Graphic Era

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DEPARTMENT

OF

PETROLEUM ENGINEERING

TMA-307	ADVANCED MATHEMATICS	L T P C 3-1-0-4

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To develop ability of students with basic concepts in transformation in discrete and continuous form in engineering.
- Course focuses on of how advanced mathematics actually helped petroleum engineering to solve problems occurred in the development gas problems.
- To understand role of formal definitions, formal and informal mathematical proofs, and thinking, and be able to apply them in problem solving in concern subject.
- To show students how Advanced Mathematics can be used in petroleum Engineering.
- To understand Fuzzy set theory so the student quickly explore solution of the problem in real world that are challenging and interesting.

UNIT-I		8	Hrs

Fourier Transforms, Fourier Sine and Cosine Transform, Use of Fourier Transform in solving Partial differential equation. Discrete Fourier Transform. Z-Transforms, properties and its applications, Solution of Difference Equations by Z- Transform.

UNIT-II		9	Hrs

Analysis of Complex Variables: Limit, continuity and differentiability of function of complex variables, Analytic functions, Cauchy-Riemann's equation, Harmonic functions, Line integral in the complex
plane, Cauchy's integral theorem, Cauchy's integral formula and its derivatives.

UNIT-III		8	Hrs

Power Series, Expansion of function of complex variables in Taylor's and Laurent's series, singularities and poles, Residue theorem, contour integration, conformal mappings and its application, Bilinear Transformation.

UNIT-IV		10	Hrs

Concept of a frequency distribution: Moments, skewness and kurtosis, Concept of Probability, Theorems on probability, conditional probability. Discrete and continuous random variables. Distribution function and their properties, probability mass and density functions, Mathematical expectation, Moment generating function and its properties. Probability distributions: Binomial, Poisson and Normal distributions and their applications.

UNIT-V		**10**	**Hrs**

Classical and Fuzzy Sets: Overview of Classical Sets, Fuzzy sets, Membership function, Basic Fuzzy set operations: Union and intersection of two fuzzy sets, complement of a fuzzy set, product of two fuzz y sets, product of two fuzzy set with a crisp number, and power of a fuzzy set, normal fuzzy set, α- cuts and strong α- cut, Decomposition of fuzzy sets, cardinality of a fuzzy set.Fuzzy Numbers and Arithmetic: fuzzy numbers, binary operation of two fuzzy numbers, fuzzy arithmetic (addition, subtraction, multiplication and division), and arithmetic operations on fuzzy numbers in the form of α- cuts sets.

COURSE OUTCOMES

After completing this course the student should be able to:

1. **Apply** Fourier transform to solve a partial differential equations, and Z-transforms to solve a difference equations arising as model of some discrete linear system.
2. **Explain** the use of and **apply** analytic & harmonic complex variable functions to model some engineering problem.
3. **Understand** use of basic theorems of Cauchy about complex integration of functions with singularities.
4. **Analyse** engineering problems using residue calculus and related integrals evaluation; and, **explore** breakdown points of a system in terms of singularities & related Laurent series.
5. **Understand** basic statistical tools like skewness & kurtosis to do data interpretation, and **apply** probability distribution to draw inferences from the data.
6. **Explain** basic concepts of fuzzy set theory and fuzzy arithmetic.

SUGGESTED READINGS

1. J. W. Brown and R. V. Churchill, "Complex variables and applications", 8th Edition, *Tata McGraw-Hill,* 2010.
2. Ian N. Sneddon, "Fourier Transforms",*Dover Publications,* 2010.
3. T.J. Ross, Fuzzy logic with Engineering Applications, Wiley Publications, 2008.
4. E. Kreyszig, "Advanced Engineering Mathematics", *Wiley Publications,* 2006.
5. B.S. Grewal, "HigherEngineering Mathematics", *Khanna Publications,* 2009.
6. R. K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", *Narosa Publications,* 2004.

TPE-301	THERMODYNAMICS	L T P C 3-1-0-4

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn about thermodynamic system properties
- To learn about laws of thermodynamics
- To learn about thermodynamic properties of homogeneous fluids and mixtures
- To learn about vapour liquid and chemical reaction equilibria
- To learn about steam refrigeration and liquefaction

UNIT-I	FUNDAMENTAL CONCEPTS	4	Hrs

Definition & scope, Macroscopic Vs Microscopic approaches. Thermodynamic System & Control Volume, Thermodynamic properties, Processes and Cycles. Thermodynamic Equilibrium; state of a system, state diagram, path and process, quasi-static process, cyclic and non-cyclic processes. Work Transfer, Different modes of work, Path and Point Functions, Indicator Diagram, Free Expansion & Heat Transfer, Specific and Latent Heats. Zeroth law of thermodynamics, Concept of temperature,
scales & measurement.

UNIT-II	FIRST LAW OF THERMODYNAMICS AND PROPERTIES OF PURE SUBSTANCES	8	Hrs

Joule's experiments, equivalence of heat and work, Extension of the First law applied to open systems, energy, energy as a property, modes of energy, pure substance; Enthalpy, two-property rule, Specific heat at constant volume and Constant Pressure,PMM1. First law applied to flow processes, state-steady flow energy equation, important applications and examples of steady flow processes, analysis of unsteady processes such as Charging and discharging a tank with and without heat
transfer.TV, PV and PT diagram PVT behavior of fluids – Gibb's phase rule.

UNIT-III	SECOND LAW OF THERMODYNAMICS	12	Hrs

Qualitative Difference between heat and work, Cyclic Heat Engine, Thermal Energy Reservoirs. Kelvin
-Planck statement & Clausius statement, Refrigerator and Heat pump. Equivalence of the two statements; Reversibility and irreversibility, Causes of Irreversibility, Carnot cycle, Carnot's Theorem & its Corollary Absolute Thermodynamic temperature scale. Reversible heat engines, Efficiency,
Equality of Ideal Gas Temperature & Kelvin Temperature.

UNIT-IV	THERMODYNAMIC PROPERTIES OF HOMOGENEOUS AND MIXTURES OR SOLUTIONS FLUIDS	10	Hrs

Thermodynamic Properties of Homogeneous Fluids:Fundamental property relations, Maxwell's relations, thermodynamic web, introduction to residual properties, residual properties from equations of state, two phase systems, thermodynamic diagrams and tables, generalized property correlation for gases.

Thermodynamic Properties of Mixtures or Solutions:Property relationships for systems of variable composition; chemical potential, partial molar properties, fugacity and fugacity coefficients – pure species and species in mixture, fugacity in ideal solutions, activity coefficients, excess properties.

Applications of Solution Thermodynamics:VLE-qualitative behavior, Duhem's Theorem, simple models for VLE. Liquid properties from VLE.

UNIT-V	**VAPOR LIQUID AND CHEMICAL REACTION EQUILIBRIA**	**7**	**Hrs**

Vapour Liquid Equilibria:Importance of phase equilibria in process industries, Phase Rule, equilibrium and stability, vapour-liquid equilibria (VLE) for miscible, partially miscible and immiscible systems, their phase diagrams, azeotrope.

Chemical Reaction Equilibria:Reaction coordinate and Equilibrium constant, Gas phase Reaction and equilibrium, Application of equilibrium criteria to chemical reactions, Gas phase Reaction equilibria and Liquid Phase equilibria, Solid gas Equilibria Effect of temperature on equilibrium constant, evaluation of equilibrium constants and composition, calculation of equilibrium compositions for

single reactions, phase rule and Introduction to multi-reaction equilibria.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Explain basic thermodynamic system properties like equilibrium and steady state, work, energy, internal energy, enthalpy etc.
2. Apply the applications of laws of thermodynamics to petroleum
3. Describe the properties of pure and real substances.
4. Acquaint with thermodynamic properties of homogeneous fluids and mixtures and application of mixture or solution thermodynamic with special reference to petroleum.
5. State and Explain thegas phase reaction equilibria and liquid phase equilibria, Solid gas equilibria. Effect of temperature on equilibrium constant, evaluation of equilibrium constants and composition, calculation of equilibrium compositions for single reactions
6. Explain about steam generators and steam engines, internal combustion engines, air standard cycles, Ideal refrigeration cycle, air vapour compression and absorption refrigeration cycle.

SUGGESTED READINGS

1. Smith, J.M., Van Ness, H.C., Abbott, M.M., "Introduction to Chemical Engineering Thermodynamics", 7th Edition, *McGraw-Hill* 2005.
2. Ahuja, P., "Chemical Engineering Thermodynamics", *PHI Learning* 2008.
3. Koretsky, M.D., "Engineering and Chemical Thermodynamics", *John Wiley* 2004.
4. Sonntag R.E., Borgnakke C., VanWylen G.J., College H., "Fundamentals of Thermodynamics", 6th Edition, *Wiley* 2003.
5. Kyle, B.G., "Chemical and Process Thermodynamics", 3rd edition, *Prentice Hall* 1999.
6. Narayanan, K.V., "Chemical Engineering Thermodynamics", *Prentice Hall* 2011.

TPE-302	APPLIED GEOLOGY	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn about the origin of earth and landforms creation by exogenic forces.
- To learn about mineral formation and properties of rocks forming minerals.
- To learn about igneous, metamorphic and sedimentary rocks.
- To learn about principal of stratigraphy and paleobiology.
- To learn about behaviour of rocks under stress and geological structures significant in petroleum industry.

UNIT-I	THE EARTH	7	Hrs

Origin, Exterior and Interior of the Earth, **Exogenic forces:** Geological Work of Glacial , Lakes ,River ,Wind, and Ocean
PLATE TECTONICS Present Plate Configuration, Types of Collision, Types of Continental Margin

UNIT-II	MINERALOGY FUNDAMENTALS	7	Hrs

Introduction to Minerals, Crystals and glass, crystalline of single and bicomponent minerals, crystal families

UNIT-III	BASIC PETROLOGY	12	Hrs

Introduction to Igneous, Sedimentary and Metamorphic Rocks, Rock cycle.

UNIT-IV	STRATIGRAPHY	8	Hrs

Stratigraphic Principles, Type Section, Type Location and Type Area, Geological Time Scale and Evolution with Time, Lithostratigraphy, Biostratigraphy, Chronostratigraphic, Magnetostratigraphic. Stratigraphic Correlation **Indian Stratigraphy:** Introduction, Tertiary Sedimentary Basins, Mesozoic Sedimentary Basins

UNIT-V	STRUCTURAL GEOLOGY	10	Hrs

Stress and Strain, Concept of Stress and Strain Rock Deformation Patterns, **Folds** Geometry, Mechanism and Classification of Folds **Faults Classification**, Mechanism and Geometry of Faults **Joints** Morphology and Mechanism **Shear Zones** Morphology and Mechanism, Salt **Domes** Morphology and Mechanism. Significance of geological structures in Petroleum Industry **Unconformity** Types of Unconformities, Recognition of Unconformities, geological and geophysical criteria, Significance of unconformities in hydrocarbon exploration

COURSE OUTCOMES

After completing this course the student should be able to:

1. Describe and relate about earth internal structure, chemical composition and lithospheric plates and its dynamics and to understand process of weathering, erosion and denudation and creation of landforms developed due to action of glaciers, lakes, rivers, wind and oceans.
2. Examine and compare about the properties of common rock forming minerals and their significance
3. Apply, illustrate and classify the formation, characteristics and occurrences of igneous, sedimentary and metamorphic rocks.
4. Analyse and explain about the geological time scale, life through ages, laws of stratigraphy and stratigraphy of India.
5. Evaluate factors causing deformations, recognize structures like fold, fault, joints and

unconformities.

6. Create and synthesize importance of geological structures and its significance in Petroleum Industry

SUGGESTED READINGS

1. Holmes, A., "Principles of Physical Geology", 2nd Edition *RonaldPress* 1965.
2. Mukherjee, P.K., "A Text Book of Geology", The World
3. Ramakrishna. M and Vaidyanathan ,R., Geology of India, Geological Society of India Publication
4. Raymond , L.A ., Petrology : The study of Igneous , Sedimentary and Metamorphic Rocks Mc Graw Hill
5. Rutley's Elements of Mineralogy- Read, H.H., CBS Publishers and Distributors, 485 Bhola Nath Nagar Shahdara, Delhi
6. Lakshman Singh, Oil and Gas Fields of India, Indian Petroleum Publication

TPE-303	FLUID AND PARTICLE MECHANICS	L T P C 3-1-0-4

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn about types of fluid, their thermodynamic properties, fluid statics and its applications.
- To learn about flow of incompressible fluid in pipes
- To learn about fluid pumping and measurement in fluid transport
- To learn particle mechanics and flow through packed bed
- To learn about particle size, its reduction, screening and filtration

UNIT-I		9	Hrs

Introduction: Nature and type of fluid, thermodynamic properties of fluid. Concept of viscosity.

Fluid Statics and its applications: The basic equation of fluid statics, pressure depth relationship, and pressure measurements.

One Dimensional Flow of Fluids: Continuity equation for a fluid of constant density, Bernoulli's equation for steady state fluid flow with friction. Differential momentum balance.

UNIT-II		7	Hrs

Flow of incompressible fluids in pipes: Shear stress distribution in a cylindrical tubes, friction factor, laminar and turbulent flow in circular pipes, friction losses. Dimensional Analysis and Dimensionless Numbers.

UNIT-III		8	Hrs

Measurements in Fluid Transport: Constant area and constant head meters, weirs and notches.

Fluid Pumping: Positive-displacement pumps: Reciprocating and rotary pumps, Centrifugal pumps: characteristics of centrifugal pump, priming and cavitation, NPSH, Fans and Compressors.

UNIT-IV		8	Hrs

Particle Mechanics: Motion of particles in fluid, effect of particle shape, Stock's law, free and hindered settling, Sedimentation and Floatation.

Flow Through Packed Beds: Characteristics of packing, Flow of a fluid through a Porous media and pressure drop behaviour

Fluidization: Fluidization characteristics, minimum fluidization velocity, application of fluidization.

UNIT-V		8	Hrs

Particle Size and its Reduction: Theory of crushing and grinding, crushing and grinding equipments. **Mechanical Separations: Screening**: Concept of screening, types of screen analysis, Sieve analysis, size distribution, size averaging and equivalence, screen effectiveness and capacity, types of screening equipments.

Filtration: Flow through filter cakes and medium, filter aids, various types of filters.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Explain different heat transfer processes and the modes of heat transfer
2. Comprehend the concept of heat transfer through composite slabs, composite cylindrical and composite spherical geometry.
3. Understand the concept of shape/view factor and the transfer of heat through radiation process.
4. Use Heat transfer concepts to know about the petroleum reservoir concept by studying the MBE and EBEs.
5. Design heat exchangers, evaporator, and distillation column, dryer and cooling tower used in petroleum refineries.

6. Apply the concept of diffusion and the laws of diffusion for the energy and mass balance equation

SUGGESTED READINGS

1. McCabe W.L., Smith J.C. and Harriot P., "Unit Operations of Chemical Engineering", 5th Edition, *McGraw-Hill* 1999.
2. Nevers N.D., "Fluid Mechanics for Chemical Engineers", 3rd Edition, *McGraw-Hill Higher Education* 2004.
3. Denn M., "Process Fluid Mechanics", Prentice Hall 1st Edition, 1979.
4. Darby R., "Chemical Engineering Fluid Mechanics", 2nd Edition, *Marcel Dekker Inc* 2001.
5. Coulson J. H. and Richardson J.F., "Chemical Engineering, Vol. II", 5th Edition, *Butterworth-Heinemann* 2003.
6. Brown G. G., "Unit Operations", 1st Edition CBS Publishers 2004.
7. Narayanan C.M. and Bhattacharya B.C., "Mechanical Operations for Chemical Engineers", 3rd Edition, Khanna Publishers 2003.

TPE-304	GEOMATIC ENGINEERING	L T P C 3-0-0-2

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn about plane and geodetic surveying and maps
- To learn about distance and angle measurement in surveying
- To learn about ground based surveying methods
- To learn about fundamentals of aerial photography
- To learn about principles of remote sensing and GIS

UNIT-I		4	Hrs

Surveying and Mapping: Plane and Geodetic Surveying; Maps, their types and uses; Survey of India Maps- Index, Numbering and Symbols

UNIT-II		8	Hrs

Measurements: Linear distances-Convential and modern methods, Directions-Bearing and azimuths, Use of Magnetic Compass; Measurement of angle by Theodolite; Elevation measurement; Contouring ; Digital Elevation Model.

UNIT-III		6	Hrs

Ground Based Surveying: Traverse Surveying- Different methods; Sources of errors; Principles of Plane Table surveying

UNIT-IV		6	Hrs

Photogrammetry: Aerial Photography, Scale, Tilt and height displacement; Stereoscopic vision, Use of Stereoscope and Parallax bar; Techniques of Photo-Interpretation; Mapping from aerial photographs.

UNIT-V		10	Hrs

Remote Sensing and GIS : Electromagnetic radiation (EMR); Energy interaction with atmosphere and earth features, atmospheric windows , spectral signatures ; Active and Passive systems of Remote Sensing, Methods of interpretation; Digital Image Processing **Geographic Information System** : Introductory Concept of GIS, Hardware and Software used in GIS, Data structure type and data models; Spatial and Non-spatial data, Data input techniques in GIS,

COURSE OUTCOMES

After completing this course the student should be able to:

1. Interpret the basics of surveying and know about the difference between geodetic and plane surveying.
2. Enumerate types of maps and their uses, how to read maps, maps Index, scale, number and symbol system.
3. Explain length, angle and elevation measurement by using different methods (theodolite and magnetic compass) and digital elevation model.
4. List the importance of contours to understand the topographic features.
5. Acquaint with traverse, plane table surveying and basics of aerial photography.
6. Use remote sensing and GIS technique, spatial and non-spatial data for information extraction.

SUGGESTED READINGS

1. Arora, K.R., Surveying, Vol. I & II, Standard Book House
2. Arora, Manoj., Geomatic Engineering, Nemchand Publications

3. Burrough, P.A. and McDonnell, R.A., Principles of Geographic Information Systems, Oxford University Press
4. Chandra, A.M. and Ghosh, S.K., Remote Sensing and Geographical Information systems, Alpha Science
5. Lilles and, T.M. and Kiefer, R.W, Remote Sensing and Image Interpretation, 4th Edition, John Wiley & Sons.

TPE-311	INTRODUCTION TO PETROLEUM OPERATIONS	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To know about surveys, their methodology and uses, prospect generation
- To know about drilling methods, types of casings, cementation, drilling fluids and its functions
- To know about logging methods, types of logs, interpretation
- To know about perforation techniques, well testing, well completion, production and transportation of hydrocarbon and storage
- To know about distillation process and petroleum products and uses
- To know about role of Information technology in E&P industry

UNIT-I	Introduction to Geological and Geophysical surveys for Oil and Gas	8	Hrs

Types of Geological and Geophysical surveys and their importance. Basic idea about Prognostication and reserves. Categorisation of wells with definition. Economic evaluation of an exploratory project. Well Programme.

