Layer.
6. Tensor Analysis.

Text/Reference Books –

1. *Advanced Engineering Mathematics*, Kreyszig, E.
2. *Advanced Engineering Mathematics, Vol II*, Reza Malek-Madani, Addison Wesley Longman.
3. *Differential Equations of Applied Mathematics*, Duff, G.F.D, & Naylor, D.

2. ELECTRICAL MACHINES AND CONTROL SYSTEMS (EE-PE-501)

A. ELECTRICAL MACHINES

1. D.C. Machines: Constructional features and principles of operation of shunt, series and compound generators and motors including EMF equation and armature reaction, performance characteristics of generators and motors, starting speed control and braking of motors. Two quadrant and four quadrant operation of motors, choice of de motors for different application. Losses and efficiency.

2. Transformers :construction , principle of operation, EMF equation, phasor diagram, leakage reactance, equivalent circuits, voltage regulation, losses and efficiency, open circuit and short circuit tests, all day efficiency, autotransformers , Instrument transformers, three phase transformers.
3. Induction motors :Construction, types of induction motor, principle of operation, equivalent circuit, torque equation, slip – torque curves, losses and efficiency,

condition for maximum torque, no load and blocked rotor tests, methods of starting and speed control.

4. Synchronous Machines:Construction, classification, working principle, armature winding and winding factors, e.m.f. equation, armature reaction, synchronous reactance and impedance, phasor diagram, open-circuit and short –circuit tests, voltage regulation by synchronous impendence method. Synchronous motor-Principle of operation, V-curve, Vector diagram, starting methods
5. Special Machines: Stepper motor, Shaded pole motor, Universal motor, Repulsion type motor, Hysteresis motor.

Text/Reference Books -

1. P.S. BHIMRA, Electrical Machinery
2. Hughes Edward, Electrical Technology, Addison Weslelonginan ltd.
3. Nagrath I.J.& Kothari D.P.Electrical Machines. TMH
4. Cotton H., Advanced Electrical Teclitiolog , Wheeler & Co.
5. Fitzerald, Kingsicy, Kusko – Dunias – Electrical Machines. TMLA.
6. Kosow L.L, Electrical Machines and Transformers. PHI

B. CONTROL SYSTEMS

1. System Modelling: Introduction to control system-Basic elements in control system – Open and closed loop control systems – Differential equation representation of physical systems– Transfer function –Mathematical modeling of electrical and mechanical systems (Translational and Rotational) –Analogous system- Block diagram representation of systems- Block diagram reduction techniques – Signal flow graph-control system components-synchros-tachometer-dc and ac servomotors-stepper motors.
2. Time Domain Analysis: Standard test signals- First order system - step, ramp and impulse response analysis-Second order system – step response analysis- steady state error –generalized error co-efficients –Effect of adding a zero to system- Principle of PI, PD and PID compensation-stability analysis – Routh Hurwitz criterion – Root locus method
3. Frequency Domain Analysis: Frequency response –Frequency domain specifications –Correlation between time domain and frequency domain specifications-Bode plot – Stability analysis using Bode plot- transfer function from bode plot-Polar plot – Nyquist stability criterion, Relative stability gain margin and phase margin.
4. Root Locus Technique: Root locus concept, development of root loci for various systems, stability considerations.

5. State Space Analysis of Control Systems:State Space Representation, Solution to Homogeneous State Equation, State Transition Matrix, Time Invariant State Equations, linear time varying systems, Controllability and Observability, Decomposition of Transfer Function.
6. Compensation: Necessity of compensation, compensation networks, application of lag and lead compensation, basic modes of feedback control, proportional, integral and derivative controllers, illustrative examples.

Text Books -

1. J. Nagrath, M. Gopal, "Control Systems Engineering", Fifth Edition, New Age International, New Delhi, 2007.
2. Katsuhiko Ogata, "Discrete Time Control Systems", Second Edition, PHI Learning New Delhi, 2006.

Reference Books-

1. Benjamin C. Kuo, "Automatic Control Systems", Seventh Edition, PHI Learning New Delhi, 1997.
2. Kannan M. Moudgalya, "Digital Control," Wiley-India, 2009.
3. R. Anandanatarajan, P. Ramesh Babu, "Control Systems Engineering", Second edition,
4. Control System – S. Ghosh, Pearson Education
5. Control System Engineering- Bhattacharjya- Pearson Education;

3. Open Elective Subject

[SURVEYING AND REMOTE SENSING (PE-O-Elv.-501)]

1. Introduction to Surveying: Objective of surveying and its importance, Classification, principles of surveying, Application of Surveying in various fields of Engineering.
2. Linear measurements : Conventional Instruments for measuring distances, ranging and chaining out of survey lines, Obstacle in chaining and errors in chaining, corrections Principles, offsets, booking field notes, problems.
3. Linear measurements (EDMs): Theory and characteristics of electromagnetic waves, radio waves, infra-red, laser waves, principle of distance measurement with EDMs
4. Angular measurements: Principle and constriction of prismatic compass, bearing of lines, local attraction, magnetic declination and examples.
5. Theodolite: The essentials of transit theodolite, definition and terms, temporary adjustments, measurement of horizontal and vertical angles, different operations and sources of error, theodolite traversing, Omited Measurements.
6. Total Station: Principle, working and construction. Corrections to be applied.

