UNIVERSITY OF PUNE
STRUCTURE AND SYLLABUS OF TE (PETROLEUM ENGINEERING)
(2008 Course)

Sub. No.	Subject	Teaching Scheme Hrs/Week			Examination Scheme (Marks)			
		L	**P**	**T/ D**	**Paper**	**TW**	**P**	**O**
Term – I								
312381	Numerical Methods and Geostatistics.	4	2	-	100	50		-
312382	Petroleum Geology I	4	4	-	100	25	50	-
312383	Drilling Operations	3	2	-	100		-	50
312384	Hydrocarbon Properties and Thermodynamics	4	2	-	100	25	-	
312385	Petroleum Production Operations	3	2	-	100	50	-	-
	Total	**18**	**12**	**-**	**500**	**150**	**50**	**50**
	Total Term – I	**30**			**750**			
Term – II								
312386	Petroleum Geology – II	4	4	-	100	25	50	-
312387	Reservoir Engineering I	4	-	-	100	-	-	-
312388	Petroleum Production Engineering I	3	2	-	100	-	-	50
312389	Natural Gas Engineering	3	--	-	100		-	-
312390	Petroleum Equipment Design and Drawing	3	2	-	100	25	-	
312391	Petroleum Field Instrumentation & Control	1	2	-	--	--	50	--
312392	Seminar	-	2			50	-	-
	Total	**18**	**12**		**500**	**100**	**100**	**50**
	Total Term – II	**30**			**750**			
	Total for the year	**60**			**1000**	**250**	**150**	**100**
	Grand Total				**1500**			

T: Theory, P: Practical, T: Tutorial, D: Drawing, TW: Term work, O: Oral

312381 NUMERICAL METHODS AND GEOSTATISTICS

(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	Examination Scheme:
Lectures: 4 Hours / Week	Paper: 100 Marks
Practical: 2 Hour/Week	TW 50 Marks

Objectives:

1. To learn methods of solving algebraic and differential equations by numerical techniques.
2. To apply numerical techniques for different processes.
3. To develop programming skills for coding of algorithms
4. To understand basic principles of Geostatistics in autocorrelation

SECTION – I

Unit 1: Complex Variables: (08 Lect.)

Functions of Complex Variables, Analytic Functions, C-R Equations, Conformal Mapping, Bilinear Transformation, Cauchy's Theorem, Cauchy's Integral Formula, Laurent's Series, Residue Theorem.

Unit 2: Statistics: (08 Lect.)

Measures of Central Tendency & measures of Dispersion, Moments, Skewness & Kurtosis. Correlation & Regression. Autocorrelation.

Unit 3: Probability: (08 Lect.)

Probability, Random Variable, Discrete & continuous, Cumulative Distributive function, Probability Density function, Properties. Expectation, Probability models, Binomial, Poisson and Normal Distributions. Test of hypothesis, χ^2 Distribution.

SECTION – II

Unit 4: Numerical Methods: (08 Lect.)

Calculus of Finite difference, Finite difference Operators, Newton's, Lagrange's & Stirling's Interpolation formulae. Numerical differentiation & Numerical Integration, Trapezoidal Rule, Simpson's $1/3^{rd}$ & $3/8^{th}$ rules, Error analysis, Computer Algorithms .

Unit 5: Solutions of Equations: (08 Lect.)

Solution of Algebraic & Transcedental equations, Method of False position, Newton-Raphson method, Method of Successive Approximations, Convergence & Stability Criteria. Solution of System of Simultaneous Linear Equations, Gauss Elimination Method, Gauss-Seidel Method. Method of least Square for Curve Fitting.

Solution of Ordinary Differential Equations, Euler's Method, Modified Euler's Method, Runge-Kutta Method, Computer Algorithems.

Unit 6: Finite Difference Techniques, Optimization: (08 Lect.)

Solution of ordinary and partial differential equations using finite difference techniques. Explicit and Implicit methods, Optimization techniques, Solution & formulation of linear programming problems, Simplex method. Estimation of errors and stability of algorithms.