UNIT-II	Fundamentals of Drilling Operations	8	Hrs

Cable tool drilling, Rotary drilling, Drilling and directional drilling method. Onland and Offshore drilling technology. Drilling bits Drilling fluids, Function, composition and composition of drilling fluids. Casing and cementation.

UNIT-III	Fundamentals of Logging Operations	8	Hrs

Classification and properties of sedimentary rocks, Introduction to Logging operations, purpose of logging , Types of logs, Spontaneous Potential log, Resistivity log, Density and Neutron logs, Sonic and Dipmeter logs, CBL, VDL logs, Temperature log and their uses. Qualitative interpretation of logs.

UNIT-IV	Fundamentals of Reservoir and Production Operations	8	Hrs

Perforation techniques, Production tubing and well head assembly, well testing, well activation, self flow and artificial methods of production of oil and gas, Separation of oil, gas and water and their storage. Transportation of oil and gas, Distillation process and products of oil and gas, Marketing and distribution of products

UNIT-V	Fundamentals of Technology in Oil and Gas Industry	8	Hrs

Role of Information Technology in oil and Gas Industry

COURSE OUTCOMES

After completing this course the student should be able to:

1. Plan Geological, Geophysical and Geochemical surveys
2. Apply methodology of prospecting, generation and processes related to start of drilling operation
3. Use drilling methods, casings and cementation process
4. Examine logging operations and different types of logging and its uses
5. Assess about production techniques and various types of well completions
6. Manage transportation of Petroleum products and petrochemical products.

SUGGESTED READINGS

1. Petroleum Geology by F.K. North
2. Geology of Petroleum by A.I. Leverson
3. Handbook on Drilling by Gatlin
4. Non Technical Guide to Petroleum Geology, Exploration, Drilling and Production by Norman J Hyne

TPE-312	GROUND PENETRATING RADAR	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn the role of the GPR surveys to map near-surface interfaces & utilities.
- To understand the basic GPR data processing & interpretation techniques.
- Comprehend the quality/ limitation & cost of GPR surveys.

UNIT-I	INTRODUCTION TO GROUND PENETRATING RADAR METHOD	10	Hrs

Brief History, Basic Principle, EM Waves Propagation, Velocity of EM Waves, Wavelength/attenuation/ dispersion. Electrical Properties of Rocks, Soils, Fluids, Magnetic Properties of Rocks, Soils, Fluids. Environmental influences of temperature, pressure, chemistry and time. Geological Heterogeneity, Anisotropy and scale. Radar Equation, Scattering, reflection, refraction and diffraction. Antenna Polarization, Fresnel Coefficient, Snell's law. Near Field, Far Field, Multi-pathing, interferences.

UNIT-II	FIELD PROCEDURE	7	Hrs

Field Procedure and Approaches for GPR Surveys. Antenna selection, frequency v/s depth, Various Antenna Configurations in various applications.

UNIT-III	DATA ACQUISITION, DATA PROCESSING	8	Hrs

Data acquisition, data handling. Data Processing: High pass, low pass filters, Ormsy bandpass filtering, Notch Filters, AGC, Move Out Correction, Terrain Correction, Migration, energy envelops, Time-depth conversion, 3D Processing of GPR Data.

UNIT-IV	DATA INTERPRETATION	7	Hrs

Data interpretation, Field Demonstration of GPR Surveys.

UNIT-V	CASE STUDIES	8	Hrs

Specific case studies & methodology for: Utility Detection, Concrete inspection, Archaeology, Pavement inspection, Ground water & geology, Cavity Detection.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Apply GPR data acquisition techniques.
2. Recognize correct sequence of processes to be used with right choice of parameters.
3. Analyze computation & application of move out and terrain correction.
4. Assess Migration, time to depth conversion.
5. Understand interpretation techniques.
6. Recognize the importance of producing a clean section of subsurface with good event continuity & sufficient resolution to meet the interpretation requirements.

SUGGESTED READINGS

1. Jol, H. M., ed. (2008). Ground Penetrating Radar, Theory and Applications. Elsevier.
2. Erica carrick Utsi (2017), Ground penetrating radar, Theory and practices. Elsevier.
3. Clark, Anthony J. (1996). Seeing Beneath the Soil. Prospecting Methods in Archaeology. London, United Kingdom: B.T. Batsford Ltd.
4. Gaffney, Chris; John Gater (2003). Revealing the Buried Past: Geophysics for Archaeologists. Stroud, United Kingdom: Tempus.

TPE-313	GEOTHERMAL ENERGY	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- This course provides about the geothermal energy, which covers both direct (including heat pump-type application) and indirect (electricity generation) usages, including Enhanced Geothermal Systems.
- To understand the principles and techniques of geothermal energy utilization and identify the major issues associated with the further development of geothermal energy.

UNIT-I	OVERVIEW OF GEOTHERMAL ENERGY	6	Hrs

Heat Transfer in rock -conduction, convection and radiation, thermal Properties of Rock and Governing Equation, Thermal Properties of Rock and Governing Equation.

UNIT-II		6	Hrs

Fluid Flow in Rocks and Structural influence. Heat Flow Measurement.

UNIT-III	RESERVOIR GEOMECHANICS	10	Hrs

Fundamentals of Geomechanics & borehole stability, Reservoir Geomechanics (hydraulic stimulation & other issues), Radio Activity Effect, Ground Water Effect. Hydrothermal Systems, chemical and Isotropic Geo thermometers, prospecting.

UNIT-IV	GEO-THERMAL SYSTEM ECONOMICS	5	Hrs

Utilization and Management of Geo-Thermal Energy, Geothermal Power Generation Direct Use of Geothermal Energy and Geothermal Heat Pump

UNIT-V	ENVIRONMENTAL IMPACT AND CLIMATE CHANGE	8	Hrs

Enhanced Geothermal System (EGS) Environmental Impact of Geothermal Energy Utilization, Climate Change and Emerging Subsurface Engineering Applications (Geothermal, CO2 Geosequestration, Underground Storage System), Case histories.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Understand overview of geothermal energy and different modes of heat transfer methods and thermal properties of rocks.
2. Calculate subsurface fluid flow, heat flow and measurements.
3. Analyze borehole stability, Radio Activity Effect and Ground Water Effect along with Hydrothermal Systems, chemical and Isotropic Geothermometers, prospecting.
4. Evaluate feasibility of geothermal energy and project economics.
5. Evaluate and monitor climate change and environmental impact assessment.
6. Create and synthesise the importance of geothermal energy and evaluating geothermal operations and preparing case studies.

SUGGESTED READINGS

1. Harnessing geothermal Energy: Application in India by Sircar, Anirbid.
2. Geothermal Energy from Theoretical Models to Exploration and Development by Ingrid Stober and Kurt Bucher.

TMA - 403	NUMERICAL AND GEOSTASTICAL METHODS	L T P C 3-0-0-2

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To develop ability of students with basic concepts of Statistic's in discrete and continuous data form petroleum-engineering point of view.
- To understand the analysis and trend of data by graphical representation and how it will have an impact on the geological interpretation of the field.
- How Graphs can help you to describe the basic shape of a data distribution; "a picture is worth a thousand words."
- To understand role of formal definitions, formal and informal Stastistics proofs, and thinking, and be able to apply them in problem solving in concern subject.
- Course focuses on how Geo-statistics actually help in petroleum engineering to solve problems occurred in the development oil & gas field.
- To understand the various methods used for data analysis and its application in Petroleum Industry.

UNIT-I	Introduction to Statistics	10	Hrs

Describing data with graphs:-

Data distributions and their shapes, Dot-plots, Pie charts, bar charts, line charts, Qualitative and quantitative variables—discrete and continuous, Relative frequency histograms, Stem and leaf plots , Univariate and bivariate data, Variables, experimental units, samples and populations

Numerical measures:-

Measures of center: mean, median, and mode, Measures of relative standing: *z*-scores, percentiles, quartiles, and the interquartile range , Measures of variability: range, variance, and standard deviation, Tchebysheff's Theorem and the Empirical Rule.

Bivariate data:-

The best-fitting line, Bivariate data, Covariance and the correlation coefficient, Scatter plots for two quantitative variables, Side-by-side pie charts, comparative line charts, Side-by-side bar charts, stacked bar charts.

Probability and ProbabilityDistribution :-

The Addition and Multiplication Rules, Bayes' Rule and the Law of Total Probability (optional), Conditional probability and independence, Counting rules (optional), Experiments and events, Intersections, unions, and complements, The mean and standard deviation for a discrete random variable, Probability distributions for discrete random variables, Random variables, Relative frequency definition of probability.

Useful Discrete Distribution:-

The binomial probability distribution, Hyper geometric probability distribution, The mean and variance for the binomial random variable, The Poisson probability distribution

Normal Probability Distribution:-

Calculation of areas associated with the normal probability distribution, The normal approximation to the binomial probability distribution, The normal probability distribution, and Probability distributions for continuous random variables.

UNIT-II	Statistical inference: estimation & hypothesis test	8	Hrs

Inferences from small samples:-

Comparing two population variances, Inferences concerning a population variance, Paired-difference test: Dependent samples, Small-sample assumptions, Small-sample inferences concerning the difference in two means.

Analysis of variance:-
The analysis of variance, The completely randomized design, Factorial experiments. The randomized block design.

Estimation:-
Estimation, standard error, confidence interval, estimation of Bayesian statistics, error bars & confidence region on graphs

Logic for hypothesis testing:
Type significance testing, Step in hypothesis testing, Parametric vs non-parametric statistical test; with examples from geological data.

UNIT-III	Regression & Correlation	8	Hrs

Linear regression & correlation technique
Introduction to linear regression, partitioning the sum of squares, Standard error of the estimate, Regression towards the mean.
Control vs response variables, correlation coefficient, confidence interval about the regression line, geological examples of linear regression

Multiple regression Analysis
Analysis of variance for multiple regression, Causality and multi- co linearity, The coefficient of determination R^2, Estimation and prediction using the regression model, The general linear model and assumptions, The method of least squares, Polynomial regression model , Qualitative variables in a regression model, Residual plots.

UNIT-IV	GEOSTATISTICAL METHODS	12	Hrs

Introduction to Geostatistics:
Geostatistical Prediction, Geostatistics versus Simple Interpolation, Limitations
Spatial Analysis: Conventional Analysis (Non-geostatistical)- Data posting, contour map, symbol map, indicator map, Moving window
Spatial Continuity Analysis (Geostatistical) - Random function concept, Experimental Variogram, Horizontal & Vertical Variogram, Interpreting Variogram modelling, cross Variogram, Multiple points statistics
Preliminary Mapping concept: Kriging & Co-kriging, Sequential Gaussian Simulation, Indicator and Object based Simulation, secondary data integration.
Sequential sampling: Geological measurement in Sequences, Sequential data analysis. **Modelling prerequisite:** conceptual model, modelling methods, Data scale versus modelling scale ,Up-scaling for efficient modelling , allowing for spatial trends in gridding & contouring: **Honouring data or minimising errors :**
How Geostatistics includes methods for uncertainty quantification. Using
Monte Carlo and other stochastic simulations techniques.

UNIT-V	MULTIVARIATE TECHNIQUES	6	Hrs

Multiple regression method ,Cluster analysis, Principal component analysis

COURSE OUTCOMES
After completing this course the student should be able to:

1. Understand the basic concept of statistic for the various type of data used in industry.
2. Apply basic properties of probability and probability distribution, and be able to relate these to real life examples.
3. Recall the basics of complex variable, and be able to apply the methods from these subjects in problem solving.

4. Apply Geostatistics basic concepts in the reservoir modelling process and its geological application in oil & gas fields.
5. Estimate the attribute value at the unknown location based on known value using statistical methods.
6. Analyze basic geological sequences to understand data analysis techniques effectively.

SUGGESTED READINGS

1. Introduction to Statistics by David M. Lane
2. Introduction to Probability & Statistics by Mendenhall, Beaver
3. Geo-statistics: modeling spatial uncertainty by Jean-Paul Chiles
4. Deutsch, C.V. 2003. Geostatistical Reservoir Modelling, 1-376. New York : Oxford University Press
5. Mallet, J.-L., Geomodeling, Applied Geostatistics Series. Oxford University Press. ISBN
   978-0-19-514460-4

TPE-401	PETROLEUM GEOLOGY	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To Learn about nature, origin, occurrence and migration of petroleum
- To Learn about chemical and physical properties
- To learn about source rock evaluation and trapping mechanism
- To Learn about petroleum reservoir and hydrocarbon estimation

UNIT-I	Nature and Origin of Petroleum	9	Hrs

Origin & Occurrence of Petroleum; Sedimentary Basin of India; Surface and Subsurface; Origin Theories: A biogenic and biogenic -Source Rock Composition and Identification. Source Material Source; Material Transformation; Reservoir Rocks: Reservoir Rock characteristics: Siliceous & Carbonates

UNIT-II	Composition of Hydrocarbon	8	Hrs

Fluid Composition in Petroleum Reservoir: Oil/Gas/Water, Chemical constituents: paraffins, cycloparaffins and aromatics; Physical properties: Colour, optical activity, refractive index, API gravity, viscosity , dew point , pore point & cloud point , flash point and burning point , Electrical conductivity.

UNIT-III	Migration and Accumulation& Entrapment Mechanism	7	Hrs

Primary and Secondary Migration. Accumulation. Petroleum Province, System and Plays; Traps: Structural, stratigraphic and combination traps, Migration Vs. Trapping Time

UNIT-IV	Source rock evaluation	12	Hrs

Petroleum kitchen: concepts of source rock (effective, possible and potential source rocks); Source rock evaluation in terms of quantity, quality and thermal maturation of organic matter. Analytical techniques: common techniques for determination of TOC; chemical and optical methods of characterization of type of organic source material and its thermal maturation.

UNIT-V	Hydrocarbon Estimation	4	Hrs

Hydrocarbon Resources & Reserves

COURSE OUTCOMES

After completing this course the student should be able to:

1. Investigate nature, origin, occurrence and migration of petroleum.
2. Examine chemical and physical properties of petroleum
3. Identify Migration and entrapment mechanism
4. Inspect source rock evaluation and techniques of trapping mechanism
5. Assess petroleum reservoir and basics of hydrocarbon estimation
6. Plan methods of Hydrocarbon exploration and evaluation source rock for search of oil and gas

SUGGESTED READINGS

1. A.I LeversonGeology Of Petroleum, 2E
2. Selley,R.C., Elements of Petroleum Geology 2E Academic Press
3. Nind, R.C., Principal of Oil Production, Mc. Graw Hill
4. Biswas, S.K (Ed)., Petroliferous Basins of India. Petroleum Asia Journal

TPE-402	RESERVOIR ENGINEERING I	L T P C 3-1-0-4

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn classification of petroleum reservoirs.
- To learn petro physical properties of the reservoir rocks.
- To learn properties and interactions of reservoir fluids.
- To learn equations governing the fluid flow in reservoirs.

UNIT-I		8	Hrs

Petroleum Reservoir: Introduction to reservoir engineering; Definition of reservoir, Common types of Petroleum Reservoir including concepts of conventional and unconventional reservoirs, Elements of Reservoir- Reservoir Rocks, Reservoir pore space and pore fluids, Cap rock and Seat seal. Structural elements of reservoir.

UNIT-II		10	Hrs

Reservoir Rock Properties: Common reservoir rocks, their origin and classification; Petro-physical properties of rocks- porosity permeability, tortuosity, texture and inter-relationship among porosity, permeability and textural parameters (grain size, sorting, shape etc).

Reservoir Fluid Characteristics: Characteristics of crude oil and natural gas, classification of crude, and phesico-chemical properties of crude oil and gas.

UNIT-III		8	Hrs

Fluid flow through porous media: Flow of fluid in porous media: Darcy law, single and multiphase flow, linear, radial and spherical flow, steady-state and unsteady stat flow. GOR, WOR equations, flow through fractures and gas coning,

UNIT-IV		8	Hrs

Reservoir Fluids; Oil, gas, water and their saturation in pore spaces of rocks; Production behavior of gas, gas condensate, and oil reservoir, Rock and fluid compressibility effect; Wettability; Capillary phenomenon. generalized Material balance equation, water flux in reservoir

UNIT-V		6	Hrs

Phase behaviour: Reservoir Phase behaviour of hydrocarbon system, equilibrium ratio,
Reservoir drives: reservoir drive, solution gas drive, gas cap drive, water drive, gravity drive, combination drive mechanism and recovery factor.

COURSE OUTCOMES

After completing this course the student should be able to:

1) Identify common types of petroleum reservoirs to understand the concepts of conventional and unconventional reservoirs.
2) Remember the petrophysical properties of rocks, reservoir fluid characteristics classification of crude oil and fluid properties.
3) Comprehend fluid flow through porous media and concept of single and multiphase flow
4) Explain about reservoir fluids, basic definition of saturation in reservoir, concept of wettability and capillary phenomenon.
5) Analyse the oil & gas phase behaviour and different types of drive mechanism in petroleum reservoir.
6) Describe the importance of reservoir engineering in oil and gas filed developments and for reservoir modelling and simulation.

SUGGESTED READINGS

1) Craft, B.C. and Hawkins, M, Revised by Terry, R.E.1990, Applied Petroleum Reservoir Engineering, Second edition; Prentice Hall.
2) Charles, R.S; G.W. Tracy and R.L. Farrar 1999, Applied Reservoir Engineering;Oil &Gas Consultants International.
3) Dake, L.P.1978; Fundamentals of Reservoir Engineering; Elsevier.
4) Frank, T.C.1962; Petroleum Production Handbook, Vol II, Society of Petroleum Engineers.
5) Slider, H.C. 1976, Practical Petroleum Reservior Engineering Methods, Petroleum Publishing Company.

TPE-403	HEAT AND MASS TRANSFER	L T P C 3-1-0-4

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To have concept of different types of heat transfer viz. conduction, convection and radiation.
- It will be useful for the students to design heat exchangers and evaporator used in petroleum refineries.
- To understand concept of diffusion, principles and design of various distillation column.
- To know different extraction and absorption methods.
- To understand design of cooling towers, dehumidification systems and dryers.

UNIT-I		10	Hrs

Basic Concept: Introduction, mechanism of heat transfer

Conduction: Fourier's law of conduction; Conduction through plane and composite wall, Heat losses and insulation: critical thickness of insulation, selection of insulating materials

Convection: Natural and forced convection; heat transfer coefficients, convection in laminar and turbulent flows

Radiation: Radiant energy-distribution, Black body, Emissive power, Exchange of energy between two surfaces, View factor. Combined heat transfer by conduction, convection and radiation.

UNIT-II		8	Hrs

Heat exchangers: Types of heat exchangers: Co-current and counter-current flows, design of double pipe heat exchanger and shell and tube heat exchanger.

Boiling and condensation: Condensation: Filmwise and dropwise condensation, various type of condenser, Evaporators: Various types of evaporator, steam economy, single effect and multi effect evaporator

UNIT-III		10	Hrs

Diffusion and Theory of Mass transfer: Basic concept of diffusion, Fick's Law of diffusion, Film theory and penetration theory, Convective mass transfer and Mass transfer coefficients.