7. Leveling instruments: Definition, different type of leveling instruments, curvatures and refraction corrections, reciprocal leveling, errors in leveling and problem solving.
8. Plane Table Surveying: General, Methods, Intersection, Traversing, Resection, two point problem and Three Points problem etc.
9. Contouring: General, Contour Interval, Characteristics, Methods of locating contours, Interpolation etc.
10. Global Positioning System (GPS): Theory, principles and applications
11. GIS: Introduction to GIS, Its application in mapping.
12. Basics of Remote Sensing

Text/Reference Books -

1. Surveying, Volume I- Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kr. Jain
2. Surveying, Volume II- Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kr. Jain
3. Basic Surveying- Walter S. Whyte
4. Fundamentals of Surveying- S. K. Roy

4. PRODUCTION ENGINEERING –II (PE-502)

1. PI & IPR of wells, surface layout. Production characteristics of Horizontal and multilateral wells - coning & skin factor. Multiphase flow in tubing and flow-lines. Sizing, selection and performance of Tubing, chokes and surface pipes. Production Optimization– Nodal System analysis.
2. Sand Control: Sand control techniques, formation sand size analysis, optimum gravel - sand ratio, gravel pack thickness, gravel selection, gravel packing fluid, gravel pack techniques, Plain Screen, Wire-wrapped Screen, Prepacked Screen.
3. Field Processing of Oil & Gas: Flash and stage separation of oil & gas; oil & gas separators, mist extractor, fluid level and pressure control system, Vertical and horizontal separators, metering separators, Heater-treater. Working pressure and safety feature in oil & gas separators, Special problems in oil and gas separation. Removal of suspended solid & water from oil & gas. Scrubbers and wash tank. Demulsification and desalting. Design of Oil and gas separation system.
4. Storage & Transport: Types & features of storage tanks, fixed roof and floating roof tanks, specification, maintenance and operation of tank batteries, Vapor Recovery System. Metering of oil & gas, sampling and testing of crude oil, gauging equipment and methods, water and sediment determination. Orifice and other metering devices and their characteristics.

Text/Reference Books -

1. Principles of Oil Well Production- T. E. W. Nind
2. Introduction To Petroleum Production, Volume I- D. R. Skinner

3. Introduction To Petroleum Production, Volume-II- D. R. Skinner
4. Oil Field Processing, Volume-2- Francis S. Manning and Richard E. Thompson
5. Petroleum Engineering – Carl Gatlin

5. RESERVOIR ENGINEERING-II (PE-503)

1. Flow of Fluids through Porous Media: Darcy's law- assumptions and applications, single and multiphase flow, Types of fluid- compressible fluid, incompressible and slightly compressible fluid; radial and spherical flow, steady state and unsteady state flow, Productivity Index, Injectivity Index, Formation Damage, Skin Effect, GOR, WOR equations, principles of fluid flow for steady state, semi steady state and un steady state conditions.

2. Water and gas coning.

3. Water influx in reservoir, different water influx models.

4. Displacement process, Immiscible, Buckeley & Leverett treatment of fractional flow & frontal advance equations.

5. Reservoir Management: Concepts of Reservoir Management and its Application

Text/Reference Books -

1. Reservoir Engineering Handbook- Tarek Ahmed
2. Advanced Reservoir Engineering- Tarek Ahmed, Paul D. Mcinney
3. Fundamental of Reservoir Engineering- L. P. Dake
4. Applied Petroleum Reservoir Engineering- Craft and Hawkins
6. Basics of Reservoir Engineering- R Cosse

6. PETROLEUM EXPLORATION-I (PE-504)

1. Surface indications of subsurface oil and gas accumulations.
2. Oil accumulation parameters.
3. Time of accumulation vis-a-vis time of oil generation.
4. Geochemical methods of prospecting: Soil geochemical surveys; Source rock characterization and Hydrogeochemistry as a tool for oil exploration.
5. Development Geology.
6. Role of Plate tectonics in Hydrocarbon accumulation onshore and offshore.
7. Sequence of geological methods of oil exploration.

Text/Reference Books -

1. Katz, Barry, Petroleum Source Rocks
2. Sahay, Bhagwan, Petroleum Exploration and Exploitation Practices
3. Hunt,John M., Petroleum Geochemistry and Geology

6th SEMESTER

1. PETROLEUM EXPLORATION-II (PE-601)

1. Introduction to Geophysics Exploration

2. Magnetic Method: The geomagnetic field, Magnetic anomalies. Magnetic survey instrument, Field method of magnetic surveys. Reduction of magnetic data, diurnal and geomagnetic correction. Interpretation of magnetic anomalies. Magnetic response of simple geometric shapes. Application of magnetic survey.

3. Gravity Method: Units of gravity, gravity measuring instruments, gravity survey, gravity anomalies, Gravity data reduction, Drift, Latitude, Elevation, and Free-air correction. Free-air and Bouguer anomalies. Gravity response of simple geometric shapes. Interpretation of gravity anomalies and application of gravity methods.