Solution of ordinary and partial differential equations using finite difference technique. Explicit and Implicit methods. Stiff differential equation.

Term Work:

Every student should carry out minimum eight exercises from the following list and submit the journal, which will form the term work.

List of Practical:

Solve Pre-formulated Mathematical Models for Petroleum Engineering Operations Using C, C++ or Mathematical Software Packages.

1. To fit the Regression lines to the set of given Data points.
2. Using χ^2 Distribution, testing the goodness of fit of the given distribution.
3. Solution of Algebraic and transcendental equations using Newton Raphson Method.
4. Interpolation Techniques using Forward, Backward and Central Differences. Lagrange's Method for unequal intervals.
5. Numerical Integration.
6. Least Square Approximation for Curve Fitting.
7. Gauss Elimination and Gauss Seidal Methods for System of Simultaneous Linear Equations.
8. Solution of Ordinary Differential Equation with initial condition using Modified Euler's Method and Runge-Kutta Method.
9. Solution of one dimensional and two dimensional Heat Flow using finite difference techniques. (Grid based Modeling Techniques)

Reference Books :

1. Chapra S.C. and Canale R. P.; Numerical Methods for Engineers, Third Edition; McGraw-Hill, Inc.
2. Freund John; Probability and Statistics for Engineers; Prentice-Hall of India Pvt. Ltd.
3. Gupta Santosh K.; Numerical methods for Engineers, New Age International Publishers Ltd., Wiley Eastern Ltd.
4. Hilderbrand F. B.; Introduction to Numerical Analysis.
5. Jensen J. L., Lake L. W., Corbette P. W. M. and Goggin D. J.; Statistics for Petroleum Engineers and Geoscientists; Prentice Hall.
6. Kreyszig E.; Engineering Mathematics; Wiley Eastern Ltd.

312382 PETROLEUM GEOLOGY I
(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	**Examination Scheme:**
Lectures: 4 Hrs / week	Paper: 100 Marks
Practical: 4 Hrs / week	Practical: 50 Marks
	Term Work: 25 Marks

Objectives:

1. To understand basic principles of geology in Petroleum system.
2. To understand the relation between geologic processes and characteristics of sedimentary rocks.
3. To understand geological time scale and important events

SECTION – I

Unit 1: Petrology: (08 Lect.)

Geology in Petroleum industry: an overview

Mineralogy, Identification and Physical properties of minerals. Igneous, sedimentary and metamorphic rocks, Rock cycle.

Unit 2:Internal and External Processes: (08 Lect.)

Surface features of earth. Weathering, erosion, and denudation; Generation of sediments, Mass movements, landforms.

Plate Tectonics and associated features. Earthquakes. Volcanism and geothermal energy, internal structure of earth,

Unit 3:Structural Geology: (08 Lect.)

Rock deformation and deformation structures, strike and dip of rocks
Folds: description, classification and mechanism of fold formation.
Joints and Fractures. Faults: description, classification and mechanism of formation. Sealing and non-sealing faults. Fault seal analysis
Structural associations.

SECTION – II

Unit 4: Physical Sedimentology and Environment of Deposition: (08 Lect.)

Sedimentation Processes. Bedform generation, Texture and Structures of sedimentary rocks. Post- depositional changes.

Depositional environments: Broad overview, classification, Sedimentary facies. Typical depositional environments related to petroleum occurrence.

Carbonate Depositional System. Clastic Depositional System, Geological Heterogeneities.

Unit 5: Applied Paleontology: (08 Lect.)

Marine depth zones and fossils. Index fossils, Mega fossils, microfossils, trace fossils. Systematic,

Importance of microfossils in petroleum geology. Significance in the interpretation of depositional, environment, and correlation. Taphonomy — principles and practices

Unit 6: Stratigraphy: (08 Lect.)