Distillation: Vapour-liquid equilibrium, Raoult's Law and Relative volatility, Enthalpy concentration diagrams, Principles of distillation, Batch distillation with and without reflux, Steam distillation, Fractionating columns, Calculation of number of plates by McCabe-Thiele method, Optimum reflux, Principles of azeotropic and extractive distillations.

UNIT-IV		8	Hrs

Liquid–liquid extraction: Ternary liquid-liquid equilibrium, Batch and continuous liquid-liquid extraction, Stage calculation.

Solid-liquid extraction: Single and multi stage extraction, Number of equilibrium stages.

Gas Absorption and stripping: packing and packed tower design

UNIT-V		6	Hrs

Simultaneous Heat and Mass Transfer: Design of cooling towers and dehumidification systems, Drying - batch and continuous, mechanism of drying, design of batch and continuous dryers. Principal of crystallization.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Acquire knowledge of different heat transfer processes and the modes of heat transfer
2. Understand the concept of heat transfer through composite slabs, composite cylindrical and composite spherical geometry.
3. Comprehend the concept of shape/view factor and the transfer of heat through radiation process.
4. Develop the concepts will let the students to know about the petroleum reservoir concept by studying the MBE and EBEs.
5. Design heat exchangers, evaporator, and distillation column, dryer and cooling tower used in petroleum refineries.
6. Apply the concept of diffusion and the laws of diffusion for the energy and mass balance equation

SUGGESTED READINGS

1) Holman, J.P., "Heat Transfer", 9th Ed., McGraw Hill
2) Treybal, R.E., "Mass Transfer Operation", 3rd Ed., McGraw Hill.
3) Kreith, F., Bohn M., Principles of Heat Transfer", 6th Ed., Brooks Cole.
4) Brown, G. G., "Unit Operations", CBS Publishers.
5) McCabe, W.L., Smith, J.C., Harriott, P., "Unit Operations of Chemical Engineering", 6th Ed., McGraw Hill.
6) Dutta, B.K., "Principles of Mass Transfer and Separation Processes" PHI Learning Private Limited.

TPE-404	APPLIED SEDIMENTOLOGY	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To attain a high level of competency in sedimentary data collection from a range of sources including cores, outcrop, logs etc.
- To use first principles to derive well-constrained, detailed, flow-process interpretations.
- To have the ability to develop internally consistent hypotheses of depositional environments and their evolution in space in time.
- To have knowledge of contemporary farcies models and the latest literature in deltaic and marine depositional systems.

UNIT-I		8	Hrs

Rocks to Sediments: Sedimentogenesis-Weathering; clastic and non-clastic sediments; Agents and mode of Sediment Transport, Simple fluid flow concepts-Laminar and turbulent flow, Reynold's and Froude Numbers; concepts of critical (Threshold) and setting velocities; Diagenesis of sediments; Provenance(Light and Heavy Minerals).

UNIT-II		8	Hrs

Textures of Siliciclastic Sediments: Grain size statistics, roundness, spherecity, surface textures; Grain Imbrications, Mass Properties of Sediments –Packing (packing density and packing proximity), Porosity, Permeability; Relationship between grain size and sorting with porosity and permeability.

UNIT-III		6	Hrs

Sedimentary structures: Predepositional Interbred(channel, Scour and fill, Flute , Groove and Tool Marks); Syndepositional Intrabed (Massive , Flat bedding , Graded bedding , Cross- bedding, Lamination and Cross- Lamination); Postdepositional deformed interbred and intrabed (Slump, Slide, Convolute bedding, Load structures); Organic (Trace fossils); Diagenetic (Concretions); Rain prints, Shrinkage Cracks , and Volcanoes, Pock Marks Paleocurrent Analysis.

UNIT-IV		6	Hrs

Sedimentary Environments: Physical and chemical parameters of depositional environments; classification of environments, concept of lithofacies models.

UNIT-V		6	Hrs

Classifications: Gravel stone, Sandstone, Mudstone and Limestone and their classifications; Evaporits, Volcanoclastic sediments

UNIT-VI		6	Hrs

Sedimentation and Tectonics: Tectonic control of Sedimentation; Plate Tectonicin relation to type and evolutions of basins; Petroleum Prospects.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Develop sedimentological knowledge and research skills to an advanced level.
2. Identify and interpret major sedimentary structures in outcrop.
3. Make careful observations of a range of sedimentary data.
4. Develop logically consistent interpretations of depositional environments and controls.
5. Relate Plate Tectonic in the evolutions of different basins.

6. Identify that pyroclastic volcanic rocks are just sedimentary rocks deposited hot and fast and most fossils are contained within sedimentary rock.

SUGGESTED READINGS

1) Baltt, H., Middleton, G.V. and Murray, T.G., Origin of Sedimentary Rocks, Prentice-Hall.
2) Boggs,S., principles of Sedimentology and Stratigraphy , Prentice-Hall
3) Leader. M.R., Sedimentology and Sedimentary Basins, Prentice-Hall
4) Reading, H.G., Sedimentary Environments- Process, Facies and Stratigraphy, Wiley – Blackwell.
5) Selley, R.C., Applied Sedimentology; Prentice-Hall

TPE – 405	PETROLEUM DRILLING ENGINEERING I	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn different types of wells and their uses.
- To learn types of drilling methods used and types of Rigs.
- To learn selection of accurate drilling mud.
- To learn kinds of cements used in cementing operation.
- To learn casing, its types and their applications.

UNIT-I		6	Hrs

Exploration; Drilling locations – Exploratory, Development; Wells – Shallow and deep wells; Classification of drilled wells – exploratory wild cat wells, exploratory test wells, explorato ry step out wells; Special wells for special purposes (Relief wells, Seismic explosion wells, Underground storage wells, effluent disposal wells, underground nuclear explosion wells).

UNIT-II		6	Hrs

Types of drilling; Cable Tool Drilling: cable tool rigs and their components; Equipments, Factors governing the choice of cable tool drilling. Rotary Drilling: Rotary drilling Rig and its components; Equipments, Factors governing the choice of Rotary Drilling; Advantages/ disadvantages over cable Tool Drilling method;

UNIT-III		12	Hrs

Drilling Fluids: Properties and Functions of drilling Fluids, composition and nature of common drilling muds, classification of drilling fluids: Water-Base Muds, Inhibitive Water- Base Muds, Oil Muds. Drilling Fluid Additives, air natural gas and aerated mud as drilling fluids, testing of drilling fluids and equipments used, Drilling Fluid Problems and Solids Control Equipment., Diagnostic Tests, Pilot Tests, Drilling hazards dependent on mud control, formation damage.

Drilling Fluid Selection: data Requirements

UNIT-IV		8	Hrs

Petroleum Well Casing: Introduction, Component Parts of a casing String, basic functions of casing, properties of Casing: casing size, length of casing, casing weight, casing grade and connections, Casing Standards and casing coupling, API Specifications of casings, Wellheads and Casing Hangers: Spool Type Wellhead, Compact Spool (Speedhead), Casing Hangers.

UNIT-V		8	Hrs

Petroleum Well Cement and cementing techniques: Cementing introduction, cement slurries, cement additives, API cement classifications – Class A, B, C, D, E, F, Special cement types in common use: Pozzolana, Diesel, Latex, Diesel – oil, Oil – in – water emulsion, Resin and Gypsum cements, Cement additives commonly use to control slurry density, filtration, thickening time and strength ,Auxiliary cementing equipments.

COURSE OUTCOMES

After completing this course the student should be able to:

1	Enumerate different types of wells and locate them.
2	Infer the basics drilling techniques.
3	Explain different types of mud and where they can be used selectively.
4	Classify different types of cements and the zones in which they can be utilized.
5	Illustrate the cementing operation performed and equipments used.
6	Recognize different casing types and depth at which they may set.

SUGGESTED READINGS

1. Gatlin, Carl, Petroleum Engineering and Well operations; Prentice Hall.
2. Shiffer, V. V., Drilling of Oil and Gas Wells; Mir Publishers.
3. Brantly, J. E., Rotary Drilling Handbook; Palmer Publications.
4. Stearns, G., Engineering Fundamentals in Modern Drilling, Tulsa: Oil and Gas Journal, 1953, Pg. 69 – 81.Weaver, D. K., Practical Aspects of Directional Drilling; API Drilling and Production Practices

TPE-411	FUNDAMENTAL OF PETROLEUM DATA ACQUISITION AND PROCESSING	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To understand the philosophy of oil exploration,
- To learn the principles of different methods used in petroleum exploration.
- To understand the basic seismic processing techniques.
- Comprehend the parameters that can seriously affect seismic data processing quality and costs.

UNIT-I	Introduction to Exploration Methods	7	Hrs

History & background of Petroleum exploration. Theory and working principles, Data acquisition, Data processing and Interpretation of Gravity, Magnetic, Electrical and Seismic methods.

UNIT-II	Basic Elements of Seismic Data	7	Hrs

Broad aspects of seismic data acquisition, concept of uphole survey and compensation of near surface irregularities in travel times. Survey types: onshore, offshore & transition zone/ 2D, 3D, 4D & multi component. Data types, Data formats. Ancillary (auxiliary) data : Shell Processing Support files/ UKOOA files/ observer's log, static correction, velocity information & coordinate information.

UNIT-III	Field Geometry, Field Statics, Preprocessing & Velocity Analysis	11	Hrs

Concepts of field geometry/ navigation merging, statics computation & application. Types of noise & multiplesand their attenuation. Muting, trace editing, despiking, Initial velocity analysis, application of NMO correction and stack.

UNIT-IV	Deconvolution & Residual Statics	8	Hrs

Weiner-Levinson technique & deconvolution. Types of deconvolution (spiking, predictive, surface consistent etc.). Deconvolutiion parameters, such as, operator length, predictive distance & white noise. Testing of deconvolution parameters. Notion of Cycle skipping, maximum allowable shift, window size, Residual statics computation and stack.

UNIT-V	Dip Move out Correction, Migration & Post stack Processes	7	Hrs

Dip move out correction, freznel zone, migration aperture, pre & post stack time migration, migration algorithms. Relative preference of Prestack depth & time migration over post stack time migration and DMO. Post stack processes.

COURSE OUTCOMES

After completing this course the student will be able to

1. Evaluate subsurface formations by various geophysical methods.
2. Apply knowledge of seismic data acquisition & processing for interpretation.
3. Identify and apply correct sequence of processes to be used with right choice of parameters.
4. Comprehend the application of geometry, computation and compensation of near surface irregularities in travel times, noise, multiple attenuation and velocity analysis.
5. Understand resolution in terms of time (deconvolution) & space (stacking & migration) and post stack processes.
6. Analyze the importance of producing a clean section of subsurface with good event continuity & sufficient resolution to meet the interpretation requirements.

SUGGESTED READINGS

1. Claerbout, J. F., 1976, Fundamentals of geophysical data processing: McGraw-Hill Book Co.
2. Dix, C. H., 1955, Seismic velocities from surface measurements: Geophysics, 20, 68-86.
3. Robinson, E. A. and Treitel, S., 1980, Geophysical signal analysis: Prentice-Hall, Inc.
4. Mayne, W. H., 1962, Common-reflection-point horizontal data stacking techniques: Geophysics,27, 927-938.
5. Yilmaz Ozdogan, Seismic Data Analysis, (SEG, 2011)

TPE-412	CORROSION EVALUATION AND MONITORING	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To understand the forms of corrosion and its protection
- To understand Corrosion in offshore drilling and processing and transportation of crude
- To understand the basic principles and of corrosion and its testing and evaluation.
- Locating and identify the type of corrosion damage
- To Understand about the corrosion monitoring techniques: **Corrosion coupon** (or mass loss coupon), **Electrical resistance, Linear polarization resistance.**
- To understand different Monitoring process parameters and chemical analysis.

UNIT-I		9	Hrs

Forms of Corrosion, Corrosion of storage tank and pipe line, Control of internal and external pipeline corrosion detection and prevention, Corrosion in offshore drilling and processing and transportation of crude, use of coating, additives, anodic and cathodic protection, aging and replacement of piping.

UNIT-II		9	Hrs

Basic principles of corrosion and its control – Forms of corrosion, uniform, Galvanic, Crevis, pitting, selective leaching, erosion, stress-corrosion, cracking – Cavitation phenomena Corrosion testing – Field testing – Electrochemical techniques for measurement of corrosion rates, corrosion detection and components examination– Accelerated salt-spray testing.

UNIT-III		8	Hrs

Locating and identify the type of corrosion damage**, non-destructive testing (NDT)** and inspection techniques, **ultrasonic testing, radiographic testing,** and **magnetic flux leakage.**

UNIT-IV		9	Hrs

Corrosion monitoring system selection, Corrosion monitoring techniques: **Corrosion coupon** (or massloss coupon), **Electrical resistance, Linear polarization resistance, Galvanic monitoring, Biological monitoring, Ultrasonic thickness monitoring, Hydrogen penetration monitoring.**

UNIT-V		7	Hrs

Monitoring of process parameters and chemical analysis. Other measurements, techniques measure the by-products of corrosion, e.g. Hydrogen probes; Acoustic emission (AE); Bioprobes. Availability and cost, Applications: system suffering from bacterial corrosion, oxygen corrosion, routine pigging, process control etc.

COURSE OUTCOMES

After completing this course the student will be able to

1. Know about different types of corrosion and its remedial techniques.
2. Explain and compare about the anodic and cathodic protection, aging and replacement of piping.
3. Illustrate about the Electrochemical techniques for measurement of corrosion rates, corrosion detection and components examination, Accelerated salt-spray testing.
4. Identify and categorize about the different techniques like NDT, Ultrasonic etc.
5. Assess and inspect the Corrosion monitoring selection system.
6. Compose the applications of different monitoring system.

SUGGESTED READINGS

1. Fontana , M.G., “Corrosion Engineering”, Edn 3, McGraw Hill, 1989.
2. Modern Electrochemistry” by Bockris, JOM, Reddy and A.K.N
3. “Handbook of Corrosion Engineering”, Roberge, P.R., McGraw-Hill,2000
4. “Elements of Materials Science and Engineering” by L.H. Van lack
5. “High Temperature Corrosion” by Per Kofstad
6. “High Temperature Coatings ” by Sudhangshu Bose
7. “Principles and Prevention of Corrosion” by Denny A. Jones
8. Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering, 4th Edition, R. Winston Revie., ISBN: 978-0-470-27725-6.

TPE-413	MUD LOGGING	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn about mud logging, work of mud logger and components of mud logging units.
- To make them understand about Data acquisitionparameters, maintenance and calibration of equipments.
- To learn about sample collection and preparation of mud logging report.
- To learn about log data interpretation and data processing.

UNIT-I	Objectives and duties of Mud Logger	6	Hrs

Mud-logging unit, users, personnel and their duties. Use of Mud logging for safety, efficiency and formation evaluation, outputs from ML unit. Rig up and rigdown.

Lag Time: Lag time and lag strokes, onshore and offshore differences, Lag time calculation and verification.

UNIT-II		8	Hrs

Mud-logging Sensors: Data acquisition, Mud logging parameters, placement of sensors, principles of sensors as Depth, WHO, SPP, SPM, Torque, Flow out, Pit level, RPM, WHP, Mud resistivity, Mud weight, H_2 S, HC Gas acquisition. Maintenance and calibration of equipments.

Chart Interpretation and Monitoring: Instantaneous and lagged parameters, data presentation, monitoring drilling logging, interpretation of events from charts as tripping, circulation, drilling, kick, check of lag time, gas chart etc.

UNIT-III		6	Hrs

Sample collection: Different type of samples and methods of collection.

Cutting Sample description: Type of samples, collection and packing of samples, Cutting description, fluorescence and cut. Calcimeter, flurometer.

Coring: Conventional and other coring methods, cleaning of core, marking and packing, transportation and storage of cores. Properties studied from cores, Preparation of core log.

UNIT-IV		8	Hrs

Master Log & Well Report: Scales of log, plotting of different parameters, interpretative lithology, abbreviations, Descriptions and remarks.

Hydrocarbon Gas: Physical properties of gas, terminology, coal gas, hydrates, porosity permeability and gas, terms for recorded as BG, TG, CG, peak gas, degasser, and gas-detection system, inferences from recorded gas, gas diagrams and ratios.

Subsurface Pressures: Hydrostatic pressure, normal and over pressure, overburden, causes of overpressure, detection of over pressure, pressure log, kick indicators.

UNIT-V		8	Hrs

Mud Engineering: Fundamentals of Fluid flow (Fluid flow, viscosity), Types & Flow (Laminar, Turbulent). Criteria for the type of flow. Types of Fluids (Newtonian & Non-Newtonian), Viscometers.

Mud Engineering: Functions of Drilling Mud, Types of Drilling muds (Water-base & Oil base) & their Chemical Additives.

Mud Properties: Mud Weight, Rheological Properties, pH, Filtrate and filter cake.
Mud Contaminants: NaCl, Anhydrite, Gypsum, and Cement.
Conditioning equipment: Shale shaker, sand trap, degasser, de-sander and de- silter.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Explain mud logging and its operations, work of mud logger in a logging unit.
2. Use mud logging data for tripping, circulation, drilling, kick, check of lag time, gas chart for interpretation.
3. Design sample collection methodologies for study and preparation of logs.
4. Create reports on mud logging.
5. Investigate drilling mud and fluid flow.
6. Know about mud Rheological properties and HSE impacts.

SUGGESTED READINGS

1. Mud logging Handbook by Whittaker,Alun
2. Basic mud logging by mahmoud Abdallah

TPE-407	INDIAN CONSTITUTION	L T P C 0-0-0-0

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn about the preamble of the constitution
- To learn about the citizenship, fundamental rights and duties, Directive Principles of State Policy
- To learn about the union and state government and its administration.
- To learn about local administration
- To learn understand election commission

UNIT-I	INTRODUCTION	8	Hrs

Constitution' meaning of the term,, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy

UNIT-II	UNION GOVERNMENT AND ITS ADMINISTRATION	8	Hrs

Structure of the Indian Union: Federalism, Centre-State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

UNIT-III	STATE GOVERNMENT AND ITS ADMINISTRATION	8	Hrs

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

UNIT-IV	LOCAL ADMINISTRATION	8	Hrs

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-V	ELECTION COMMISSION	8	Hrs

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

COURSE OUTCOMES

After completing this course the student should be able to:

1. Illustrate the meaning and importance of constitution.
2. Describe the importance of Preamble of the Indian Constitution and its significance.
3. Elucidate the Fundamental Rights and Duties, Directive Principles of State Policy
4. Outline the Structure and Functions of Union and State Government.
5. Understand Local and Urban Administration.
6. Explain the role and functioning of Election Commission

SUGGESTED READINGS

1. Indian Polity by Laxmikanth
2. Indian Administration by Subhash C. Kashyap
3. Introduction to the Constitution of India' by D.D. Basu
4. Public Administration in India by Avasthi and Avasthi

TPE-501	PETROLEUM GEOPHYSICS	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To develop ability of students with basic concepts of role of Seismic data in Oil & Gas
- Exploration and development.
- To understand various method of Seismic data acquisition in onland and offshore.
- Concept of multiplexing and demultiplexing, data sorting system and data format.
- To understand the basic concept of Seismic data processing techniques.
- Develop ability for Seismic data Interpretation for prospect generation and development plan

UNIT-I		4	Hrs

Introduction to Geophysics: History of development of Petroleum Geophysics; Geophysical methods commonly used in oil & gas exploration (gravity, magnetic, electrical, seismic methods);

UNIT-II		10	Hrs

Seismic Prospecting : Seismic waves, their characters and laws governing their propagation (Snell's law, Huygens principle, reflection, refraction, attenuation, absorption and scattering/diffraction); Sources of seismic energy – Explosives impact, vibroseis and air gun and their main characteristics; Recording of seismic signals (Digital recording system, Niquest Frequency), geophones and their response characteristics, principle of digital recording of seismic signals; Concept of impedance, Reflection coefficient, Earth convolution model, Seismic reflection and refraction surveys (2D and 3D data acquisition on land and marine), up-hole surveys; Multiplexing, Georeferencing and datum, principles of CDP shooting, Coherent and incoherent, grouping of geophones.