3. Seismic Methods: Geometry of refracted ray path, planar interface. Two layer case with horizontal interface. Methodology of refraction profiling. Field surveys arrangements. Recording instruments and energy source. Corrections applied to refraction data. Interpretation of refraction data. Application of seismic refraction method, Passive seismic

4. Geometry of reflected ray path, planar interface, single horizontal reflector. Importance of seismic reflection survey over seismic refraction survey technique. Common depth point (CDP) profiling and stacking. 2-D data processing and interpretation of reflection data. Introduction to 3-D data acquisition, processing and interpretation. Applications of seismic method in oil exploration, Concept of 4-D seismic and its application.

Text/Reference Books -

1. Robinson Edwin S., Coruh, Cahit Basic Exploration Geophysics
2. Dobrin, Milton B. Introduction to Geophysical Prospecting
3. Heiland, C. A. Geophysical Exploration
4. W. M. Telford, Geldart, L. P., Sheriff, Robert E. - Applied Geophysics

2. SEDIMENTARY AND PETROLEUM GEOLOGY (PE-602)

SECTION – A (Sedimentary Geology)

Introduction: Sedimentary processes, Textural properties, Pore Morphology and its significance, Sedimentary structures, Important rock groups with special reference to sandstones and carbonates, Reconstruction of sedimentary Environment, Tectonics, sedimentation and sequence stratigraphy, Role of sedimentology in petroleum exploration. Elements of basin modeling.

SECTION – B (Petroleum Geology)

1. Physical and chemical characteristics of crude oil, Origin of oil, source rock and maturation.
2. Migration of oil--mechanism, pattern and barriers.
3. Reservoir rocks and cap rocks
4. Entrapment of oil -- types and mechanism.
5. Geology of prospective basins of India.

Text/Reference Books -

1. Pettijohn, Sedimentary Rocks
2. Peter K. Link, Basic Petroleum Geology
3. Richard C. Selley, Elements of Petroleum Geology
4. Boggs, Sam, Principles of Sedimentology and Stratigraphy
5. Selley, Richard C., Applied Sedimentology (Second Edition)
6. Sengupta, S.M., Introduction to Sedimentology

3. **Elective (PE-Elv-603)**

(i) Improved Oil Recovery

1. Reservoir engineering aspects of Improved Oil Recovery: Water flooding, Well spacing for fluid injection.

2. Buckley Leverett Principle for immiscible flooding. Mobility ratio concept.

3. Fractional Flow Curve: Fractional Flow Equation, Details of Fractional Flow Curve, types, water saturation profile.

4. Production engineering aspects of IOR: Formation energy, pressure maintenance, gas and water sources, Secondary Recovery of oil by water injection and immiscible gas injection, gas re-injection in conjunction with water flood, water flooding, pattern flooding, infill drilling, oil recovery efficiency, future prospects.

5. Treatment of water for reservoir compatibility: Design consideration for water handling and injection system, Injectivity problems. Gas compression for injection, gas compressors. Gas collection and distribution system for injection.

6. Enhanced Oil Recovery: Thermal, Chemical, Miscible etc.

7. Oil & Gas Field Development: Development of Oil & Gas Fields: Rate and order of drilling well, well spacing & pattern, selection of development scheme, economic aspect of development of oil and gas fields. Production variants, performance prediction, Recovery factor, Stages of preparation of development plans. Basics of petroleum Economics.

Text/Reference Books -

1. Reservoir Engineering Handbook- Tarek Ahmed.
2. The Reservoir Engineering Aspects of Waterflooding- Forrest F. Craig, Jr.
3. The Design Engineering Aspects of Waterflooding- Stephen C. Rose, John F. Buckwalter and Robert J. Woodhall
4. Improved Recovery, Oil and Gas Production- Nicholas J. Const

(ii) **PETROLEUM ECONOMICS**

Fundamentals of petroleum economics, Computation of economic indices viz. Capital investment, payout period, IRR, NPV, Cash Flow and profit analysis techniques, performing basic economic and financial calculation, world energy economics, competing fuel analysis, theory of a Firm in the petroleum sector, depreciation and cost resource pools, company financing, joint ventures, sunk cost analysis, fixed and variable cost, principles of discounting, cost of capital, portfolio management in the petroleum industry, Economic life etc. Analysis of different variants based on technical and economic considerations. Economic development of Marginal fields, Innovative ways to economize asset development, profit and loss analysis, Inflation.

Text/Reference Books -

1. Petroleum Economics: Issues and Strategies of Oil and Natural Gas Production, Rognvaldur Hannesson
2. Principles of Petroleum Economics, Khudhair Abbas Al. Nadiawal (LAMBERT)

4. **RESERVOIR ENGINEERING-III (PE-604)**

1. Introduction to Oil and Gas Well Testing.
2. Steady State Flow Tests (Indicator Diagram).
3. Diffusivity Equation, its derivation & Solution.
4. Reservoir Pressure Measurements and Significance: Techniques of pressure measurement.
5. Pressure Transient Tests: Draw-down and Buildup test analysis, Horner's approximation.
6. Wellbore effects, Radius of investigation, Principle of Superposition, Multilayer reservoirs.
7. Injection well testing.
8. Multiple well testing, Interference testing, Pulse Testing, Pressure fall-off test in injection wells.
9. Type curves & its uses, well test analysis by use of Type curves.
10. Drill Stem Testing: Equipment, DST chart observation and preliminary interpretation.
11. Gas Well Testing.