Principles of Stratigraphy, Stratigraphy and sedimentation, Wilson cycle
Unconformity, Transgression-regression.
Litho-Bio-Chronostratigraphy, correlation,
Geological Time Scale, Important Events, Outline of Indian Geology.
Introduction to Sedimentary Basins of India

Term work:

Every student should carry out minimum ten exercises from the following list and submit the journal, which will form the term work.

List of Experiments:

1. Study of properties and identification of important rock forming minerals and rocks in hand specimens (minimum six practical sessions).
2. Introduction to Petrological and binocular stereomicroscope.
3. Study of important sedimentary structures and textures.
4. Study of important fossil forms.
5. Study of topographic sheets
6. Study of Geological maps at least six maps.
7. Petrography of Carbonate and Clastic Sedimentary rocks

Practical examination will be based on the experiments carried out as a part of term work.

Reference Books:

1. Arthur Holmes; Principles of Physical Geology; Chapman and Hall.
2. Kunt Bjorlykke; Sedimentology and Petroleum Geology; Springer Verlag.
3. Sengupta S. M.; Introduction to Sedimentology; Oxford and IBH Publishing Company.
4. Shelly R. C.; Introduction to Sedimentology; Academic Press.
5. Nichols Gary: Sedimentology and Stratigraphy. Wiley Blackwell. Second edition. 2009. 432 pp.

312383 DRILLING OPERATIONS
(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs / week	Paper: 100 Marks
Practical: 2 Hrs / week	Oral: 50 Marks

Objectives:

1) To understand oil well drilling engineering and operations.
2) To get familiarized with field equipment practices, difficulties and actions to be taken.
3) To learn fundamental equations and calculations used in drilling engineering.

SECTION – I

Unit-1: Drilling Rig (8Lect)

Rotary / top drive drilling for oil and natural gas, introduction to hardware system, power generation system, Hoisting, Rotary and drilling fluid circulation system, Rig selection, onshore offshore rigs, onshore and offshore drilling operations, Horse power calculations for draw-works and rotary advantages and disadvantages of top drive system.

Unit-2: Drilling Operations and Difficulties (8Lect.)

Downhole drilling problems and solutions, factors affecting rate of penetration, drill off test, bit section, IADC classification of bit, dull bit gradation, circulation system, mud pumps, numerical related to mud pumps of circulation system, problems concerned with drilling fluid and drill pipe stuck up, geometry of a stuck pipe. Hole problems (lost circulation, kick etc) well control equipment BOP.

Unit-3: Drilling Techniques and Fishing (8Lect.)

Introduction to directional, horizontal multilateral drilling techniques. Types of well, coring operations, Fishing tools and operations. Terminology used in directional wells and basic mathematics used in directional wells (DMS to Dec. Deg, co-ordinate system).

SECTION-II

Unit-4: Casing and Cementation (8Lect.)

Casing and Cementation, Functions, types, API grades properties of casing, Threads and couplings, Functions, classification of cement, Strength retrogenion, Cement additives, Methods of cementation, Equipment accessories, Field problems pertaining to cementation job, Cement slurry calculations.

Unit-5: Drilling Fluids (8 Lect.)

Drilling fluid, Functions, Types, compositions, Properties of mud, Field test, Rheology, Additives and contamination, Selection of drilling fluids and mud, Conditioning equipments, Mud calculations, Hydrostatic pressure, Volume, Weight related calculations during drilling.

Unit-6: Mud Engineering (8Lect.)

Fluid flow and associated pressures in the rotary rig circulating system, Pressure changers during tripping and casing operations, Types of flow, Pressure losses in pipe & annulus during drilling operations, pressure drop across bit nozzles, ECD.

Term work:

Every student should carry out minimum eight exercises from the following list and submit the journal, which will form the term work.