UNIT-III		10	Hrs

Seismic data processing: concept of multiplexing and demultiplexing, data sorting and concept of different data gathers.

Seismic velocity: Different types of velocity, velocity analysis technique and its importance at various stages of seismic data processing and interpretation. Problems related to static and their correction. Filters, Navigation and Seismic merge, designature, Gain, basic noise identification, classification and attenuation technique.

Events other than primary reflection (Multiple, diffractions, refractions and surface/air waves) and their basic removal techniques. Basics of binnig, regularization and Migration of seismic data. NMO correction, muting and Stacking. Automatic gain control (AGC), post stack remnant noise removal.

UNIT-IV		8	Hrs

Seismic data interpretation: Picking and tracking horizons/seismic markers on 2D & 3D data .Identification of faults and marking fault patterns, tying loops and digitization of picked horizons. Concept of seismic resolution (vertical and horizontal), tuning thickness and Fresnel zone. Integration of seismic data with well data, synthetic seismograms, VSP data and available geological information/data.

UNIT-V		8	Hrs

Polarity reversal, Polarity and phase problems. Direct hydrocarbon indicator: Amplitude versus offset (AVO), Dim spot, Bright spot, Gas chimney, Flat spot, etc. 4D seismic interpretation. Data formats (SEGY, SEGD etc.) Seismic attributes, concept of 4D Seismic and Seismic data Inversion.

COURSE OUTCOMES

After completing this course the student will be able to

1. Illustrate the role of geophysics in oil and gas industry.
2. Use Gravity, Electrical and Magnetic surveys in hydrocarbon exploration.
3. Acquaint with the Seismic data acquisition technique carried out in offshore and onland.
4. Explain in-house seismic data processing, including navigation merge, noise and multiple attenuation, migration and post migration processing.
5. Interpret the basic seismic data (2D and 3D).
6. Make out fundamentals of quantitative interpretation, advance processing and attribute analysis.

SUGGESTED READINGS

1. Dobrin, M.B and Savit, C.H., Introduction to Geophysical Prospecting, McGraw- Hill.

2 D.S.Parasnis(1996); Principles of Applied Geophysics, Springer

3 Catuneanu, O., Principles of Sequence Stratigraphy, Elsevier

4 McQuillin, R., Bacon, M and Barclay, W., An Introduction to Seismic Interpretation,: Reflection Seismic in Petroleum Exploration, Kluwer Academic Publication.

5 Seismic Stratigraphy-Application to Hydrocarbon Exploration(Ed.C.E.Payton) American Association of Petroleum Geologists-Memoir-26

6 Alistair R Brown (1986); Interpretation of 3 Dimensional seismic data, 5th Edition,SEG-USA.

TPE- 502	WELL LOGGING AND FORMATION EVALUATION	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn the role of well logging for mapping the subsurface physical property of the sediments of different formations.
- To understand basic principle of measuring petrophysical property of formations using different logging tools & Technology.
- To develop practical understanding of the interpretation of logs recorded by wire line tools and techniques,
- To Estimate the various reservoir parameters i.e. Mineral Volumes, porosity, Permeability,
  Oil Saturation, and net pay.
- Application of these parameters for estimation of reserve and its production in oil and gas fields.

UNIT-I		6	Hrs

Subsurface Geological Investigations: Drilling; well logging, classification of well logging methods; their importance in formation evaluation; Limitations.

UNIT-II		6	Hrs

Auxillary logs; Drill time log, Caliper log, Dipmeter log, Temperature log, Cement bond log, Casing collar location log, Mud Logs, and their applications.

UNIT-III		8	Hrs

Electrical logs; Basic principles of Spontaneous Potential logs and Resistivity logs, normal and lateral resistivity logs; Focused logs; Micro resistivity logs and their role in formation evaluation; Induction logs principles and their application.

UNIT-IV		8	Hrs

Radiation logs; Basic principles of various types of radiation logs - natural gamma ray log, gamma – gamma log, neutron – gamma log, neutron thermal and chlorine log; Porosity determination and cross – plots.

UNIT-V		6	Hrs

Sonic and NMR logs; Basic principles of Sonic logs; Sonic logging tools, porosity determination; NMR logging principles and techniques; Bound and free water estimation; Application of these logs.

UNIT-VI		6	Hrs

Well logs as Tools for Sedimentological Studies; Sedimentary textures-grain size variations, sorting; progradation, retrogradation; Transgression and regression.

COURSE OUTCOMES

After completing this course the student will be able to

1. Identify basic requirement of logging tools to understand the sub-surface Geology.
2. Recognize the basic logs required in the industry by different logging tools.
3. Learn the principle of logging tools & Technology.
4. Understand individual wire-line log data & Hi-Tech tool data.
5. Interpret different wire-line log data by cross plotting & computing techniques.
6. Apply well log data in exploration & Development in oil & gas field.

SUGGESTED READINGS

1. Fundamentals of well-log interpretation by O.SERRA, Direction Exploration, de la SNEA (P),Pau, France.
2. Schlumberger "Log Interpretation Principles and Applications" Schlumberger Publication.
3. Open hole Log Analysis and Formation Evaluation by Richard M. Bateman Faculty Member, Texas Tech University.
4. Schlumberger ("Log Interpretation Charts" Schlumberger Publication.
5. Rider, M: The Geological Interpretation of Well logs", 2003
6. K Bhuyan and Q R Passsey: Clay Estimation from GR and Neutron-Density porosity Logs.1994.

TPE-503	PETROLEUM PRODUCTION ENGINEERING I	L T P C 3-1-0-4

LEARNING OBJECTIVES

1. To learn about the onshore oil and gas facility.
2. To learn about the various equipment and methods of oil and gas processing.
3. To learn about oil storage facility.
4. To learn about various equipment and produced hydrocarbon measuring devices
5. To learn about various water injection system.

UNIT-I	ONSHORE OIL AND GAS FACILITY	8	Hrs

Composition and physico-chemical properties of oil and gas. Production well architecture – Surface and subsurface components, Well flowlines, Group Gathering Station – Process systems and equipment, Central Tank Farm, Gas Collecting Station, Pipelines, Early Production System

UNIT-II	OIL AND GAS PROCESSING	12	Hrs

Function of Oil facility – Processes and equipment, Separators- Principles, Functions, Components, Orientation, and types of separators. Two phase and Three phase separators, Performance, Function of Gas facility - Gas sweetening methods, process, equipment, Gas dehydration methods, process, equipment, Crude oil emulsions- Definition, Types of emulsions, Formation of crude oil emulsions, Characteristics and physical properties, Stability of emulsions, Stability measurement, Demulsification mechanism, Emulsion treating methods and equipment, Desalting, Dehydration, Stabilisation.

UNIT-III	OIL STORAGE	4	Hrs

Central tank farm, Types of storage tanks, Storage options, Pressure - vacuum valves, Guages, Tank breathing, Filling/pumping operation, Gas blanketing systems, Vent system, Controling liquid leaks from tanks, Tank battery

UNIT-IV	EQUIPMENT AND MEASURING DEVICES	8	Hrs

Gas compressors - Classification and types. Centrifugal and Reciprocating compressors, Pumping units, Chillers, Electrical systems -Power sources, Motors, Prime movers – Reciprocating engines, Gas turbine engines, Liquid and gas measurement : Custody transfer, Types of Liquid meters, Design, Performance, LACT, Types of Gas meters, Design, Performance

UNIT-V	WATER INJECTION	8	Hrs

Surface facility, Water injection plant, sources of injection water, plant layout, equipment, processes, Surface and produced water treatment for maintenance of injection water quality, Need for treatment, Treatment methods, Equipment

COURSE OUTCOMES

After completing this course the student will be able to

1. Examine work in onshore production system including GGS, GCS and CTF.
2. Classify the working in oil and gas processing facilities.
3. Inspect the work in oil storage area.
4. Monitoring and assessing the working of oilfield equipments and measuring devices.
5. Investigate the working in water injection plant.
6. Develop skills and confidence to work in production domain in an oil & gas field.

SUGGESTED READINGS

Production Operations byThomas O. Allen and Alan P.
Roberts Principles of oil well production by T. R. W. Nind
Petroleum Production Engineering by BoyunGuo, W. C. Lyons and Ali Ghalambor

TPE-504	RESERVOIR ENGINEERING II	L T P C 3-1-0-4

COURSE OBJECTIVES

The followings are the main learning objective of this course

- To understand the Flow of fluid in pours media
- To understand GOR, WOR equations, flow through fractures and gas coning
- To illustrate the principles different reserve estimation techniques, volumetric, MBE, decline curve analysis
- To explain the performance prediction of depletion, gas cap, water and combination drive
- To evaluate Displacement fractional flow and rate of frontal advance equation.
- To evaluate Reservoir Management: concepts, components and applications

UNIT-I		9	Hrs

Flow of fluid in pours media: Darcy law, single and multiphase flow, linear, radial and spherical flow, steady-state and unsteady state flow. GOR, WOR equations, flow through fractures and gas coning

UNIT-II		9	Hrs

Reservoir fluids: Phase behavior of hydrocarbon system reservoir estimation, resourse and reserve concept, different reserve estimation techniques, volumetric, MBE, decline curve analysis, latest SPE/WPC/IS classification.

UNIT-III		8	Hrs

Production behavior of gas, gas condensate, and oil reservoir, Rock and fluid compresebility effect, generalized MB Equation, water flux in reservoir, performance prediction of depletion, gas cap, water and combination drive,

UNIT-IV		8	Hrs

Displacement fractional flow and rate of frontal advance equation. Water flood performance, Reservoir Pressure Measurements and Significance: Techniques of pressure measurement

UNIT-V		9	Hrs

Reservoir Management: concepts, components and applications, well spacing, Introduction to reservoir modeling and simulation, commercial software's for reservoir modeling and simulation in petroleum industry and applications.

COURSE OUTCOMES

After completing this course the student will be able to

1. Know about the Flow of fluid in pours media
2. Explain and compare about understand GOR, WOR equations, flow through fractures and gas coning
3. Illustrate about the principles different reserve estimation techniques, volumetric, MBE, decline curve analysis
4. Identify and categorize about the performance prediction of depletion, gas cap, water and combination drive
5. Asses and inspect the Displacement fractional flow and rate of frontal advance equation.
6. Compose the Reservoir Management: concepts, components and applications, well spacing

SUGGESTED READINGS

Text Books

1) Craft, B.C. and Hawkins, M, Revised by Terry, R.E.1990, Applied Petroleum Reservoir Engineering, Second edition; Prentice Hall.
2) Charles, R.S; G.W. Tracy and R.L. Farrar 1999, Applied Reservoir Engineering;Oil &Gas Consultants International.
3) Dake, L.P.1978; Fundamentals of Reservoir Engineering; Elsevier.
4) Frank, T.C.1962; Petroleum Production Handbook, Vol II, Society of Petroleum Engineers.
5) Slider, H.C. 1976, Practical Petroleum Reservior Engineering Methods, Petroleum Publishing Company.

TPE-506	PETROLEUM REFINING ENGINEERING	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course is

1. To learn global and Indian petroleum refinery.
2. To learn crude oil distillation process and operating variables.
3. To learn thermal conversion process such as Visbreaking and coking processes.
4. To learn about major insights into secondary processes like catalytic Cracking, Hydrocracking and Catalytic Reforming,
5. To learn finishing processes.
6. To gain insight into lube oil manufacturing processes.

UNIT-I		8	Hrs

Introduction to Petroleum Refinery: Global and Indian Petroleum Refinery**,** Crude oil availability, Emerging Scenario in petroleum Refining

Evaluation of crude oil and petroleum products: Short term and Long term evaluation Composition of crude oil, crude Assay, TBP and ASTM distillation, Evaluation crude oil base and other properties, Product quality analysis and Standards

UNIT-II		8	Hrs

Crude oil distillation: Introduction, Impurities in Crude Oil, Need for Desalting of Crude Oils, Electric Desalting of Crude Oil, Crude Oil Distillation, Atmospheric and Vacuum Distillation of Crude Oils, Effect of crude characteristics and Operating variables in Crude oil distillation. Processing of high TAN crude oil

UNIT-III		8	Hrs

Thermal Conversion Process: Thermal Cracking Reactions, Thermal Cracking, Visbreaking-Conventional and Soaker, Coking Processing Delayed, Fluid and Flexi Coking, Petroleum Coke

UNIT-IV		6	Hrs

Catalytic Conversion Process: Fluid Catalytic Cracking (FCC), Hydro cracking, Catalytic Reforming, Alkylation, Isomerization and Polymerization.

UNIT-V		10	Hrs

Finishing Processes: Hydrogen Sulphide Removal Process, Sulphur Conversion Process, Sweetening Process, Solvent Extraction Process and Hydrotreating Process.

Lube Oil Manufacturing Processes: Vacuum Distillation, Solvent Deasphalting, Solvent Extraction of Lube Oil Fractions, Solvent Dewaxing Process, Hydro-finishing Process, and Manufacture of Petroleum Wax. Lubricating greases and Bitumen processing

COURSE OUTCOMES

After completing this course the student will be able to

1) Describe the importance of Natural gas refinery and biorefinery.
2) Explain various separation processes like distillation, extraction, adsorption and Oil & gas stabilization.
3) Analyze about advances in catalyst and Spent catalyst management.
4) Interpret Technological Development in Steam Cracking process.
5) Discuss on hydrogen production and management in refinery.
6) Apply the idea of Energy management in Petroleum refinery.

SUGGESTED READINGS

1) Nelson W. L., "Petroleum Refinery Engineering", McGraw Hill. 1941
2) Meyers R.A. Handbook of Petroleum Refining Processes Third Edition McGraw Hill Publication 2004
3) Surider Praksh. Refining Processes Elsevier 2003

4) Raseev, S. Thermal and Catalytic processes in Petroleum Refinery. Marcel & Decker, Inc. Newyork 2003.
5) Waquier J.P. “Petroleum Refining” Vol 1 & II, 1995 Editions Technip.
6) Speight, J.G. the Chemistry and Technology of Petroleum “ Third Edition Marcel Decker, Inc, NewYork 1999
7) Rao B. K. B., "Modern Petroleum Refining Processes", Oxford & IBH.
8) Mall I. D., " Petrochemical Process Technology", Macmillan India Ltd. 2007

TPE-511	MACHINE LEARNING FOR RESERVOIR CHARACTERIZATION	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- Students will be able to get the data analytics process.
- To Lean about data analytics modules called exploratory data analysis and data pre-Processing.
- To learn the workflows for static and dynamic data inconsistency check with the physics.
- To Learn to statistical learning, data mining and cover Intelligent Data Miner Workflows:

UNIT-I	Exploratory Data Analysis and Data Pre-processing	6	Hrs

Introduction to Data Analytics; Exploratory Data Analysis (EDA) (Visualization, and Descriptive Statistics)Data Preprocessing

UNIT-II	Supervised Machine and Unsupervised Machine Learning	8	Hrs

Decision Tree; Regression (Linear and Logistics); Model Evaluation
Model Evaluation; Ensemble Methods (Bagging, Boosting and Random Forest) ; Cluster Analysis (k-Means and Hierarchical)

UNIT-III	Reservoir Data	8	Hrs

Data reformatting ;Data cleaning; Static data processing; Time series signal processing; Anomaly detection algorithms; Data categorization; Data segmentation and partitioning; Spatio-temporal database generation

UNIT-IV	Data Analysis	6	Hrs

Statistical analysis ;Generalize linear models development ; Advanced dimensionality reduction techniques and algorithms ; Clustering algorithms; Advanced KPI identification

UNIT-V	Building reservoir Models	12	Hrs

Core Analysis: Sample Preparation and Selection; Determining bulk volume, pore volume and grain volume ;Determining net mean stress for core analysis measurements ;Core Porosity (Total and Effective),Permeability (How and Why) ; Petrophysical Rock Types, Facies and Capillary Pressure Concepts
Introduce the Advanced Flow Unit Concept (4-Component Stratigraphic Modified Lorenz Plots and Modified Lorenz Plots as a key core-log integration technique)
Introduce well test determined flow capacity, flow regime and well bore condition (skin)

Wettability and relative permeability for understanding reservoir performance and characterization

COURSE OUTCOMES

After completing this course the student should be able to:

1. Learn and develop machine learning models.
2. Identify the correct workflows and processes for developing the right machine learning based models.
3. Recognise various machine learning algorithms for data cleaning, time series signal processing, anomaly detection, statistical analysis, dimensionality reduction, clustering, KPI identification, and shallow and deep learning algorithms and Neuro-Fuzzy algorithm
4. Develop interpretable machine learning based models.
5. Perform quality control of the trained models.
6. Create and develop online and automated machine learning models

SUGGESTED READINGS

1. Machine Learning for Subsurface Characterization 1st Edition by Siddharth Misra Hao Li Jiabo He; Gulf Professional Publishing

TPE- 512	OIL FIELD INSTRUMENTATION & CONTROL	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To know about concept & importance of quality control of petroleum products.
- To learn about Classifications of Instruments and its standardization
- To learn about basics of process instrumentation
- To know about elements of measuring system used in petroleum industries and their function.

UNIT-I	Classifications of Instruments and its standardization	10	Hrs

Classification of instruments, metrological terms, definitions, units and standards, performance characteristics, calibration requirement, Hierarchy of standards and traceability, measurement of uncertainty codes and symbols etc.

UNIT-II	Measuring Instruments	10	Hrs

Instruments for indicating, recording and control of pressure (including mud pressure), flow, temperature, viscosity, level, pH, density, weight, penetration. torque. RPM, magnetic flux

UNIT-III	Instrumentation during different operations	7	Hrs

Instrumentation at drilling site, separation, transportation and storage of oil and gas operations. Aspects of process safety and reliability related to instrumentation, pipeline monitoring

UNIT-IV	Elements of measuring system and their function	8	Hrs

Measurement of process variables; sensors, transducers and their dynamics, transfer functions and dynamic responses of simple systems, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response and controller tuning, cascade, feed forward control.