Text/Reference Books -

1. Pressure Transient Test- SPE
2. Well Testing- John Lee
3. Pressure Buildup and Flow Tests in Wells – C. S. Matthews and D. G. Russell
4. Advances in Well Test Analysis – Robert C. Earlougher

5. OPEN ELECTIVE (PE-O-Elv.- 601)

[ENERGY SCENARIO IN INDIA]

1. Introduction to Energy, Primary and Secondary Energy Resources, Commercial and Non-Commercial Energy, Commercial Energy Production, Renewable and Non-Renewable Energy.
2. Major Primary Energy Sources in India (Coal, Oil, and Natural Gas), nuclear energy, thermal energy, potential energy, Commercial Energy and Non Commercial Energy, Primary Energy supply and Present Consumption Trend in India.
3. Energy Needs of Growing Economy, Long Term Energy Scenario (Future prospects of Gas Hydrates, CBM & Shale Gas etc in India), Energy Pricing in India, Energy Sector Reforms.
4. Energy and Environment: Air Pollution, Climate Change, the Greenhouse Effect.
5. Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features.
6. Statutory guidelines in Indian Energy Sector: Various statutory bodies of Indian Government involved with the entire energy sector in India such as capita DGH, DMS, OISD, MoPNG, CPCB, SPCB, MoEF, etc. , concept of production sharing contract (PSC), functions of above statutory bodies in relation to upstream energy operations in India, industrial safety standards.

Text/Reference Books -

1. Online Energy Journals/Publications
2. Government Guidelines
3. Published Papers

6. MANAGERIAL ECONOMICS (HU-601)

1. Nature, scope and methods of managerial economics.
2. Managerial Economic Concepts – Incremental concept; Opportunity Cost concept; Equi-marginal concept; discounting concept; Risk & Uncertainty.
3. Law of Diminishing Marginal Utility.
4. Demand Analysis – Meaning & type; Law of Demand – features; Exceptions; Market Demand Schedule & Curve; Elasticity of Demand – Price elasticity, cross elasticity& income elasticity.

5. Indifference Curve approach and its properties.
6. Supply – its law, elasticity & curve.
7. Types of markets; Pricing under various market conditions – Perfect competition, imperfect competition & monopolistic competition.
8. Profit & Profit measurement.
9. Inflation – meaning; Demand-pull, cost-push inflation; Inflationary gap; Causes and steps to control inflation.
10. National Income – Concepts & methods of measurement; Difficulties in measuring national income.

Text/Reference Books -

1. Managerial Economics by William F. Samuelson and Stephen G. Marks
2. Managerial Economics: Theory, Applications, and Cases by W. Bruce Allen, Keith Weigelt, Neil Doherty and Edwin Mansfield
3. Managerial Economics by Christopher Thomas and S. Charles Maurice

7TH SEMESTER

1. RESERVOIR MODELING AND SIMULATION (PE-701)

Reservoir Modeling:

Introduction to general modeling: Introduction to concept geological modeling. Types of model and designing of various models depending on reservoir complexities, rock properties, fluid properties – concept of back oil model, compositional model.

Reservoir Simulation:

1. Overview: Introduction, Historical background, application of simulator, various types of models.
2. Flow Conditions: Single phase, two phase and multiphase flow equations for one, two and three dimension models.
3. Special Concept: Explicit and implicit, grid system, finite difference & finite element method, matrix solution, iterative method, stability criteria.
4. Data Preparation:
5. Pesudo functions
6. Reservoir model Solution Techniques: Implicit Pressure and Explicit Saturation (IMPES), Implicit pressure and Implicit saturation (IMPIS).
7. Preview of numerical solution methods: Direct process, iterative process.
8. History Matching: Mechanics and parameters of match
9. Special Concept on Coning and Compositional Models simulation.
10. Optimization using Economic and Techno-economic evaluation: Computation of economic indices viz. different variants base on technical and economic consideration.
11. Introduction to streamline simulation & comparison of conventional/Streamline simulation.

Text/Reference Books -

1. Principles of Applied Reservoir Simulation, by John R. Fanchi
2. Advanced Petroleum Reservoir Simulation by Rafiq Islam, S.H. Moussavizadegan, Shabbir Mustafiz and Jamal H. Abou-Kassem
3. Practical Enhanced Reservoir Engineering: Assisted with Simulation Software by Abdus Satter, Ghulam M. Iqbal and James L. Buchwalter
4. Practical Reservoir Simulation by M. R. Carlson
5. Modern Reservoir Engineering: A Simulation Approach by Henry B. Crichlow
6. Reservoir Simulation (SPE Monograph Series, Vol 13) by Calvin C. Mattax and Robert L. Dalton

7. Fundamentals of Numerical Reservoir Simulation (Developments in Petroleum Science) by Donald W. Peaceman

2. Elective-I:

(i) **TRANSPORTATION AND MARKETING OF PETROLEUM AND PETROLEUM PRODUCTS (PE-ELV-701)**

1. Transportation of petroleum & petroleum products.
2. Basics of pipeline construction, operation and protection.
3. Pump and compressor stations. Instrumentation and control.
4. Metering and measurements of oil and gas.
5. Traffic management, Fire and safety rules.
6. Indian and Global supply scenario of petroleum and petroleum products. Product quality control. Bulk distribution and handling-domestic, commercial and industrial.
7. Storage of petroleum products in fixed installations. Standards and regulations.
8. Role of International oil companies and OPEC pricing mechanism. Administered and market determined pricing mechanism in India. Conservation of petroleum & its products, Spot and other market control mechanism.