List of experiments:

1) Study of rotary, hoisting, system and power transmission system on a drilling rig.
2) To determine mud density, marsh funnel viscosity and pH of given drilling fluid sample.
3) Mud rheology test to determine viscosity, gel strength of yield point using fann-viscometer.
4) Measurement of filtration behavior and wall cake building properties using dead weight hydraulic filtration for low pressure, low temperature test and to rest resistivity of each component.
5) Sand and liquid content in drilling fluid sample.
6) Circulation system, rig hydraulics and pressure loss analysis during drilling fluid circulation.
7) Fundamentals of primary well control, kick and necessary equipments.
8) Total cation exchange capacity of the drilling fluid.
9) Differentials sticking coefficient using differential sticking tester.
10) Thickening time test and study of atmospheric pressure consistometer.
11) Compressive strength test of cement.

Oral

Oral examination will be based on all engineering fundamentals of the subject and journal submitted

Reference Books:

1) Gatlin C.; Petroleum Engineering, Drilling and Well Completions, Prentice Hall.
2) Rabia H.; Oil Well Drilling Engineering, Graham Trotman Ltd., London.
3) Azar, J. J., G. Robello Samuel; Drilling Engineering, Penn Well.
4) Drilling Mud and Cement Slurry Rheology Manual; Gulf Publishing Company.
5) Smith.P.K'Cementing' SPE Pulications 2nd Edition 1976.
6) Mitchel R F (Editor), Drilling Engineering, In Petroleum Engineering Handbook, Volume 2 , SPE Publication, 2007, 770 pp

312384 HYDROCARBON PROPERTIES AND THERMODYNAMICS

(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs / week	Paper: 100 Marks
Practical: 2 Hrs / week	Term Work: 25 Marks

Objectives:

1. To understand importance of thermodynamics in solving problems related to complex mixture of hydrocarbons.
2. To gain insight into vapor – liquid, liquid – solid phase equilibrium.
3. To understand principles of thermodynamics in Wax and Asphaltene formation.

SECTION – I

Unit 1: Basic Definitions and Laws of Thermodynamics: (08 Lect.)

Closed System, Open System, State Function, Path Function, First Law, Second Law, Third Law, Internal Energy, Enthalpy, Entropy, Free Energy.

Unit 2: Equations of State: (08 Lect.)

Relationship between pressure volume and temperature, Vapor – Liquid Equilibrium, Critical Point, Compressibility Factor, Van der Waal's Equation, Soave-Redlich-Kwong Equation, Peng – Robinson Equation, Equations derived from the Virial development.

Unit 3: Calculation of Thermodynamic Properties: (08 Lect.)

Vapor Pressure, Clapeyron Equation, Phase Rule, Degrees of Freedom, Clausius – Clapeyron equation, Gibbs – Duhem equation, Fugacity, Activity Coefficients, Partial Molar Properties, Chemical Potential, Maxwell Relations.

SECTION – II

Unit 4: Phase Equilibrium Vapor –Liquid Equilibrium: (08 Lect.)

Vapor – Liquid Separation, Flash Calculations, Multi-component Mixture, Phase Equilibrium for Complex Mixtures, Oil – Gas separation.

Unit 5: Thermodynamics of Porous Media: (08 Lect.)

Capillary action, Flow through porous media, Knudsen Diffusivity, Phase equilibrium across curved interfaces, Laplace – Young Equation, Effect of Curvature on Saturation Pressure, Condensation and Vaporization in porous media.

Unit 6: Solid – Liquid Equilibrium: (08 Lect.)

Liquid – Solid Equilibrium Diagram, Paraffin Crystallization, Thermodynamics of Wax Precipitation, Thermodynamics of Asphaltene Formation, Phase Diagrams for Gas Hydrates, Hydrate formation Equilibria.

Term Work:

Every student should carry out minimum eight exercises from the following list and submit the journal, which will form the term work.

List of Practical:

1. Experimental determination of vapor – liquid equilibrium for binary mixtures.
2. Determination of Joule Thomson Coefficient.
3. Experimentation on Porous media – Effect of Curvature.
4. Multi-component Flash Calculations.
5. Guidelines for selection of a proper Thermodynamic Model for Commercial Simulator and its implications
6. Flash Calculation at different conditions using commercial simulator like ASPEN / HYSYS packages
7. Determination of Bubble Point and Dew Point of multi-component mixtures using commercial packages like ASPEN / HYSYS.
8. Experimentation on Gas Hydrate formation.
9. Experimentation on Asphaltene Formation.
10. Thermodynamic and Kinetic Interactions between Hydrocarbons and $CaSO_4$ in deep carbonate reservoirs.