UNIT-V	Process Instrumentation	10	Hrs

Basics of process instrumentation: Static and dynamic characteristics of instruments and their genera1 classification: Introduction to process control, basic principles. Applications of Process Control. Control loop and its components. Concept of transfer function and transient response of first and second order elements

Instrumentation for various process variables: Temperature, pressure, flow, liquid level, humidity and composition.

COURSE OUTCOMES

After completing this course the student will be able to

1. Illustrate the concept of units and standards, performance characteristics, calibration requirements for different measuring instruments.
2. Predict through Instruments for indicating, recording and control of pressure (including mud pressure), flow, temperature, viscosity, level, pH, density, weight, penetration, torque.
3. Illustrate about the Instrumentation at drilling site, separation, transportation and storage of oil and gas operations.
4. Categorise the concept of Measurement of process variables; sensors, transducers and their dynamics, transfer functions and dynamic responses of simple systems, process reaction curve, controller modes (P, PI, and PID)
5. Prioritize the concept of transfer function and transient response of first and second order elements
6. Design the process instrumentation applied in petroleum industries.

SUGGESTED READINGS

1. Speight, J.C.; The Chemistry and Technology of Petroleum, Marcel Dekkar, New York, 1991.
2. Ram Prasad , Petroleum Refining Technology , Khanna Publishers , Delhi 2000
3. Rao, B.K.B; Modern Petroleum Refining Processes, 4/e, 2002, Oxford and IBH Company Pvt. Ltd.
4. G.D. Hobson, W. Pohl, Modern Petroleum Technology (Part I &II), John Wiley & Sons, N.Y., 1986.
5. Stephanopoulos G., “Chemical Process Control – An Introduction to Theory and Practice”, Prentice-Hall of India. 1990.
6. Coughanowr D. R. and Le Blanc S., “Process System Analysis and Control”, 3rd Ed., McGraw Hill. 2008

TPE-513	HYDROCARBON ACCOUNTING	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- Hydrocarbon exploration and production is high-risk capital-intensive business, requires multiple partner to invest and share the risk.
- Hydrocarbon Production is a multiphase flow and many a times metering is not sufficient and accurate. Given this allocating one's share of produce is a complex business problem faced by a Petroleum Engineers/Managers-

UNIT-I	PROCESSES AND OPERATIONS	8	Hrs

Oil Reservoir vs Gas Reservoir, Black Oil vs Low Shrinkage vs High Shrinkage - PT Curves Type of wells, Production workflow, Why multistageseparator, Well Testing
Production Forecasts, Integrated Production system Capacity. PVT – what it tells about Oil reservoir/Oil Formation Volume Factor, Gas Formation Volume factor

UNIT-II	BUISNESS FUNDAMENTALS	7	Hrs

What is Deferment, what is in scope, what is out Scheduled, Unscheduled deferment and Excess Capacity. Cause code and standard process groups. Controllable and Uncontrollable deferment

1. PSC/Royalty/Signature: Production split, Sample PSC
2. Production data and production data Lifecycle

UNIT-III	METERS AND WORKFLOW	6	Hrs

Metering classes and calibration frequency, Flow meters, application and uncertainty range, HPIM Data customers and ways to input well data, HCA Flow with Meters

UNIT-IV	HYDROCARBON ALLOCATION	5	Hrs

Definition, why do we do HCA, Challenges, EC Subsurface and Block, Formation concept, Key approaches, Two Stage reconciliation, Numerical

UNIT-V	HYDROCARBON APPLICATION	5	Hrs

Hydrocarbon Application Landscape, Gas imbalance, Scheduling and Nomination

COURSE OUTCOMES

After completing this course the student should be able to:

1. Gain a broad perspective of the global oil business: Exploration, production, supply, transportation and refining
2. Boost your fundamental analysis of netbacks and refinery margin calculations, vessel chartering, pipelines & terminals
3. Learn the technical, commercial and environmental aspects of the oil and gas business
4. Appreciate the causes and impact of the recent price volatility in crude oil and natural gas markets
5. Recognize the cause and effect of unconventional oil and gas on the industry from a financial and environmental perspectives
6. Analyze the relevant engineering and business fundamentals and hands on exposure to oil field challenges and numerical problems.

SUGGESTED READINGS

1. Hydrocarbon Accounting Platforms The Ultimate Step-By-Step Guide; 5starcooks
2. Fundamentals of Oil & Gas Accounting 5th Revised edition Edition (English, Hardcover, Charlotte J. Wright And Rebecca A. Gallun)

PPE-551	PETROLEUM TESTING & INSTRUMENTATION CONTROL LAB	L T P C 0-0-2-1

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To know the characteristics feauture of RTD
- To understand about the Characteristics of different Thermistors.
- To understand the response of first order system in interacting and non-interacting mode
- To determine the different petroleum products testing parameters
- To determine the quality of petroleum products.

LIST OF EXPERIMENTS

1.	To observe the characteristics of RTD (Resistance Temprature detector)[PT - 100] over a range of temprature.
2.	To observe the Characteristics of Thermistor over a range of temperature.
3.	To observe the potential difference generated in the thermocouples.
4.	To calculate Step response of first order systems arranged in Interacting mode and non-interacting mode.
5.	To observe the linearity, accuracy and hysteresis of current to pressure and pressure to current converter.
6	Determine the Cloud & Pour Point of Petroleum Products.
7	Determine the Flash & Fire Point of a given crude oil by Pensky Martens Apparatus.
8	Find out the Smoke Point of given Petroleum product.
9	Determine the Aniline Point of given Substance.
10	Estimation of kinematic viscosity by Saybolt Viscometer.
11	Estimation of Net & Gross Calorific value of coal sample using Bomb Calorimeter.
12	Determine the Melting Point of Wax and Grease

COURSE OUTCOMES

After completing this course the student will be able to

1. Establish the relationship between Temperature-Resistance for RTD.
2. Predict the different testing parameters.
3. Establish the relationship between Temperature-Resistance for different types of thermistors.
4. Estimate the different viscosity by different viscometer.

SUGGESTED READINGS

1. Speight, J.C.; The Chemistry and Technology of Petroleum, Marcel Dekkar, New York, 1991.
2. Ram Prasad , Petroleum Refining Technology , Khanna Publishers , Delhi 2000
3. Rao, B.K.B; Modern Petroleum Refining Processes, 4/e, 2002, Oxford and IBH Company Pvt. Ltd.
4. G.D. Hobson, W. Pohl, Modern Petroleum Technology (Part I &II), John Wiley & Sons, N.Y., 1986.
5. Stephanopoulos G., “Chemical Process Control – An Introduction to Theory and Practice”, Prentice-Hall of India. 1990 .
6. Coughanowr D. R. and Le Blanc S., “Process System Analysis and Control”, 3rd Ed., McGraw Hill. 2008

SIPE 501	SUMMER INTERNSHIP PROJECT – SEMINAR I	L T P C 0-0-0-1

During this semester each student is expected to undertake a minimum of four weeks Project based / industrial / field training. The students are expected to submit a report, which shall be evaluated by an internal assessment committee during ongoing semester for 100 marks.

TPE-601	RESERVOIR MODELING AND SIMULATION	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To know about reservoir parameters and principles of production and recovery.
- To develop methods for improving petroleum reservoir models.
- To introduce Fractured Reservoir Simulation.
- To impart knowledge on Compositional Simulation

UNIT-I	Brief Review of Reservoir Parameters	4	Hrs

Physical and chemical properties of rocks, pores in rocks, pore fluid and saturations. Introduction to performance prediction techniques.

UNIT-II	Brief Principles of Production and Recovery	4	Hrs

Fundamentals of Material and volumetric balance, decline curve analyses, estimation of water flooded oil saturation.

UNIT-III	Basics of Reservoir Modelling and Simulation	12	Hrs

Need for numerical solutions; Taylor series; Error terms; Numerical approximations; Spatial and temporal derivatives for finite difference approximation; Discrete flow equations for single phase flow: general reservoir fluid flow equations; Reduction to the black oil model; Formulation of boundary conditions; discretization of source/sink terms; Definition of matrix coefficients; Truncation errors and stability; Solution of linear equations; Discussion of non-linear solution methods.

UNIT-IV	Introduction to Fractured Reservoir Simulation	10	Hrs

Equations for modelling fluid flow in naturally fractured reservoir using dual porosity and dual permeability systems; Fracture matrix interaction; Numerical significance of scale dependent and non Fickian behaviour; Oil water and Oil gas simulation;

UNIT-V	Introduction to Compositional Simulation	10	Hrs

Compositional fluid formulation vs. Black Oil fluid formulation; Thermal models; History matching; Planning and executing a reservoir simulation study; Reservoir simulation and management; Selection of a numerical method for simulation.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Explain the principles of production and recovery.
2. Apply the basics of physical and mathematical modelling for conventional and unconventional reservoirs.
3. Analyze flow equations for single and multiphase flow.
4. Interpret the basics of fractured reservoir simulation and oil-water and oil-gas simulation.

5. Identify the standard process used in oil industry for reservoir modelling for black oil model and compositional model.
6. Use software like RMS, ROXAR and PETREL to understand Reservoir Modelling and Simulation and Compositional Simulation.

SUGGESTED READINGS

1. Zhangxin Chen. (2008) Reservoir Simulation: Mathematical Techniques in Oil Recovery, Society for Industrial and Applied Mathematics.
2. Abou Kassem, J. H., Farouq Ali, S. M., and Islam, M. R. (2006) Petroleum Reservoir Simulation: A Basic Approach, Gulf Publishing Company.
3. Fanchi John R. (2005) Principles of Applied Reservoir Simulation, Gulf Professional Publishing.
4. Carlson, M. R., (2003) Practical Reservoir Simulation: Using, Assessing, and Developing Results, Pennwell Books.
5. Mattax, C.C. and Kyte, R.L. (1990) Reservoir Simulation, Monograph Series, SPE, Richardson, TX.
6. Ahmed, T. (2006). Reservoir Engineering Handbook. Gulf Professional Publishers,(3 rd edition)

TPE-602	DATA SCIENCE	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn about oil and gas data.
- To learn about technology.
- To learn about data models, data architect.
- To learn about basic programming in Machine Learning Models using Python.

UNIT-I	Introduction to Data Science	5	Hrs

An Overview of Analytics and Data Science, Analytics Methodology and Problem Solving Frameworks, Models and Algorithms

UNIT-II	SQL for Data Base	7	Hrs

Introduction to SELECT statements, Filtering data with the WHERE Clause, Sorting Data with the ORDER BY Clause, Querying Multiple Tables with Joins, Aggregate Functions, Grouping data with the GROUP BY Clause, Filtering Groups with the HAVING Clause

UNIT-III	Analytics, Statistics and Visualization	9	Hrs

Descriptive Analytics and Statistics, Data Visualization with Excel, Data Analytics Models, Introduction to Inferential Statistics and Probability Concepts, Hypothesis Testing Concepts and Framework, Advance Hypothesis Testing

UNIT-IV	Introduction to R	8	Hrs

Simple Data Processing with R, Data Visualization with R, Predictive analytics with R: Linear Regression, Logistics Regression, Time Series forecasting in R

UNIT-V	Introduction to Machine Learning and Python	11	Hrs

Introduction to ML, Introduction to Python, Data Manipulation, Visualization in Python, Machine Learning Models using Python: Tree Based Model, Clustering

COURSE OUTCOMES

After completing this course the student should be able to:

1. Classify oil and gas data life cycle.
2. Apply SQL for data filtering, creating and joining tables.
3. Apply technology for data analytics data visualization and model creation.
4. Compose and program R for predictive analytics, Linear & Logistics Regression and Time Series forecasting
5. Apply ML, Python and Data models for QC.
6. Create and synthesise programs for SQL, R, and Machine Learning.

SUGGESTED READINGS

1. Big Data, Management and Analytics by Nitin Upadhya
2. R for Data Science by Garrett Grolemund & Hadley Wickham
3. Python Data Science Handbook: Essential tools for working with data.

TPE-603	NATURAL GAS ENGINEERING	L T P C 3-1-0-4

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn about types, composition and properties of natural gas.
- To learn about gas hydrates, shale gas and coal bed methane.
- To learn about gas dehydration and sweetening process.
- To learn about natural gas processing and multiphase gas liquid flow.
- To learn about natural gas utilization and concept of gas refinery.

UNIT-I		8	Hrs

Introduction: Classification of natural gas, Estimation of gas reserves and non-associated gas reserves. Natural gas availability. Importance of natural gas as fuel and chemical feed stock

Properties: Phase behavior fundamentals, properties of natural gas, gas and liquid separation.

Processing: Crude oil and gas processing, natural gas, processing of natural gas for C_2 /C_3 separation, Liquefaction of Natural gas

UNIT-II		8	Hrs

Natural Gas Hydrates: Natural gas hydrates, hydrate thermodynamics and formation kinetics, hydrate exploitation.

Gas Hydrates: Determination of hydrate formation temperature/ pressure, condensation of water vapor, temperature drop due to gas expansion, thermodynamic inhibitors, kinetic inhibitors and anti agglomerates.

Shale Gas: Advances in Shale gas drilling and processing,

Coal bed Methane: Coal bed methane processing and underground gasification

UNIT-III		8	Hrs

Gas Dehydration: Gas-water system, water content determination, glycol dehydration, solid bed dehydration.

Acid Gas Treating: Gas sweetening processes, solid bed adsorption, chemical and physical solvent

processes, desulphurization, membrane separation.

UNIT-IV		10	Hrs

Gas Processing: Absorption, refrigeration, fractionation and design consideration, design procedures for absorption, adsorption and membrane separation.

Gas Engineering: Steady state flow of gas through pipes, multiphase gas liquid flow, gas compression, gas flow measurement, gas gathering and transport. Corrosion in natural gas transportation.

UNIT-V		6	Hrs

Natural Gas utilization: Natural gas in production of liquid fuel, natural gas as fertilizer and petrochemical feed stock, importance of Shale gas and gas hydrates as Chemical feed stock, Concept of gas refinery

COURSE OUTCOMES

After completing this course the student should be able to:

1) Classify phase behaviour and gas separation.
2) Explain about gas hydrates, shale gas and coal bed methane processing.
3) Understand gas dehydration and acid gas treating.
4) Describe about natural gas processing design procedures.
5) Analyze natural gas as fertilizer and petrochemical feed stock.
6) Summarize shale gas and gas hydrates as chemical feed stock.

SUGGESTED READINGS

1) William C. L., "Standard Handbook of Petroleum and Natural Gas Engineering", Vol. 2, 6th Ed., Gulf Publishing Company. 2001

2) Arnold K. and Steward M., "Surface Production Operations: Design of Gas Handling Systems and Functions", Butter Worth Heinemann. 1999

3) Molhatab S., Poe W. A. and Speight J. G., "Handbook of Natural Gas Processing and Transmission", Gulf Publishing Company. 2006

4) Kidney A. J. and Prvish W. R., "Fundamentals of Natural Gas Possessing", CRC. 2006.

5) Saeid Mokhatab, William A. Poe, James G. Speight, "Hand Book of Natural Gas Transmission and Processing" Elsevier, 2006.

6) Mohon Kelkar, "Natural Gas Production Engineering", PennWell, 2007.

7) John Carroll, " Natural Gas Hydrates, A guide for Engineers", Second Edition, Gulf Professional Publishing is an imprint of Elsevier 30 Corporate Drive, Suite 400, Burlington, MA 01803, USA, Linacre House, Jordan Hill, Oxford OX2 8DP, UK.

8) Boyun Guo and AIi Ghalambor, Natural Gas Engineering Handbook. Tips Technical Publication.

TPE – 604	PETROLEUM DRILLING ENGINEERING II	L T P C 3-1-0-4

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn rotary drilling technology and rig components.
- To learn types of drilling bits used and bit operations.
- To learn drill string fundamentals and its applications.
- To learn casings and cementing fundamentals and design parameters..
- To learn drilling hydraulics and its applications.

UNIT-I		6	Hrs

Basics of Drilling Technology: Well Life Cycle and drilling process overview, Drilling and Cable Tool Drilling.
Rotary Drilling: Principle, Drilling Rigs component and equipments, Special Marine Equipments, Drilling Cost Analysis, Exercises.

UNIT-II		8	Hrs

Drilling Bit: Types of drilling bits: Drag Bits, Roller Cone Bits and Diamond Bits. Bit Design: Roller Cone Bit Design, PDC Bit Design, bit selection: roller cone bit and Fixed Cutter Bits, Bit Evaluation, Bit Performance, Cost per Foot Calculations. Rock failure mechanism, Factors affecting Tooth Wear, Factors Affecting Bearing Wear, Terminating Bit Run, Factors affecting Penetration rate, Bit Operation, Exercises.

UNIT-III		8	Hrs

Drill String fundamentals: Drill string components, basic Functions, Yield, Tensile & Torsional Strength, Rotary Shouldered Connections Drill String Design: Buoyancy, Overpull, Collapse & Burst Pressures, Neutral Point calculations, Buckling.
Assembly (BHA): BHA Characteristics and its components, BHA selection criteria in vertical and deviated wells.

UNIT-IV		10	Hrs

Well casings: Types of casing and their functions, determination of casing setting depth, preparation of casing program.
Casing Design: Manufacture of Casing Standardization of Casing API Casing Performance Properties Casing Design Criteria Special Design Considerations
Cementing Operations: Fundamental of Primary Cementing Operations, Cement additives and additive calculations, various Cementing operations, evaluation of Cement jobs and cementing calculations for various casing strings, cement evaluation tools.

UNIT-V		8	Hrs

Drilling Hydraulics: Hydrostatic Pressure in Liquid Columns, Hydrostatic Pressure in Gas Columns, Hydrostatic Pressure in Complex Fluid Columns, Annular Pressures During Well Control Operations, Buoyancy, Nonstatic Well Conditions, Flow Through Jet Bits ,Rheological Models, Rotational Viscosometer, Laminar Flow in Pipes and Annuli, Turbulent Flow in Pipes and Annuli, exerciese.

COURSE OUTCOMES

After completing this course the student should be able to:

1) Illustrate principle and applications of rotary drilling rig.
2) Identify several drilling bit and their applicable techniques.
3) Recognise drill string and BHA assembly.
4) Explain different types of casings and casing design criteria.
5) Understand cement placement techniques and cement additives
6) Interpret drilling hydraulics and application of laminar and turbulent flows.

SUGGESTED READINGS

1. Rogers, W. F., Composition and Properties of Oil Well Drilling Fluids, Gulf Publication Co.
2. Rabia, H, Well Engineering and Construction, Entrac Consulting, 2002, ISBN: 0954108701
3. G Robert F. Mitchell and Stefan Z. Miska, Fundamentals of Drilling Engineering, SPE Textbook Series Vol. 12.
4. Carl Gatlin, Drilling and Well completion, Prentice-Hall, INC.