Pipeline engineering

1. Objective and scope of pipeline as a means of fluid transportation with special reference to crude oil/gas/refined products, Economics of Pipeline transportation.
2. Design of Pipeline: Factors influencing oil, gas and refined products as pipeline design; Hydraulic surge and water hammer; specific heat of liquids; river crossing; pipe size and station spacing etc.
3. Theory and different formulae of the flow of fluids in oil/gas pipelines; basic equations for the flow of fluids through pipes; different flow equations for laminar and turbulent flow of compressible and incompressible fluids (Newtonian); Introduction to the flow of Non-Newtonian fluids through pipes; multiphase flow and loop pipelines.
4. Construction of pipelines; materials; project specifications; general equipment specifications (Pipes, valves and fittings); Installation of expansion loops. Pigging, Pigging Technology: pig launcher and receiver, intelligent pigging, types of pigs.
5. Corrosion protection and control; Design of cathodic protection system, Pipeline automation.
6. Offshore Pipeline: Design and control of Sag and Over bend; Description of stinger; and Riser, articulated stinger, construction of offshore pipeline.
7. Hydrates, wax & scale - formation and prevention. Crude conditioning and use of additives to improve flow conditions.

8. City distribution network of oil/gas. Lease and custody transfer.

Text/Reference Books -

1. Petroleum marketing practices and problems by William H. Day
2. Petroleum Transportation Handbook, By: Harold Sill Bell
3. The economics of petroleum, Author: Joseph Ezekiel Pogue
4. Petroleum transportation, By-National Petroleum Council. Committee on Petroleum Transportation
5. Fundamentals of Pipeline Engineering By Jacques Vincent-Genod
6. Pipeline engineering by Henry Liu
7. Petroleum Engineering Handbook, Vol. 3

(ii) **FLUID MECHANICS AND THERMODYNAMICS**

FLUID MECHANICS

1. Introduction: Properties of fluids, fluid statics, fluid kinematics; Integral relations for a control volume.
2. Reynolds transport theorem, conservation equations for mass, momentum and energy.
3. Differential relations for a fluid particle, conservation equations in differential form; Stream function, vorticity.
4. Dimensional analysis and similitude; Viscous flows in ducts; Boundary layer flows; Inviscid incompressible flows.

Text/Reference Books -

1. F. M. White, Fluid Mechanics,McGraw-Hill.
2. B.R. Munson, D.F. Young, and T.H. Okhiishi, Fundamentals of Fluid Mechanics, John Wiley.
3. R.W. Fox and A.T. McDonald,Introduction to Fluid Mechanics, John Wiley.
4. S.W. Yuan, Foundations of Fluid Mechanics, Prentice Hall of India.

3. THERMODYNAMICS

1. Thermodynamic systems; States, processes, heat and work;
2. Zeroth law; First law;
3. Properties of pure substances andsteam, Mollier diagram;
4. Second law, Carnot cycle, entropy, corollaries of the second law;
5. Application of first andsecond laws to closed and open systems; irreversibility and availability, exergy analysis; Thermodynamic relations;
6. Properties of mixtures of ideal gases;
7. Thermodynamic cycles - Otto, Diesel, dual and Joule.
8. Third Law of Thermodynamics.

Text/Reference Books -

1. P. K. Nag, Engineering Thermodynamics, Tata MCgraw Hill.
1. R E Sonntag, C Borgnakke& G J Van Wylen, *Fundamentals of Thermodynamics*, John Wiley.
2. G F C Rogers and Y R Mayhew, *Engineering ThermodynamicsWork and Heat Transfer*, Pearson.
3. J P Howell and P O Buckius, *Fundamentals of Engineering Thermodynamics*, McGraw Hill.
4. Y. A. Cengel and M. A. Boles, *Thermodynamics, An Engineering Approac*,Tata McGraw Hill.

4. Elective-II: (PE-Elv-702)

(i) WELL SERVICING & WORKOVER

Workover system, workover rigs and selection, rigless workover including Endless/ Coiled tubing unit, minor & major workover jobs-diagnosis & remedial measures water shut off and gas shut off- Chemical treatment and conformance control. Workover & completion fluids - types & selection, Formation damage, Workover planning & economics, asphaltine wax.