Reference Books:

1. Vidal Jean.; Thermodynamics: Applications in Chemical Engineering and Petroleum Industry; Editions Technip, 2003.
2. Smith, J. M. and Van Ness H. C.; Introduction to Chemical Engineering Thermodynamics; McGraw-Hill, 1996.
3. Abbas Firodabadi.; Thermodynamics of Hydrocarbon Reservoirs, McGraw-Hill Publishing, 1999.
4. Whitson C H and Brule M R, Phase Behavior, SPE Monograph Series 20, 2000, 240 pp.
5. Danish Ali; PVT and Phase Behavior of Petroleum Reservoir Fluids.

312385 PETROLEUM PRODUCTION OPERATIONS
(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs / week	Paper: 100 Marks
Practical: 2 Hrs / week	TW: 50 Marks

Objectives:

1. To get familiarized with basic subsurface and surface production operations and equipments.
2. To understand typical problems during completion and production of a well and learn possible remedial measures to improve wellbore productivity.
3. To understand multiphase flow and Inflow Performance Relationship.

SECTION – I

Unit 1: Surface Production Equipment and Facilities: (08 Lect.)

Well equipment, Casing hangers, Seal assembly, typical wellhead assembly and attachments, Typical Christmas tree assemblies, Components and design considerations of wellhead equipment and choke, Subsea wellhead and completion aspects, Surface Safety Valve, Sub-Surface Safety Valve, chock sizing.

Unit 2: Bottom-hole Production Tools and equipment: (08 Lect.)

Subsurface control equipment, Surface Safety Valve, Sub-Surface Safety Valve, Bottom-hole chokes and regulators, Circulation devices, Expansion joints, Safety joints, Landing nipples, Polished bore receptacles, Blast joints, Flow couplings, Production packers, Types, Working / setting mechanism, Seating and Unseating of packer. Length and force changes in tubing.

Unit 3: Multiphase Flow (08 Lect.)

Introduction, reservoir aspect, types, Flow patterns during vertical and horizontal flow, Critical production rate and remedial measures to decrease in production. overall production system, pressure loss in tubing, multiphase flow regimes. Poettmann and Carpenter method. Gilbert's correlations. Optimum GLR. Heading cycle. Choke performance, types of chokes.

SECTION – II

Unit 4: Well Completion Engineering: (08 Lect.)

Objectives, Types of well completion with sketches, Production tubing, API grades, Well completion procedure, Well completion fluid, Well activation, Swabbing and circulation, Well perforation, Perforation fluid, Packer fluid, Factors affecting perforation efficiency, Well killing and well control during completion, Factors to be considered in well completion, Introduction to intelligent well completion. Completion for horizontal and multilateral wells. Tubing design consideration. Repeat formation tools and operation.

Unit 5: Inflow Performance Relationship (IPR I) (08 Lect.)

Reservoir considerations in well design, Flow through porous medium around the wellbore, Introduction to inflow performance, Productivity index. PVT properties of oil, water and gas. Flow efficiency, Darcy's Law, Formation damage diagnosis of Skin effect, IPR in case of different drive mechanism. Vogel IPR equation, Standing's extension. Fetkovich approximation.

Exercises based on above topic.

Unit 6: Workover Operations: (08 Lect.)

Workover fluids, Workover jobs, Water and gas coning, Squeeze cementation, Liquid loading of gas wells, Well problems identification, Mechanical problems of well and formation related workover problems, Solution to well production problems. Formation damage, types, causes.

Introduction to well stimulation operations, design considerations, Well completion and workover aspects of wells on artificial lift and gravel packed wells.