TPE-605	PETROLEUM PRODUCTION ENGINEERING II	L T P C 3-1-0-4

LEARNING OBJECTIVES

- To learn about the offshore oil and gas facility.
- To learn about the various equipment and methods of well completion.
- To learn about production system concepts.
- To learn about various artificial lift techniques.
- To learn about various tertiary recovery methods.

UNIT-I	OFFSHORE OIL AND GAS FACILITY	8	Hrs

Geotechnical aspect, Loads on offshore structures, Offshore production structure types for shallow and deep water, Station keeping system, Subsea production system, Wet , Dry Tree, Collection manifolds, Feeder lines, Production riser, Process platform, Process systems – Oil, Gas, Water, Process equipment, Oil storage, transportation, Gas transportation, Water disposal, Safety systems

UNIT-II	WELL COMPLETION	8	Hrs

Definition, Types, Completion equipment, design, process, Perforating oil &gas wells- Definition, shaped charge perforation operation, perforating guns, geometry of perforation, gun conveying methods, Well activation- compressed air & liquid nitrogen. Special completions, smart wells, intelligent completions.

UNIT-III	PRODUCTION SYSTEM CONCEPTS	6	Hrs

Fundamentals of Reservoir Deliverability, Wellbore Performance, Choke Performance, Well Deliverability, Forecast of Well Production, Production Decline Analysis, Production optimisation

UNIT-IV	ARTIFICIAL LIFTS	10	Hrs

Reservoir pressure and well productivity, Types of artificial lifts – Sucker rod pump, Electrical submersible pump, Progressive cavity pump, Hydraulic pump, Gas lift, Plunger lift, Selection methods, Design, Equipment, Operation, Performance, Application

UNIT-V	OIL PRODUCTION ENHANCEMENT	8	Hrs

Primary recovery – Definition, Types of reservoir energy, Producing mechanisms, Secondary recovery- Definition, Water injection, Gas injection, Process, Mechanism, Equipment, Methods, Tertiary recovery- Definition, Recovery factor of EOR, Selection, Thermal EOR, Chemical EOR, Microbial EOR- Process, Mechanism, Equipment, Methods, IOR

COURSE OUTCOMES

After completing this course the student will be able to

1. Assess the working in offshore production platforms and subsea system.
2. Construe the working of well completion process and equipment.
3. Inspect the completion equipment for production system.
4. Apply the appropriate artificial lift method.
5. Identify and apply appropriate EOR method.
6. Develop knowledge based skills and confidence to work in oil field.

SUGGESTED READINGS

Principles of oil well production by T. R. W. Nind

Petroleum Production Engineering by BoyunGuo, W. C. Lyons and Ali Ghalambor

The technology of artificial lift methods by Kermit E. Brown

PPE-661	RESERVOIR MODELING AND SIMULATION LAB	L T P C 0-0-2-1

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn the Concept of Reservoir Model.
- To learn data loading for reservoir modeling on workstation
- To learn QC of various datafor modeling.
- To learn various step of modeling process
- To learn application of reservoir model

List of Experiments

1. Introduction of computer system and software
2. Introduction to reservoir model.
3. Workflow for building a Reservoir Model
4. Project creation &Data loading
5. Data quality checking & Data correction in the project created in the system.
6. Fault Data Import
7. Fault modeling process
8. Surface data Import
9. Structure Modeling process
10. Zonation & Layering scheme
11. Facies modeling
12. Property modeling
13. Making contacts
14. Reserve Eatimation.
15. Visit to Industrial Reservoir modeling lab.(if possible)

COURSE OUTCOMES

After completing this course the student should be able to:

- Understanding of computer system required for modeling.
- Understanding of the various data required for modeling
- Data loading process for modeling
- Techniques for Data Visualization and QC.
- Various steps for reservoir model building
- Reserve estimation.

SUGGESTED READINGS

1. RMS training manual
2. Deutsch, C.V. 2003. Geostatistical Reservoir Modelling, 1-376. New York : Oxford University Press
3. Kelkar, M and Perez, G. 2002. Applied Geostatistics for Reservoir Characterization. 1-264. Society of Petroleum Engineers.

TPE-611	ALTERNATE ENERGY RESOURCES	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To have overall knowledge on World and Indian energy scenario in coal, oil, gas, nuclear and electricity.
- To learn detail about solar energy, hydro power and wind energy.
- To learn about biomass characteristics and energy from biomass like biodiesel and bioethanol.

UNIT-I		4	Hrs

Energy Scenario: World and Indian energy scenario, Indian statistics of **coal, oil, gas, nuclear & electricity**, energy consuming sectors, environmental consequences, need of renewable energy: advantages, types of renewable energy, and their potential in India.

UNIT-II		12	Hrs

Solar Energy: Solar spectrum, types of radiations and measurement, Solar Thermal systems: Types of flat

plates collectors, solar hot water, solar pond, pond, solar stills, solar dryers, solar passive buildings, solar chimneys.

Solar photovoltaic system: Semi-conductors, p-n-junction, solar cell, its operating principle and characteristics, SPV power plants, sizing of SPV system including storage batteries, applications of SPV systems.

UNIT-III		6	Hrs

Hydro power – Principle, Large Hydropower Dams & Reservoirs; Small Hydropower schemes (SHP), classification of SHP, types of SHP schemes, Assessment of power potential, flow –duration curves, components of a typical SHP plant, types of hydraulic turbines; impulse and reaction turbines, types of generators, switchyards.

UNIT-IV		6	Hrs

Winds Energy: Analysis of wind data, assessment of energy potential, types of wind machines, components of a WECS; wind farms, generators.

UNIT-V		12	Hrs

Biomass and other sources: Biomass and biofuel, biomass resources, agro-forestry and short rotation intensive culture based biomass production, biomass characteristics densification, pyrolysis, anaerobic digestion, biomass gasification, biodiesel, bioethanol, diesel engines etc and other sources Hydrogen, fuel cells, tidal, geothermal and wave energy.

COURSE OUTCOMES

After completing this course the student will be able to

1. Expand overall knowledge on World and Indian energy scenario.
2. Recognize the energy demand and supply statics of India and world.
3. Identify the characteristics of ideal energy resource, distinction between conventional, unconventional and renewable energy resources.
4. Illustrate the principle, generation, advantage, disadvantage, potential and environmental impact of various renewable energy resources like solar energy, wind energy, geothermal

energy, ocean energy, hydropower energy etc.

5. Explain the importance of biomass and how this old form of energy can become a better option for mankind.
6. Accustom with latest trends, global market scenario and research related to renewable energy sector.

SUGGESTED READINGS

1) Rai, G.D., "Non- conventional energy sources", Khanna Publishers, Delhi.
2) Rao, S. and Parulekar, B.B., "Energy Technology", Khanna Publishers, Delhi.
3) Boyle. God frey, "Renewable Energy: Power for a sustainable future"(2nd edition) Oxford University. Press, Oxford.
4) Maithani P.C., "Renewable energy in the global context", Concept Publishing Co., New Delhi
5) Upender, Pandel and Poona, M.P.L. (Editors)" Energy Technologies for sustainable development" Prime Publishing House, Delhi.
6) .S.P. Sukhatme, "Solar Energy Principles of Thermal Collection and Storage (2nd Edition), Tata Mc Graw Hill.

TPE - 612	DISASTER MANAGEMENT	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To Know about the natural and manmade disaster in oil and gas industry
- To learn about national disaster management act -2005.
- To learn about the role and responsibilities of various agencies
- To acquaint the students about managing the disaster in oil and gas industry.

UNIT-I		8	Hrs

Introduction, types of Disasters, Natural Causes, Floods, Hurricanes, Tornadoes, Tsunami, Earthquake, Lightning, national disaster management committee, state disaster management committee, other agencies involved to overcome disaster,
Disasters due to Man-made Causes, Civil disturbances, terrorist Attack, Hostage Crisis, Bomb threats

UNIT-II		7	Hrs

States/Districts Contingency Plans / Relief codesNeed, purpose and scope of disaster management plan, Risk analysis, types of risk analysis, national disaster management act -2005, objectives, role and responsibilities of various agencies, Mechanism for coordination for the Disaster Response , National Crisis Management Committee (NCMC) , Crisis Management Group (CMG) , States Crisis Management Group

UNIT-III		7	Hrs

Disasters in E&P sector due to Man - made Causes(non Operational), Civil disturbances, bomb threats etc, Terrorist strike, Hostage Crisis, Bomb Threats, Strikes, SABOTAGE, Interface with other plans,

UNIT-IV		9	Hrs

Disasters in e &p sector due to Man - made Causes(Operational)
Fires, Oil/gas well blowouts, TOXIC GAS RELEASES, Oil / Chemical spills,, HYDROCARBON RELEASE, Accidents involving radioactive substances, PIPE LINE CATASTROPHE LEAKAGE
Additional Emergencies specific to offshore installations: Potential Offshore Vessel Collision, Helicopter crash on Helideck in Offshore, Helicopter crash-Ditch in sea, Helicopter Emergency landing, Office/Offshore accommodation fire, , Dropped object incidents
Diving Incidents, Man Overboard incidents, Offshore Complex Abandonment,

UNIT-V		9	Hrs

Interface with other plans, Level of Disaster (type i, ii, iii a and iii b), managing disaster, emergency preparedness, crisis management team, its capabilities, emergency scenarios, mock drills, emergency requirements, legal issues, Installation Level / Process Plant unit level / platform level / Rigs

COURSE OUTCOMES

After completing this course the student will be able to

1. Understand disaster, its types, causes
2. Know need, scope of DMP, agency involved, risk analysis
3. DMP in E&P sector (Operational and non operational
4. Level of disaster, its types
5. Managing disaster, interface with other agencies
6. Crisis management team, emergency scenarios, role of agency at various level

SUGGESTED READINGS

- **NATIONAL DISASTER ACT 2005**
- **NATIONAL DISASTER MANAGEMENT PLAN OF ONGC**

TPE-613	OIL AND GAS ASSET MANAGEMENT	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course is to

- Learn scope of asset management and integration
- Know HSE issues and creating project investment analysis
- Understand decision in exploration and appraisal of well
- Understand decisions in field development
- Learn asset optimization

UNIT-I		8	Hrs

Objectives of E&P Asset Management

Systems and Processes in Asset Management

UNIT-II		8	Hrs

E&P Risk Analysis, Technology Management in E&P, Role of IT in E&P, Data Base Management

Software Maintenance

UNIT-III		8	Hrs

Accounting Standards and Policies, Changes to Reserves Estimates, Accounts for De- Commissioning Cost, Calculation of Depreciation, Depletion and Amortization, Joint Ventures and Production Sharing Accounting, Drilling Well and Operation Cost Estimates

UNIT-IV		8	Hrs

Estimation of Production Operation Cost and Control, Material Inventory Control and Accounting

UNIT-V		8	Hrs

Legal and Contractual Issues in Asset Management, Crude Oil and Gas Pricing

COURSE OUTCOMES (CO)

At the end of the course the student should be able to:

1. Understand upstream asset management
2. Create project investment analysis
3. Be proactive in identification of risk sources
4. Improved skills in decision making in upstream operations
5. Enhance their knowledge to minimize risks
6. Develop their ability to optimize upstream assets

SUGGESTED READINGS

1. Integrated Reservoir Asset Management: Principles and Best Practices 1st Edition by John Fanch Gulf Publication

TPE-711	DIRECTIONAL, HORIZONTAL, AND MULTILATERAL DRILLING	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To learn about application of directional drilling and well planning
- To learn about various equipment, tools and techniques
- To learn about directional control approaches
- To learn about navigation drilling system
- To learn about multilateral and horizontal drilling

UNIT-I	DIRECTIONAL DRILLING	8	Hrs

Definition, Directional well, Horizontal well, Applications of directional drilling Well Planning –Reference systems, Coordinates, Planning for well trajectory, Types of directional patterns, Nudging, Proximity analysis, Toolface orientation

UNIT-II	DOWNHOLE MOTORS	8	Hrs

Positive displacement motors, Turbines Deflection Tools and Techniques – Whipstocks, Jetting, Downhole motor and bent sub

UNIT-III	DIRECTIONAL CONTROL WITH ROTARY ASSEMBLIES	8	Hrs

Side force and tilt angle, Directional control principles, Bit type effect on rotary assemblies, Stiffness of drill collors

UNIT-IV	NAVIGATION DRILLING SYSTEMS	8	Hrs

Steerable turbines, DTU Navigation drilling system, Adjustable kick-off motor, Kicking off, MWD, Directional drilling fluids, Bore hole stability

UNIT-V	MULTILATERAL DRILLING	8	Hrs

Definition, Forms of multilateral wells, Classification of multilateral wells, Factors for multilateral drilling, Horizontal drilling

COURSE OUTCOMES (CO)

At the end of the course the student should be able to:

1. At the end of the course the student should be able to:
2. Plan directional well trajectory for different type of well profile.
3. Select the deflection equipments and tools.
4. Design and execute directional survey.
5. Plan the working of multilateral drilling.
6. Recognize, plan and execute horizontal drilling.

SUGGESTED READINGS

1. Fundamentals of drilling Engineering by Robert F. Mitchell, Stefan Z. Miska
2. Well construction and Engineering by H. Rabia
3. Applied drilling engineering by A.T.Bourgoyne Jr. et al.

TPE-712	RESERVOIR MANAGEMENT	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To understand the fundamentals of reservoir management
- To understand the reservoir management processes and developing the plans in managing the reservoir
- To classify the data, acquisition, analysis and application, validation, storing etc.
- To apply the Reservoir model and know about Role of reservoir model in reservoir management, integration of G & G and reservoir model
- To apply Reservoir management plans: strategy for newly developed field and Secondary and EOR operated field

UNIT-I	Introduction	9	Hrs

Scope and Objectives, Reservoir **management concepts:** Definition and history, fundamentals of reservoir management, synergy and team; integration of geosciences and engineering, integration of exploration and development technology

UNIT-II	Reservoir management process:	9	Hrs

Setting goals, developing plans and economics, surveillance and monitoring, evaluation
Data acquisition, analysis and management: Classification of data, acquisition, analysis and application, validation, storing and retrieve

UNIT-III	Reservoir model	7	Hrs

Role of reservoir model in reservoir management, integration of G & G and reservoir model, Matured field reservoir Management

UNIT-IV	Reservoir performance analysis and prediction	9	Hrs

Naturally producing mechanism, reserves and role of various forecasting tools- volumetric method, MBE, Decline curve and mathematical simulation

UNIT-V	Reservoir Management economics	8	Hrs

Evaluation, risk and uncertainties Reservoir management plans: strategy for newly developed field and Secondary and EOR operated field

COURSE OUTCOMES

After completing this course the student will be able to

1. Know about the fundamentals of reservoir management
2. Explain the reservoir management processes and developing the plans in managing the reservoir
3. Illustrate and classify the data, acquisition, analysis and application, validation, storing etc.
4. Identify and categorize Reservoir model and know about Role of reservoir model in reservoir management
5. Asses and inspect the integration of G & G and reservoir model
6. Compose the Reservoir management plans: strategy for newly developed field and Secondary and EOR operated field

SUGGESTED READINGS

1. Advanced reservoir management and Engineering by Ahmed Tarek , Meehan, D. Nathan
2. Craft, B.C. and Hawkins, M, Revised by Terry, R.E.1990, Applied Petroleum Reservoir Engineering, Second edition; Prentice Hall.
3. Charles, R.S; G.W. Tracy and R.L. Farrar 1999, Applied Reservoir Engineering;Oil &Gas Consultants International.
4. Dake, L.P.1978; Fundamentals of Reservoir Engineering; Elsevier.
5. Frank, T.C.1962; Petroleum Production Handbook, Vol II, Society of Petroleum Engineers.
6. Slider, H.C. 1976, Practical Petroleum Reservior Engineering Methods, Petroleum Publishing Company.

TPE-713	HYDROCARBON PROCESS ENGINEERING	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To gain insight into Major challenges and future strategies in petroleum industry.
- To gain knowledge on Distillation, extraction, adsorption, absorption and membrane processes.
- To learn the process like Fluid Catalytic Cracking, Hydrocracking, Naphtha and Gas cracking
- To introduce students with Future Fuels such as Biofuel and bio-augmentation of fuel stock.
- To impart knowledge on hydrogen production and management in refinery.

UNIT-I		6	Hrs

Introduction: Major challenges and future strategies in petroleum refining industry, petroleum and petrochemical integration for value addition, future fuel quality and refinery economics, Natural gas refinery and biorefinery.

UNIT-II		12	Hrs

Separation Processes in Petroleum and Gas Processing: Distillation, extraction, adsorption, absorption and membrane processes.

Advanced Distillation: Advances in crude oil distillation and processing of gases, major equipment, design criteria, tower packing, operation control and troubleshooting. Design aspects of crude oil distillation

Oil & gas stabilization and separation: Oil & gas stabilization**,** Oil gas and water separation theory and separation equipment and design criteria, Low temperature exchange (LTX system), Lease Automatic Custody Transfer (**LACT**) unit.

UNIT-III		8	Hrs

Advances in Catalyst: Advances in catalyst in petroleum and Petrochemical industry. Spent catalyst management

Fluid Catalytic Cracking: Development in technology, equipment, FCC catalyst and additives, reaction kinetics, FCC reactor and regenerator design criteria, recent developments in FCC hardware.

Hydrocracking: Technology and design aspects, recent trends in hydro cracking technology, hydrocracker catalyst development

UNIT-IV		10	Hrs

Catalytic Reforming: Catalytic reforming process, reaction kinetics, reforming reactor design, catalyst preparation characterization, development and optimization, catalyst deactivation and regeneration, recent trends-global and Indian scenario.

Alkylation and Isomerization: Recent trends in Alkylation and Isomerization and their importance

Lube Base Stock: Advances in lube base stock refining.

Naphtha and Gas cracking: Naphtha cracker design criteria, Technological Development in Steam Cracking process. Energy conservation measures, Catalytic cracking for olefin production.

UNIT-V		4	Hrs

Future Fuels: National fuel policy, fuel options, Biofuel and bio-augmentation of fuel stock, hydrogen production and management in refinery. Energy management in Petroleum refinery

COURSE OUTCOMES

After completing this course the student will be able to

1. Identify major challenges of refining and petrochemical industry.
2. Explain the different separation processes used in petroleum and gas processing.

3. Make use of the advances in catalyst in various secondary conversion processes.
4. Illustrate about the olefins, methane and aromatics production methods.
5. Interpret the different polymers, elastomers and synthetic fibres manufacturing.
6. Aware of the future fuels policy and energy management in petroleum industry.

SUGGESTED READINGS

1) Dawe R. A., "Modern Petroleum Technology Part I", by Institute of Petroleum (IP), John Wiley. 2002
2) Lueas A. G., "Modern Petroleum Technology Part II", by Institute of Petroleum (IP), John Wiley. 2002
3) George J. A., Abdullha M. A. and Parera J., "Catalytic Naphtha Reforming: Science and Technology", Marcel Dekker. 1994
4) Sadeghbeigi R., "Fluid Catalytic Cracking Handbook", 2nd Ed., Gulf Professional. 2000
5) Seader, J. D. and Henley, E. J "Separation Process Principles", 2nd Ed., Wiley. 2006

TPE-714	FLOW THROUGH POROUS MEDIA	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To know the general overview of porous media flow
- To understand about the introduction to various theoretical tools.
- To characterize and predict the flow is provided in this course.
- To understand the conceptual models of relative permeability and saturation
- To understand the diffusion concept in porous media
- To know the Introduction to flow through deformable porous media.