Text/Reference Books -

1. Completion & Workover Fluid, Monograph Vo;-19- Kenneth L. Bridges
2. Introduction to Oilwell Service and Workover, Lesson 1 – Publisher: The University of Texas at Austin - Petroleum Extension Service
3. Production Operations: Well Completions, Workover, and Stimulation by Thomas O. Allen
4. Production Operations: Well Completions, Workover, and Stimulation by Thomas O. Allen
5. Completion and Workover Fluids (Henry L. Doherty series) by Kenneth L. Bridges
6. Well Completion and Servicing. Author: D. Perrin
7. A Primer of Oilwell Service and Workover

(ii) UNCONVENTIONAL GASES.

a) COAL BED METHANE

1. Introduction to CBM.
2. Present status of coal bed methane.
3. Formation and properties of coal bed methane.
4. Thermodynamics of coal bed methane.
5. Exploration & Evaluation of CBM.

6. Drilling, completion and logging of coal bed methane wells.
7. Hydro-fracturing of coal seam.
8. Production installation and surface facilities.
9. Well operation and production equipment.
10. Treating and disposing produced water.
11. Testing of coal bed methane wells.

b) NATURAL GAS HYDRATES

1. Introduction to gas hydrates.
2. Formation and properties of gas hydrates.
3. Exploration & Evaluation of Gas Hydrates.
4. Prevention & control of gas hydrates.
5. Gas hydrates accumulation in porous medium.
6. Gas extraction from gas hydrates.
7. Uses and application of gas hydrates.

c) SHALE GAS

1. Introduction to shale gas
2. Present status of shale gas in National and International level.
3. Future prospect of shale gas.

Text/Reference Books -

1. Growing Interest in Gas Hydrates- Timothy S. Collett, Rick Lewis, Takashi Uchida
2. "Unconventional Gas" Schlumberger--Author: Donna Garbutt
3. Hydrates of Hydrocarbons- Yuri F. Makogon, 2003

4. Elective-III: (PE-Elv.-703)

(i) ENHANCED OIL RECOVERY

1. Introduction to EOR, Basic principles and mechanism of EOR, Mobility ratio concepts, Screening of EOR process.
2. Chemical Flooding: Polymer flooding, Surfactant flooding, Caustic flooding; ASP flooding – Principles and applications.
3. Miscible Flooding: First contact miscibility, Multiple Contact Miscibility-Condensing Gas Drive, Vaporizing Gas Drive, Principles and applications of CO_2 flooding.
4. Thermal Recovery Techniques - Steam stimulation, hot water flooding, steam flooding and in-situ combustion process.
5. Microbial EOR - Principles & Applications.

Text/Reference Books -

1. Principles of Petroleum Reservoir Engineering- Gian Luigi Chierici
2. Enhanced Oil Recovery Textbook Vol-6- Don W. Green G. Paul Willhite
3. The Reservoir Engineering Aspects of Water flooding- Forrest F. Craig, Jr.
4. The Design Engineering Aspects of Water flooding- Stephen C. Rose, John F. Buckwalter and Robert J. Woodhall
5. Improved Recovery, Oil and Gas Production- Nicholas J. Const
6. Improved Oil Recovery by Surfactant and Polymer Flooding- D. O. Shah, R. S. Schechter

(ii) FLUID FLOW THROUGH POROUS MEDIA

Darcy's law, single and multiphase flow, linear, radial and spherical flow, steady state & unsteady state flow, flow through fractures, GOR, WOR equations, water and gas coning, skin factor, formation damage, productivity index, injectivity index, principles of Fluid Flow for steady state, semi steady state & unsteady state conditions, Flo equations for the beds in series and parallel for the linear and radial flow systems.

Text/Reference Books -

1. Reservoir Engineering Handbook- Tarek Ahmed
2. Advanced Reservoir Engineering- Tarek Ahmed, Paul D. Mcinney
3. Fundamental of Reservoir Engineering- L. P. Dake
4. Applied Petroleum Reservoir Engineering- Craft and Hawkins

Open Elective Subject (PE-O-Elv.-701)

[PETROCHEMICAL ENGINEERING]

Chapter 1: Petrochemicals

a. History and growth of petrochemical industry.
b. Petrochemical industries in India
c. Trends in Petrochemical Industries
d. Petrochemicals from Natural Gas : Methane, ethane, propane and butane based Petrochemicals.

Chapter 2: Raw materials

a. Crude oil and natural gas as raw materials for petrochemical industries, Individual hydrocarbons and Petroleum cuts as feed stock for petrochemical manufacture.
b. Manufacture of petrochemical feedstock, such as ethylene, propylene, BTX and synthesis gas for manufacture of ammonia and methanol.
c. Separation process used for purification of product gases of a gas cracker.

d. Petrochemical Feed Stocks: Aromatics, un-saturates and saturates (linear and cyclic).

Chapter 3: Polymerization

a. Basic concept of polymer chemistry, the type and structure of the macromolecular products, Physical and mechanical properties of high molecular mass compounds.

b. Classification of polymers according to the Gas Cracker Products.

Chapter 4: Oxidation

a. Basic reactions ad mechanisms min the oxidation of hydrocarbons.

b. Process for oxidation of light olefins, production of ethylene oxide, acetaldehyde, acrylonitrile etc.

Chapter 5: Manufacture of petrochemicals

a. Hydration of Olefins, basic concepts concerning hydration of olefins.

b. Direct and indirect ways of olefins hydration.

c. Manufacture of low molecular weight alcohols from olefins.

d. Processes used in sulfuric acid as a means of obtaining a under molecular weight range of alcohols.