UNIT-I		9	Hrs

Introduction, Permeability, Porosity, Various forms of characterizations Darcy's Law, Mass Continuity in Cartesian and Cylindrical Coordinates, Pressure Equations

UNIT-II		9	Hrs

Reynold's Number for Porous media, Kozeny Carman, and Ergun Equation Transport mechanisms: Bulk and Surface Diffusion, Knudsen Transport, Klinkenberg effect, slip flow

UNIT-III		9	Hrs

Immiscible displacement, two phase mass continuity, capillary pressure Conceptual models of relative permeability and saturation

UNIT-IV		9	Hrs

Progression of saturation front in two phase flow, Buckley Leverett theory Miscible displacement, Diffusion in porous media, Tracer Test

UNIT-V		10	Hrs

Introduction to Taylor Aris Dispersion, Dispersion Regimes Migration and interception of fine particles Introduction to flow through deformable porous media

COURSE OUTCOMES

After completing this course the student will be able to

1. Know the concept of porous media flow
2. Explain the different equations and problem solving skill based on these equations
3. Examine the conceptual models of relative permeability and saturation
4. Evaluate the concept of two phase flow
5. Asses the idea about the dispersion Regimes Migration and interception of fine particles
6. Apply in research activities related to porous media flow.

SUGGESTED READINGS

1. Muskat M and Wycoff R D, The flow of homogeneous fluids through porous media.
2. Khillar, K and Fogler, S (1998) Migration of fines in porous media. Kluwer Academic Publication
3. Panfilov, M (2000) Macroscale models of flow through highly heterogeneous porous media Kluwer Academic Publication.
4. Bird, R. B.; Stewart, W. E. & Lightfoot, E. W. (2002) Transport phenomenon, John Willey and Sons.

TPE-715	OFFSHORE DRILLING OPERATIONS	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course is to

- Learn about the key aspects of drilling operations, drill rig types offshore drilling.
- Learn about the mechanics and design of drill bits, function and key issues associated with drill bit selection.

UNIT-I		8	Hrs

Introduction to offshore oil and gas operations, deviations from onshore drilling. Sea states and weather: meteorology, oceanography, ice, sea bed soil. Buoyancy and stability.

UNIT-II		10	Hrs

Offshore Fixed Platforms: Types, description and operations. Offshore Mobile Units: Types, description and installation. Station keeping methods like conventional mooring & Dynamic Positioning: Types and Basic operations of a DP system, Major components of the DP system , D Prig vs moored rig , Types of thrusters used by DP vessels, Basic layout of a power distribution system onboard a DP vessel and associated protection systems, Power management system. Watch Circles -Drive-off; Drift-Off. Offshore Drilling: Difference in drilling from land, from fixed platform, jackup, ships and semi submersibles

UNIT-III		8	Hrs

Deepwater Drilling: Introduction-History & Geology, Floating Drilling Rigs and chronological Advancements, Basic Floating Rig equipment, Rig Automation. Dynamic Positioning: Types and Basic operations of a DP system, Major components of the DP system, D Prig vs moored rig, Types of thrusters used by DP vessels, Basic layout of a power distribution system onboard a DP vessel and associated protection systems, Power management system. Watch Circles -Drive-off ; Drift-Off.

UNIT-IV		8	Hrs

Open Water Operations: Remotely operated vehicles: Wellhead components for open water operations, Guidance systems; Guideline system; Guideline less system; Mudmat, connector selection, Jetting structural casing versus cementing in a drilled hole, Operational Procedures, Special considerations , high currents, shallow water , flows, drill with mud –"pump and dump" concept, Special cementing operations. Riser Systems: Riser system Components, Buoyancy, Riser Tensioners & Tensioning Criteria, Basic Riser Analysis, Riser Operations, Emergency Disconnect, High Current Operations.6.Subsea Wellheads: Overview of Wellhead Components, Tool Description, Wellhead sizing.BOP System: Wellhead & LMRP Connectors, RAM preventers, Annular Preventers, Choke & Kill line valves, LMRP, Landing & latching the BOP, Control System, Back-up system, BOP Stack Testing, Diverter System.

UNIT-V		8	Hrs

Deepwater Casing & Cementation: Review of conductor and surface casing design, Casing design process flow, Casing seat Selection, Kick Tolerance, Burst, Collapse, Tensile and bucking criteria & Calculations, Software assisted Casing Design, Casing running, Casing connections, Cementing Procedures , Casing and liner cementing; squeeze cementing, Cementation Hardware. Well Abandonment; Abandonment Guidelines & Regulations: Plug placement; balance plug calculations; inflow test, Barrier placement. Review and case studies.

COURSE OUTCOMES (CO)

At the end of the course the student should be able to:

1. Recognize offshore drilling operations and weather monitoring.
2. Comprehend offshore platform types and different Station keeping methods.
3. Identify offshore drilling equipments and their functions.
4. Design offshore drilling equipments
5. Analyze and construct deepwater casing.
6. Analyze and compose deepwater cement.

SUGGESTED READINGS

1. Offshore DrillingBook by Margaret Haerens, Greenhaven Press, 2010
2. Subsea Engineering Handbook, Second Edition by Yong Bai (Author), Qiang Bai (Author) : Gulf Publication
3. Offshore Operation Facilities: Equipment and Procedures by Huacan Fang, Menglan Duan (2014): Gulf Publication

TPE-716	PETROLEUM DATA MANAGEMENT	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To enable students to develop knowledge and understanding of subsurface exploration and production data and evaluate its importance to the upstream oil and gas business.
- Apply the processes, systems and procedures for receiving, cataloguing, loading and storing data, including quality control, while accommodating a degree of unpredictability
- Evaluate data management from an end user perspective
- Identify and analyse the systems and standards for ensuring data quality prior to its use for interpretation and workflows and explain the consequences if these are not in place.
- Understanding of the application and value of data quality and governance standards, policies and strategies.

UNIT-I	INTRODUCTION OF EXPLORATION AND PRODUCTION DATA	6	Hrs

Exploration and Production terminology; Introduction to petroleum geology; Subsurface data types and data life cycle; Information management; Wells and well information;

UNIT-II	EXPLORATION AND PRODUCTION DATA LIFECYCLE	6	Hrs

Acquisition of well data; Acquisition and processing of seismic data; Acquisition of drilling and production related data and information and its uses; Interpretation and use of well and seismic data; Organisational context for data management; Business value of subsurface data management

UNIT-III	EXPLORATION AND PRODUCTION DATA MANAGEMENT	8	Hrs

Data receipt; Cataloguing and indexing; Loading and storing data; Distribution of subsurface data; User-generated content and data use; Data maintenance; Promoting and facilitating access to data; Effective search and retrieval; Data archiving; Data retention and disposition.

UNIT-IV	EXPLORATION AND PRODUCTION SERVICE MANAGEMENT	6	Hrs

User engagement; Service management; Project support; Master data management; project data management; Data flow, transfer and exchange.

UNIT-V	DATA QUALITY AND GOVERNANCE	8	Hrs

Data quality management standards; Business rules for data quality; Data quality management methods and tools; Geodetics and data quality; Managing confidentiality and data rights; Data integrity and access control; Data governance policies and strategies, Standards and data governance, Data governance roles; Data procedures in data governance.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Describe the upstream oil and gas industry, the activities that use and generate subsurface data and the associated costs and value of the data.
2. Differentiate between data, information and knowledge and judge whether the difference is significant in different scenarios.
3. Evaluate and articulate the scope and value of information management in the upstream oil and gas industry in the context of information need.
4. Understand and convey the lifecycle of subsurface exploration and production data and related information management issues.
5. Evaluate the organisational context for data management and relationships with other disciplines including Geomatics, GIS and Information Technology.
6. Critically analyse the challenges of implementing a data governance framework within the business and effective measures to maintain the success of the framework.

SUGGESTED READINGS

1. PPDM: https://ppdm.org/ppdm
2. Manual CGG
3. Manual Emerson: Roxar, Tempest

TPE-717	ADVANCED EOR TECHNIQUE	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To understand the basic concepts of Enhanced Oil Recovery for incremental oil gain.
- To enable students to understand different recovery Processes, use of simulator to perform numerical.
- To expertise in Enhanced Oil Recovery Process to maximize recovery after primary and secondary recovery from mature fields
- To expose students to a wide variety of research areas and concerns in and around Enhanced Oil Recovery and new technology
- To expose students with necessary engineering skills such as solving engineering and analytical problems using upstream technology products

UNIT-I	INTRODUCTION	**5**	**Hrs**
Enhanced Oil Recovery from Reservoir, Implication, Pressure Maintenance as EOR method, Drive Index Modification. Reserve estimation and Decline Curve Analysis.			
UNIT-II	IMMISCIBLE DISPLACEMENT PROCESS	**6**	**Hrs**
Fractional Flow and Frontal Advance Rate Equation, Water Flooding- Mechanics and Performance, Displacement Front Monitoring, Polymer Loss In Reservoir.			
UNIT-III	MISCIBLE DISPLACEMENT PROCESS	**6**	**Hrs**
High Pressure Gas and Enriched Gas Displacement Process, LPG Flooding, Alcohol Flooding, CO2 Flooding, Surfactant Flooding.			
UNIT-IV	THERMAL RECOVERY PROCESS	**6**	**Hrs**
Steam Stimulation and Flooding, in situ Combustion Process, Reservoir Selection and Process Design.			
UNIT-V	MICROBIAL RECOVERY TECHNIQUE	**8**	**Hrs**
Introduction of Microbial Recovery Technique, Principles and Application and Potential, Indian Patents in MEOR.			

COURSE OUTCOMES

After completing this course the student should be able to:

1. Acquire the Basic knowledge of Drive Indices for selecting proper Enhanced oil recovery in petroleum reservoirs.
2. Estimate the quantity of oil or gas present in the reservoir by different methods i.e. reserve estimation and Decline Curve.
3. Apply the uses of geological, well productivity, well spacing and hydro dynamical parameters for developments of oil & gas fields.
4. Understand the phenomenon of various multiphase flows and transport models in Reservoir Simulation.
5. Apply investment decisions in those fields where production enhancement are needed.
6. Acquire the Basics knowledge of Reservoir Modeling Softwares.

SUGGESTED READINGS

1. Ertekin, T, Abou-Kassem, J.H. and G.R. King, Basic Applied Reservoir Simulation, SPE Text Book Vol. 10, 2001.
2. Lake, Larry W., Enhanced Oil Recovery, Amazone, 1st Edition, June'1996.
3. Enhanced Oil Recovery Field Case Studies, J Sheng, 1st Edition, 24th May 2013, Gulf Professional Publishing.

TPE-718	RESERVOIR, PRODUCTION SURVEILLANCE AND CONTROL	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

➢ To understand reservoir surveillance methods and decision support systems.

➢ To learn about production systems monitoring and production measurements.

➢ To learn about production data management and data QC.

UNIT-I	Introduction and Planning	6	Hrs

Reservoir Surveillance: Global Perspective, Surveillance and Decision Making; Objectives of Surveillance

Asset-Management Planning: Uncertainty Management; Reservoir Surveillance Plans; Developing Surveillance Plans

UNIT-II	**Well and Production Systems and** Subsurface Measurement Principles	8	Hrs

Production Systems: Surface Facility; Surface Production Monitoring; **Well Systems:** Well Drilling; Well Construction; Well Completions

Measurement Characteristics: Measurement Types; Measurement Quality; Instrument Reliability; Measurement Frequency; Hardware Characteristics; Measurement Principles; Fiber - Optic Measurement Principles ;Calibration Principles.

UNIT-III	Measurement Equipment and Procedures	6	Hrs

Data Collection Considerations; Tool Conveyance and Positioning; Telemetry Conveyance; Measurement Equipment; Choice of Equipment; Running Procedures and Best

UNIT-IV	Data Assessment and Quality Control	10	Hrs

Data Analysis Model; Data-Handling Steps; Impact of Data Frequency on Analysis; Data-Quality Assessment Framework; Data Preparation; Data Errors; Treatment of Inconsistent Data; Denoising Data Filtering; Data Smoothing; Data Correction; Production-Logging Tool Survey Good Practices

UNIT-V	Unconventional Reservoirs and Case study	7	Hrs

Resource Characteristics; Appraisal Program; Production Mechanisms; Laboratory Core Measurements; Measurements to Determine Quality of completions

Case studies
Planning; Integration; Space-Time Surveillance; Steam flood Surveillance; Workflow Automation and Collaborative Environment

COURSE OUTCOMES

After completing this course the student should be able to:

1. Identify reservoir surveillance methods and decision support systems.
2. Analyze Uncertainty Management, Reservoir Surveillance and preparing Surveillance Plans.
3. Explain production systems monitoring and production measurements.
4. Identify Measurement Equipment and Procedures fordata collection.
5. Analyze data and perform QC.
6. Evaluate case studies and identify best practices in Unconventional Reservoirs.

SUGGESTED READINGS

1. Reservoir Surveillance Paperback by Jitendra Kikani (Author); Society of Petroleum Engineers

TPE-719	CITY GAS DISTRIBUTION	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To understand the process and life cycle of City Gas Distribution
- Enable students to identify different pressure levels in city gas distribution
- To impart knowledge of metering systems in city gas distribution
- To give students knowledge about Gas transmission & Distribution of Pipelines.
- Enable students to acquire safety and environmental aspects in city gas distribution.

UNIT-I	INTRODUCTION TO CITY GAS DISTRIBUTION	8	Hrs

Introduction of GCD, Evolution of GCD in India, Indian Gas Reserves, GCD Indian scenario, LNG in India, PNG In India, Flow Equations- General Flow Equation, Panhandle- A equation, Panhandle B equation, Weymouth equation

UNIT-II	CITY GAS STATION	8	Hrs

Design of city gas station for distribution to various segments (Domestic and commercial), City gas station, district Regulating/distributing station, Pressure controlling stations, Advantages of PNG and CNG over LPG, CNG Stations, Gas metering and conditioning.

UNIT-III	Gas METERING IN GCD	6	Hrs

Gas metering in feeder line, at consumer end, Control system , Pressure regulation, Meters for GCD, Errors in gas metering.

UNIT-IV	GAS TRANMISSION AND DISTRIBUTION PIPELINES	8	Hrs

Classification based on the functions, Classification based on the Access, Classification Based on Jurisdiction, classification on pressure of gas to be transported, Steel pipelines, Polyethylene pipelines, Valves in GCD, Pressure regulators.

UNIT-V	CHALLENGES AND ENVIRONMENTAL IMPACT OF CGD	10	Hrs

Gas Allocation and Gas Availability Issue, Logistic and Infrastructure Issues, Financial Challenges, Health and Safety: Gas Leakage, Detection of leakage, Safety Standards, Safety guidelines, Impact on environment.

COURSE OUTCOMES

After completing this course the student will be able to

1) Identify applications of Natural Gas in different sectors like Industrial, Commercial, Residential
2) Design of City Gas Distribution Network i.e. Primary Network, Secondary Network and Distribution Network
3) Analyze types of metering system used in city gas distribution
4) Understand Gas transmission & distribution of pipelines
5) Examine Pipeline Network Analysis.
6) Examine environmental issues related to safety in City Gas Distribution

SUGGESTED READINGS

1. George A. Antaki, “Piping & Pipeline Engineering” kindle edition, May 2003.
2. City gas distribution: An Indian perspective by Rao, Bhaskar B. K.

TPE-720	OIL AND GAS FIELD DEVELOPMENT PLANNING AND ECONOMICS	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To provide a comprehensive overview of the steps required to achieve an optimal field development plan
- To gain an appreciation of the key project drivers
- To understand the data needed to develop or redevelop an oil or gas field, and the additional information that could be collected to improve value and reduce risk

UNIT-I	INTRODUCTION	6	Hrs

Life cycle of an oil and gas field, Hydrocarbon accumulations and their discovery, Reserves and resources, Types of reserves – Proved, proved subeconomic and inf erred reserves. Key drivers, Evaluating and mitigating risk & uncertainty, Organisational structures, Assurance and the use of analogues

UNIT-II	COLLECTING AND EVALUATING DATA FOR A DISCOVERED OIL/GAS FIELD	10	Hrs

Basic geological data for development planning. Data collection from initial wells. Determining the key rock properties – porosity, water saturation & contacts, Estimating hydrocarbons in place, Determining permeability, Methods of estimating recoverable volumes including analogues, decline curves material balance and reservoir simulation. Discovery well – Delineation of the field limits – Volumetric estimation of in place reserves

UNIT-III	FIELD DEVELOPMENT PLANNING	6	Hrs

Planning development wells based on the reservoir parameters and economic criteria – Well spacing - Final development plan – Rate of production – Oil recovery factor – Water injection – Pressure maintenance – Abandoning the field – Abandonment pressure.

UNIT-IV	BOTTOM HOLE STUDIES	8	Hrs

Collection of reservoir samples, performance of routine reservoir tests like productivity index, build-up test, draw down test, interference test, back pressure test, and isochronal test. Calculation of reservoir parameters like, K, Kh, Skin, flow efficiency, P.I., P*, P etc. and other PVT parameters. Significance of pressure and temperature data in hydrocarbon exploration and exploitation.

UNIT-V	IDENTIFICATION AND TREATMENT OF SICK WELLS	10	Hrs

Definition of a sick well, criteria for identification of sick well – Channeling, Channel detection – Cement bond log (CBL) - Variable density log (VDL) - Cement evaluation tool (CET) - Remedial measures – Cement squeeze. Sickness due to leakage – Detection of leakage, temperature survey, temperature anomaly, Radioactive isotope (tracer) survey, Activated oxygen log, isolation by packers. Reperforation and activation.

COURSE OUTCOMES (CO)

At the end of the course the student should be able to:

1. Recognize the steps required to achieve an optimal field development plan
2. know the key project drivers
3. Understand the data needed to develop or redevelop an oil or gas field
4. Develop field development plan
5. Identify Sick Wells
6. Treat Sick Wells

SUGGESTED READINGS

1. Field Development Plan – Oil and Gas by Mohammad Ismail Iqbal

TPE-721	FUNDAMENTAL OF ROCK MECHANICS	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To understand the role of formation , strength of rock material and Wellbore mechanics in drilling operation and well design
- To understand in-situ stress changes and how they impact on wellbore and borehole behavior.
- Measurement and estimation techniques for key drilling parameters, such as pore pressure and in-situ stresses.

UNIT-I	Introduction to Petroleum Rock Mechanics	4	Hrs

Definition and classification of rocks , Why study stress in rocks? Units of measurement ,Theory of Elasticity, Materials behavior ,Hooke's law ,Hooke's law in shearanalysis of structures ,Hooke's law ,Hooke's law in shearanalysis of structures , Theory of inelasticity, Constitutive relation for rocks

UNIT-II	Stress/Strain Definitions and Components	4	Hrs

General concept , Definition of stress, Stress components ,Definition of strain ,Strain components. Stress and Strain Transformation, Transformation principles, Two-dimensional stress transformation , Stress transformation in space ,Tensor of stress components ,Strain transformation in space

UNIT-III	Porous Rocks and Effective Stresses	6	Hrs

Anisotropy and in homogeneity ,Anisotropic rocks, transversal isotropy ,Formation pore pressure ,Effective stress ,Formation porosity and permeability

UNIT-IV	Failure Criteria	8	Hrs

Failure criteria for rock materials , The von mises failure criterion ,Mohr-coulomb failure criterion ,The griffith failure criterion ,Hoek-brown failure criterion, Druker-prager failure criterion , Mogi-coulomb failure criterion

UNIT-V	Rock Strength and Rock Failure	12	Hrs

Strength of rock material ,Empirical correlations, Formation fracture gradient, Rock tensile strength, Rock shear strength . Stresses Around a Wellbore , Properties of rock formation around a wellbore . Wellbore Instability Analysis, Wellbore fracturing pressure, Wellbore collapse pressure, Instability analysis of multi-lateral boreholes, Instability analysis of adjacent boreholes Instability analysis of underbalanced drilling, shallow fracturing, General fracturing model Compaction analysis for high-pressure, high-temperature reservoirs Breakthrough of a relief well into a blowing well, Fracture model for load history and temperature, Effects of flow induced stresses

COURSE OUTCOMES

After completing this course the student should be able to:

1. Acquire the knowledge for classification of rocks for engineering purposes.
2. Comprehend different types of tests for various properties of rocks.

3. Acquire the knowledge on various methods used for stabilization of rocks.
4. Assess different property of porous rocks.
5. Recognise different failure criterias of different types of rocks.
6. Understand the geomechanics of well bore stability.

SUGGESTED READINGS

1. Petroleum Rock Mechanics (Drilling Operations and Well Design) by Bernt Aadnoy, Reza Looyeh
2. Engineering Geology and Rock Mechanics by Dr. B P Verma

TPE-722	DIGITAL OILFIELD AND INTEGRATED OPERATION	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course is

- To learn about Digital oilfield implementations in hydrocarbon industry.
- To aware about tool and technologies used in Digital oilfield.
- To learn different factors of optimization in Digital oilfield.
- To learn about digital oilfield data acquisition and Information Management.

UNIT-I	Introduction to Digital Oilfield (DOF)	4	Hrs

(Conceptual) Definition of DOF; Elements of DOF; Drivers, History, and Evolution; An Early Industry Example of DOF Application; Current Adoption Status/Development

UNIT-II	Tools/Technologies for Digital OilField	6	Hrs

Hardware/Software; Infrastructure/Communication, Data Disruptive Technologies – how they impacted the E&P industry and how we have used them Processes and People

Methodologies

Digital Strategies/Designing solutions; Phased pilot approach: phased development, pilot sides, iterative roll-out plan

UNIT-III	Digital (Intelligent) Oilfield Implementation	8	Hrs

Digital Oilfield Implementation; Defining the DOF Integration Platform
Optimization: Assessments; Baseline assessment; Project readiness Field Development Planning Basics
Factors of Digital Oilfield Implementation: Project Definition; Corporate Structure; Relevant Resources to Drive the Implementation; Experienced Personnel in DOF Projects; Post Implementation Review

UNIT-IV	Field Assessment; Data Acquisition & Delivery Systems,	8	Hrs

Data Measurement; Data Transmission; Surveillance and Monitoring; Modelling and Analysis; Subsurface study; Conceptual design; Detailed design; Execution Value Realization & Sustainment

Data acquisition and Information Management:(People) Capability development
Collaborative Work Environment (CWE)

UNIT-V	Collaborative Environment	6	Hrs

Principles of Collaborative Work Environment; Domain Experts & Required Technology; CWE Business Workflow; Developing asset-specific business process; Strategy in process embedment

COURSE OUTCOMES

After completing this course the student should be able to:

1. Apply Digital oilfield implementations in hydrocarbon industry.
2. Identify Tools/Technologies for Digital OilField implementations
3. Use of tool and technologies used in Digital oilfield.
4. Categorize different factors of optimization in Digital oilfield.
5. Plan and create digital oilfield data acquisition and Information Management Systems.
6. Design and create CWE.

SUGGESTED READINGS

1. Intelligent Digital Oil and Gas Field: Concepts, Collaboration and right – time decisions

TPE-723	ADVANCED WELL STIMULATION TECHNIQUE	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

1. Familiarization of principles and applications of various theories and techniques necessary to design, estimate and maximize production performance in a cost effective manner.
2. Familiarization of formation damage, sick well analysis, damage mechanisms and mitigation.
3. Familiarization of acidization basic concepts, acid formulation, placement etc.
4. Familiarization of hydrofractuing operations, rock failure, frac. fluids, proppants frac. evaluation etc.

UNIT-I	FORMATION DAMAGE	8	Hrs

Formation Damage basics, reasons, effect on productivity, Skin effect: types and evaluation, Determination of skin, Damage mechanism and mitigation methods

UNIT-II	ACIDIZATION	8	Hrs

Acidization Mineralogy, composition of sand stone, limestone etc. Acid mineral interaction, reaction rate, calculation of acid for acidization. Additives and its selection, treatment design, equipment and post job evaluation. Safety aspects

UNIT-III	HYDROFRACTURING	10	Hrs

Hydrofracturing, Mechanism of fracture generation, orientation and extent, frac. gradient evaluation, Proppant evaluation and selection, frac fluid components, additives equipment, fracturing and post frac, procedure, evaluation. Frac job: Equipment and procedure, evaluation. Safety aspects

UNIT-IV	CONSIDERATIONS IN FRACTURE DESIGN	6	Hrs

Size limitations- Considerations with predetermined size or volume- Benefits of high proppant concentrations- Effect of reservoir properties- Effects of perforations on fracture execution.

UNIT-V	POST-TREATMENT EVALUATION AND FRACTURED WELL PERFORMANCE	10	Hrs

Selected references before the finite conductivity fracture models- Cinco and Samaniego model- Comments on damaged and chocked fractures- Post-fracture well analysis- Interpretation for finite conductivity fracture wells with wellbore storage- Comparison of production forecasts for untreated and fractured wells- Calculation of the fracture length and conductivity of long-flowing wells.

COURSE OUTCOMES

After completing this course the student should be able to:

1. Evaluation of skin and its components.
2. Evaluate mechanism of formation damage in horizontal wells and suggest methods of mitigation of formation damage
3. Identify acidization process, acid formulations, additives, acid placement techniques and evaluation
4. Evaluate Hydrofracturing, rock mechanics, different models, frac fluids, proppants, additives, frac equipment
5. Solve practical problems in reservoir fracturing and remedies to resolve the same
6. Design and analyze fracturing approaches for petroleum reservoir stimulation.

SUGGESTED READINGS

1. Reservoir Stimulation Michael J.Economides, Kenneth G.Nolte
2. Production Operations (Vol. ii) Thomas O Allen, Alan P Roberts
3. Petroleum Production Systems Michael J.Economides, A.Daniel Hill, Christine Ehilg Economides,

TPE-724	PETROLEUM ECONOMIC RISK AND UNCERTAINTY ANALYSIS	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To enable the students about bidding procedure, PSC, concept of M & A, project evaluation.
- To incorporate the knowledge about cash flow analysis
- To enrich the mind of students to understand economic indicators.
- To acquaint students about Fiscal regime in E&P business
- To aware the students about the uncertainties in exploration , development and project evaluation

UNIT-I	Introduction and role of Petroleum Economics in E & P industry	7	Hrs

Petroleum Economics and it's significance, Exploration License, Wild cat drilling stage, DOC stage, Appraisal stage, FDP submission, Infill drilling, Farm-in and Farm out opportunities, Project evaluation, Uncertainties and risk involved and how to overcome

UNIT-II	Cash Flow Analysis	8	Hrs

Development concept selection, Costing , CAPEX, OPEX, Abandonment cost, Sunk cost

UNIT-III	Economic Indicators	8	Hrs

Net Present Value (NPV), Internal Rate of Return (IRR), Pay out period, Capital Productivity Index

UNIT-IV	Fiscal Systems	8	Hrs

Types of fiscal systems worldwide, , oyalty tax regime, Production sharing contracts, Service agreements, Revenue sharing model, Evolution of Indian Fiscal regimes in E & P industry, Economic life of a field

UNIT-V	Uncertainties and Risk Analysis	9	Hrs

Different types of uncertainties and risk involved in E & P industry, Risk above the ground, Geological risk, Source Rock, Reservoir Rock, Seal, Trap, Play dynamics, Probability concept and EMV, Sensitivity analysis, Decision analysis, Managing risk through portfolio optimization

COURSE OUTCOMES

After completing this course the student should be able to:

1. Infer bidding procedure, PSC, concept of acquisition and merger, project evaluation
2. Understand cash flow analysis
3. Comprehend economic indicators
4. Explain Fiscal regime in E&P business
5. Recognize uncertainties in exploration , development and project evaluation
6. Illustrate various risks involved in E&P business

SUGGESTED READINGS

1. The Economics of petroleum by Pogue, Joseph E.(Joseph Ezekiel)
2. Dynamic Risk Analysis in Chemical and Petroleum Industry (Revised) by Nicola Paltrinieri, Faisal Khan

TPE-725	PETROCHEMICAL TECHNOLOGY	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To aware of profile of Indian Petroleum and Petrochemical Industries and evaluation of feed stocks.
- To learn production technology of various petrochemical products viz., methanol, ethylene, propylene etc.
- To learn processing of C_4 and C_5 hydrocarbons for the manufacture of Butane, Butadiene, Isoprene etc.
- To know Aromatic production technology
- To learn technology of production of Polymers and synthetic fibres.

UNIT-I		6	Hrs

Introduction: Petroleum Refining and Petrochemical Industries, Petrochemical Feedstocks, Structure of Petrochemical Complexes. Integration of Refinery and Petrochemical Alternative feed stock for Petrochemicals

Profile of Indian Petroleum and Petrochemical Industries: Indian Petroleum Industry, Petrochemical Feedstock in India, Petrochemical Product Profile.

Evaluation of feed stock: Evaluation of Petroleum and Petrochemical feed stock for Olefin. Aromatics and Linear alkyl benzene

UNIT-II		12	Hrs

Olefins Production: Steam Cracking for Production of Olefins, Gas Sweetening Unit, C_2/C_3 Extraction Unit, Steam Cracking Process Technology, Emerging Technologies for Production of Olefins

Methane and Synthesis Gas Derivatives: Synthesis Gas and Ammonia, Urea, Methanol, Formaldehyde, Acetic Acid, Acetylene.

Ethylene and Ethylene Derivatives: Ethylene, Ethylene Oxide, Vinyl Chloride, Vinyl Acetate, Acetaldehyde, Ethanol, Ethanol Amine.

Propylene and Propylene Derivatives: Sources of Propylene, Propylene Oxide, Propylene Glycol, Acetone, Cumene, Acrylic Acid.

UNIT-III		4	Hrs

C_4 And C_5 Compounds: Fluid Catalytic Cracking, FCC Gases as Petrochemical Feedstock, Processing of C_4 Stream from Steam Cracker and FCC, Oxygenates from Refinery C_4 and C_5 Stream ,

Upgrading of C_5 Cut For Recovery of C_5 Chemicals. Butadiene, 1-Butene, N-Butenes, Isobutylene, N-Butane, Octenes, 1, 4-Butanediol, Chloroprene, Isoprene.

UNIT-IV		**8**	**Hrs**

Aromatic Production: Petroleum Feed Stock for Aromatic Hydrocarbons, Catalytic Reforming and Aromatic Hydrocarbon Production, Pyrolysis Gasoline as Aromatic Feedstock, Aromatic Separation from Reformate and Pyrolysis Gasoline, p-Xylene, Emerging Technologies for Production of BTX; Aromatic Conversion Processes.

Aromatics-BTX Derivatives: Linear alkyl benzene**,** Ethyl Benzene and Styrene, Benzoic Acid, Aniline.

UNIT-V		**10**	**Hrs**

Polymers, Elastomers, Polyurethanes: Characteristics Of Polymer, Classification Of Polymers, Polymerization Reactions, Polymerization Reactors, Polyethylene, Polypropylene, Polystyrene, Epoxy Resin, PET Resins, Polycarbonate, Phenol formaldehyde, urea Formaldehyde and melamine formaldehyde , Polyurethane, Synthetic Rubbers, Styrene butadiene rubber(SBR) and Polybutadiene.

Synthetic Fibers Monomers and Fibre: Cyclohexane, Caprolactum, Adipic Acid, Adiponitrile, Hexamethylenediamine, Acrylonitrile, Terephthalic acid and Nylon 66, Nylon 6, Acrylic Fibers. Polyester

COURSE OUTCOMES

After completing this course the student should be able to:

1. Understand the profile of Indian Petroleum and Petrochemical Industries and evaluation of feed stocks.
2. Learn production technology for methane, ethylene, propylene and its derivatives and their applications.
3. Explain different refinery process, fluid catalytic cracking and C_4 and C_5 compound recovery.
4. Use the emerging production technologies for aromatics BTX (benzene, toleune and xylene)
5. Interpret production technology of various petrochemical products viz., methanol, ethylene, propylene, Butane, Butadiene, Isoprene, synthetic fibres etc.
6. Apply the applications of petrochemicals in fertiliser, polymer and paint industry.

SUGGESTED READINGS

1) Mall I. D., " Petrochemical Process Technology", Macmillan India Ltd. 2007
2) Chauval, A. And Lafabuye, G.L., 'Petrochemicals Processes', Part-I &Ii Ed, Rue Ginux (1986).
3) Little, D.M., 'Catalytic Reforming', Pen Well Publishing House (1985).

TPE-726	SUBSURFACE MAPPING	L T P C 3-0-0-3

LEARNING OBJECTIVES

The followings are the main learning objective of this course

- To understand the basic data for subsurface mapping to delineate hydrocarbon reservoir.
- To learn the log correlation
- To learn integration of different data types, seismic attribute analysis & hydrocarbon indicators.
- To learn the mapping techniques and their application in property mapping.

UNIT-I	Review and Integration of various data types for subsurface mapping	4	Hrs

The need for sound subsurface mapping. Case histories of integrated subsurface studies.

UNIT-II	Well log analysis, correlation of logs and extraction of relevant subsurface information	12	Hrs

Brief review of key log types, including gamma ray, density, spontaneous potential, resistivity, sonic, porosity, dipmeter logs etc. and petrophysical aspects. Log correlation: Structural and stratigraphic applications

UNIT-III	Seismic analysis. 2D, 3D & time lapse seismic, attribute analysis	12	Hrs

Brief review of principles of reflection seismology, 2D versus 3D (and time-lapse) interpretation/ mapping concepts Attribute analysis, Hydrocarbon indicators and mapping.

UNIT-IV	Fundamentals of contouring, Construction & interpretation of fault plane, structure & thickness maps	7	Hrs

Rules of contouring, Techniques of contouring- Styles of contouring, Computer versus interpretative. Structure contour map- Mapping the fault plane(s), reference horizons. Interval, isochore/ isopach, and pay thickness maps, Computerized techniques – benefits and drawbacks.

UNIT-V	Integrated mapping, Integration of LWD data for geosteering	5	Hrs

Structural versus stratigraphic, Facies maps, 3D visualization. Fault characterization, from 3D seismic to well log to core. Real-time subsurface mapping, Modifying the geological model with concurrent data, changing the borehole trajectory- Structural, stratigraphic and fluid aspects.

COURSE OUTCOMES

After completing this course the student should be able to

1. Correlate various well logs and their indirect relation to petro physical properties.
2. Identify various attributes and hydrocarbon indicators.
3. Understand techniques of integration of various data types.
4. Classify various methods of contouring.
5. Apply knowledge in creating isochore / isopach and pay thickness maps.
6. Recognize real-time subsurface mapping, modification of geological model with concurrent data and visualization.

SUGGESTED READINGS

1. Applied Subsurface Geological Mapping with Structural Methods by Denial J. Tearpock and

Richard E. Bischke
2. Alistair R Brown (2011); Interpretation of 3 Dimensional seismic data, 7th Edition, AAPG Memoir 42 SEG Investigations in Geophysics, No. 9
3. Schlumberger Log Interpretation Principles/ Applications (1989), Schlumberger Educational Series.
4. Telford W. M. Geldart L. P. and Sheriff R .E . Applied Geophysics (1990), second edition, Cambridge University press
5. Yilmaz Ozdogan, Seismic Data Analysis, (SEG, 2011)

PROJ. - PE 701	PROJECT PHASE I	L T P C 0-0-0-2

The objective of the project is to enable the students to work in groups of not more than four members in each group on a project involving analytical, experimental , design or combination of these in the area of Petroleum Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. The evaluation is based on continuous internal assessment by an internal assessment committee. The internal assessment marks for Phase I will be carried over to Phase II

Course Outcomes

After completing the project work, the student will be able to

1. Identify and describe the problem, and relevance with industry
2. Search the literature and develop an overview of the problem
3. Use systematic methodology by applying knowledge of science and engineering to develop solution for the problem.
4. Apply design principles, and carry out experimental work to develop data,
5. Use modern engineering tools to analyse and interpret data
6. Apply professional ethics by acknowledging the source of information.
7. Synthesise data to derive meaningful conclusions and present the same in a systematic way
8. Acquire basic skills for working in a team
9. Imbibe lifelong learning skills
10. Communicate effectively in written, oral and graphical form.

PROJ. – SIPE 701	SUMMER INTERNSHIP PROJECT – SEMINAR II	L T P C 0-0-0-1
During this semester each student is expected to undertake a minimum of four weeks Project based / industrial / field training. The students are expected to submit a report, which shall be evaluated by an internal assessment committee during ongoing semester for 100 marks.		

PROJ. - PE 801	PROJECT PHASE II	L T P C 0-0-0-10

Project work phase II could be an extension of the project phase I / new project can be assigned to the students during ongoing semester. On completion of the work, a project report should be prepared and submitted to the department. The project work and the report will be evaluated by an internal assessment committee. There will be report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the University.

Course Outcomes

After completing the project work, the student will be able to

1. Identify and describe the problem, and relevance with industry
2. Search the literature and develop an overview of the problem
3. Use systematic methodology by applying knowledge of science and engineering to develop solution for the problem.
4. Apply design principles, and carry out experimental work to develop data,
5. Use modern engineering tools to analyse and interpret data
6. Apply professional ethics by acknowledging the source of information.
7. Synthesise data to derive meaningful conclusions and present the same in a systematic way
8. Acquire basic skills for working in a team
9. Imbibe lifelong learning skills
10. Communicate effectively in written, oral and graphical form.