Chapter 6: Processes for Petrochemical Manufacture

a. Ammonia and methanol synthesis, OXO synthesis.

b. Manufacture of some important commercial polymer products.

Chapter 7: Petroleum Product safety & Transportation

a. Product Handling & Safety : Loss Prevention, underground storage, Product Blending.

b. Transport and distribution, Fire Prevention & safety devices.

Text/Reference Books -

1. Petrochemical Processes- A.Chuvel, G. Lefebure
2. Petrochemicals- Djebbar Tiab, Erle C, Donaldson
3. Petrochemical Technology Assessment- John Wiley
4. Petrochemicals – B. K. Bhaskar Rao

8TH SEMESTER

1. OFFSHORE OPERATIONS (PE-801)

1. Introduction to offshore oil and gas operations.
2. Sea States and Weather: Meteorology, oceanography, ice, sea bed soil.
3. Buoyancy and stability.
4. Offshore Fixed Platforms: Types, description and operations, design.
5. Offshore Mobile Units: Types, description and installation. Station keeping methods like conventional mooring & dynamic positioning system.
6. Offshore Drilling: Difference in drilling from land, from fixed platform, jackup, ships and semi submersibles. Use of conductors and risers. Deep sea drilling.
7. Offshore Well Completion - Platforms and subsea completions, Deep water applications of subsea technology.
8. Offshore Production: Oil processing platforms, gas processing platforms, water injection platforms, storage, SPM and SBM, transportation and utilities.
9. Deep water technology: Introduction, definition & prospects. Deep water regions, Deep water drilling rig – selection and deployment, Deep water production system, emerging deep water technologies – special equipment and systems, Remote operation vessels (ROV).
10. Divers and Safety: Principles of diving use of decompression chambers, life boats.
11. Offshore field developments, Analysis of offshore structures, Offshore platforms & their stability, Buoyant force calculation, Bracing & framing patterns in offshore structures, Welding of offshore structures, layouts of jacketed offshore platforms.
12. Analyses of Sea environment: Wind, waves and current forces- Characteristics, analysis and force evaluation, Sea soil & sea bed, Offshore piles and their foundation.
13. Tubular/ rectangular joints - Types, design, protection and failures.
14. Corrosion in offshore structures and its protection, Buckling & bending in offshore structures and in offshore pipe lines, Risk factors and risk analysis.
15. Offshore mobile rigs: Types, load and stress analysis, Fatigue calculation and safety factors, Marine risers and tensioners.
17. Structural analyses

Text/Reference Books -

1. Offshore Multiphase Production Operations- Mack Shipper & Stuart Scott
2. Deep Water Petroleum Exploration & Production: A non-technical guide- W. L. Laffer, R. Pattarozzi

2. Elective (PE-ELV-802)

i. **NATURAL GAS ENGINEERING**

1. Gas from condensate and oilfields. Scope of Natural gas industry. Basic thermodynamic and system energy concepts in Natural Gas Engineering.
2. Physical properties of natural gas and hydrocarbon liquids associated with Natural gas.Reservoir aspects of natural gas.
3. Flow of fluids. Compression calculations.Heat Transfer and Mass Transfer principles andapplications in Natural Gas Engineering.
4. Gas flow measurement. Process control and instrumentation in natural gas processing plants.
5. Natural Gas Processing. Field separation and oil absorption process. Refrigeration and low temperature processing. Liquefaction Process. Dehydration of Natural Gas sweetening of Natural gas and sulphur recovery, Processing for LPG, LNG, CNG,system.
6. Transmission of Natural Gas. Specifications.Utilization of Natural Gas. Underground storage and conservation of Natural Gas.
7. Unconventional gas: Coal Bed Methane, Natural Gas Hydrate. Insitu Coal Gasification.
8. Conversion of gas to liquid.

Text/Reference Books -

1. Natural Gas: A Basic Handbook by J. G. Speight
2. Handbook of Natural Gas Transmission and Processing by Saeid Mokhatab, William A. Poe and James G. Speight
3. Natural Gas Engineering Handbook by Boyun Guo and Ali Ghalambor
4. Advanced Natural Gas Engineering by Michael Economides and Xiuli Wang
5. Standard Handbook of Petroleum and Natural Gas Engineering: Volume 1 & 2, (by William C. Lyons Ph.D. P.E
6. Working Guide to Petroleum and Natural Gas Production Engineering by William C. Lyons

ii. HEAT AND MASS TRANSFER

1. Modes of heat transfer.
2. Conduction: 1-d, 2-d, and 3-d steady conduction, 1-d unsteady conduction – analytical /numerical/ graphical solution methods, fins.
3. Convection: fundamentals, order of magnitude analysis of momentum and energy equations, hydrodynamic and thermal boundary layers, dimensional analysis, free and forced convection, external and internal flows, heat transfer with phase change.

4. Radiation: Stefan Boltzmann law, Planck's law, emissivity and absorptivity, radiant exchange between black surfaces.
5. Heat exchangers: LMTD and -NTU methods, heat transfer enhancement techniques, special heat transfer processes like transpiration and film cooling, ablative cooling.
6. Mass transfer: molecular diffusion, Fick's law, equimolar counter diffusion, molecular diffusion in a stationary gas, analogy between heat and mass transfer, evaluation of mass transfer coefficients by dimensional analysis. Mass transfer in boundary layer, flow over a flat plate.

Text/Reference Books -

1. F.P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley and Sons.
2. J.P. Holman, Heat Transfer, McGraw Hill.
3. M.N. Ozisik, Heat Transfer – A basic approach, McGraw Hill.
4. A. Bejan, Convection Heat Transfer, Interscience.

3. **INDUSTRIAL ENGINEERING AND MANAGEMENT (PE-ME-803)**

1. Basic functions of Management – Planning, organizing, staffing, directing and controlling.
2. Introduction to Industrial Engineering techniques.
3. Productivity: definition, measurement.
4. Work study and its role in improving productivity of an organization.
5. Types of production systems.
6. Introduction to production planning and control.
7. Concepts of Human Resource Management – Selection, Training & Development.
8. Finance Management – Capital Budgeting Techniques. Pay-back period, ARR, NPV, IRR, PI; Sources of capital; Cost concepts and Break-even analysis.
9. Project Management – Introduction, Network construction & identification of critical activities in CPM & PERT

Text/Reference Books -

1. S L Narasimhan, D W McLeavey, P J Billington, Production, Planning and Inventory Control, Prentice Hall,
2. J L Riggs, Production Systems: Planning, Analysis and Control, Wiley.
3. A Muhlemann, J Oakland and K Lockyer, Productions and Operations Management, Macmillan.
4. H A Taha, Operations Research - An Introduction, Prentice Hall of India.
5. J K Sharma, Operations Research, Macmillan.

4. HEALTH, SAFETY, SECURITY & ENVIRONMENT IN PETROLEUM INDUSTRY (PE-804)

Health Hazards in Petroleum Production Refining and Utilization:

1. Introduction to national and international safety and environment management.
2. Toxicity, Physiological, Asphyxiation, respiratory and skin effect of Petroleum Hydrocarbons (including mixtures), sour gases (eg Hydrogen sulphide and carbon monoxide etc) with their thresh-hold limits.
3. Effect of corrosive atmosphere and additives during acidizing, sand control and fracturing jobs etc.

Safety System:

1. Introduction to API grades and standards related to Petroleum Industry.
2. Hazards analysis, developing a safe process, failure mode analysis, safety analysis (API-14C) safety analysis function evaluation chart (synergic approach).
3. Manual & atmospheric shut down system, blow down systems.
4. Gas detection system
5. Fire detection and suppression systems.
6. Personal protection systems & measures.
7. HSE Policies, standards & specifications
8. Disaster & crisis management.
9. Qualitative and quantitative risk analysis techniques, safety practices in drilling, production and design of installation.
10 Safety regulation -mines act, oil mines regulation, petroleum rule, petroleum act, atomic ERB rules, explosive act, explosive rule, occupational health hazards in hydrocarbon industries.

Environment:

1. Environment concepts, impact on eco-system, air, water and soil.
2. The impact of drilling & production operations on environment, Environmental transport of petroleum wastes.
3. Offshore environmental studies, offshore oil spill and oil spill control.
4. Oil mines regulations and other environmental legislations.
5. Environmental impact assessment.
6. Waste treatment methods, waste disposal method, remediation of contaminated sites.
7. Air & noise pollution.
8. Biodiversity.

Text/Reference Books -

1. Occupational Safety and Health for Technologists, Engineers, and Managers (7th Edition) (Alternative Etext Formats) by David L. Goetsch
2. Safety and Health for Engineers by Roger L. Brauer and Roger Brauer
3. Elements of Industrial Hazards: Health, Safety, Environment and Loss Prevention by Ratan Tatiya
4. Process Technology: Safety, Health, and Environment by Charles E. Thoma

5. **OPEN ELECTIVE SUBJECT (PE-O-Elv.-801) [PETROLEUM FORMATION EVALUATION]**

1. Direct Methods: Mud logging, coring – conventional and Sidewall coring, Core analysis and its importance.
2. Indirect Methods: SP and resistivity logs, radioactive logs, acoustic logs (principles, types of tools, limitation and applications). Evaluation of CBL/ VDL
3. Production Logging: Introduction, type of tools, principles, limitations and applications.
4. Special Type of Logging Tools: Casing inspection tools (principles, application and limitation), Formation micro scanner (FMS), NMR logging principles. Logging in high angle wells. USIT, SFT, RFT.
5. Log Interpretation and Analysis Techniques.
    a) Standard log interpretation methods.
    b) Cross-plotting methods: neutron-density, sonic-density and sonic-neutron etc.
    c) Clean sand interpretation
    d) Concepts of invasion – RXO, Tornado charts.
    e) Shaly sand interpretation.

Text/Reference Books -

1. Well Logging II: Electric and Acostic Logging- James R. Joeden, Frank L. Compbell
2. Encyclopedia of Well Logging- Robert Desbrandes
3. Geophysical Well Loagging- J. P. Vaish