Term Work:

Every student should carry out minimum six exercises from the following list of practicals. This will form the basis for term work assessment. Analysis of data should be carried out using programming / excel based spreadsheet on computers wherever applicable.

List Experiments:

1. Reservoir aspects of various well configurations for the overall field development.
2. Study of wellhead equipment, Christmas tree and flow control.
3. Design considerations of various well completion methods.
4. Bottom-hole equipment, installation, operational aspects and application.
5. Repeat formation testing tools and operations.
6. Tubing design consideration.
7. Well Stimulation equipment and design.
8. Analysis of pressure and temperature effects on tubing, packer setting mechanism and force required to unseat a packer.
9. Study of multiphase regimes with their characteristics
10. IPR for two phase reservoir

Reference Books:

1. Allen Thomas, and Alan Roberts; Production Operations, Volume 1 and 2; Oil and Gas Consultants International, Inc.
2. Cholet H.; Well Production Practical Handbook; Technip Editions; Paris, France.
3. Danish Ali; PVT and Phase Behavior of Petroleum Reservoir Fluids.
4. Gatlin C.; Petroleum Engineering, Drilling and Well Completions; Prentice Hall.
5. Mian M. A.; Petroleum Engineering Handbook Vol. I and II; Penwell Books.

312386 PETROLEUM GEOLOGY II

(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	**Examination Scheme:**
Lectures: 4 Hrs / week	Paper: 100 Marks
Practical: 4 Hrs / week	Practical: 50 Marks
	Term Work 25 marks

Objectives:

1. To understand the concept of petroleum system.
2. To understand subsurface mapping techniques.
3. To understand distribution of petroleum systems in time and space

SECTION – I:

Unit 1: Composition and Properties of Hydrocarbons: (08 Lect.)

Composition and properties of oil, gas and associated water. Occurrence of hydrocarbons.

Unit 2: Origin and Migration of Hydrocarbons: (08 Lect.)

Introduction to the concept of Petroleum Geosystems. Origin of hydrocarbons, source rock evaluation. Migration of hydrocarbons: Primary, Secondary.
Accumulation: Reservoir Rock, Properties.

Unconventional natural hydrocarbon sources.

Unit 3: Hydrocarbon Traps and Seals: (08 Lect.)

Kinds of Traps, Geological conditions giving rise to various traps in sand-shale sequence and carbonates. Seal rocks, geological conditions giving rise to seals, stratigraphic, sedimentary and structural.

SECTION – II:

Unit 4: Basin Analysis I (8 Lect.)

Introduction to the concept of Basin Analysis. Classification, Lateral variations.

Sedimentary Basins: Concept of sedimentation models, classification and development.
Heat flow analysis, development of petroleum system,

Unit 5: Basin Analysis II (8 Lect.)

Introduction to the Geology of Petroliferous Basins of India. Distribution of Petroleum in time and space. Important world occurrences. Geology of Deepwater Deposits.

Mapping subsurface structures, Seismic and sequence stratigraphy, use of modelling in hydrocarbon generation and exploration.

Unit 6:Well Site Geology: (08 Lect.)

Subsurface data sources.
Principles of subsurface geology.
Introduction to production geology.

List of Experiments:

Every student should carry out minimum ten exercises from the following list and submit the journal, which will from the term work.

1. Simple structural problems (at least 10).
2. Surface and subsurface geological maps (at least 6).
3. Description of cuttings, core and interpretation of data.
4. Preparation of lithology and composite log, preparation of Correlation charts.
5. Study of gas chromatograph.
6. Stratigraphy of petroliferous basins of India.
7. Geological Tour Report.

Practical examination will be based on the experiments carried out as a part of the term work.

Reference Books:

1. Selley, R.C.: Elements of Petroleum Geology, Academic Press. 1998
2. Hund J. M.; Petroleum Geochemistry and Geology (Ed. 2nd); Freeman and Co., New York.
3. Kunt Bjorlykke; Sedimentology and Petroleum Geology; Springer Verlag.
4. Leverson A. I.; Petroleum Geology; Freeman Press.
5. North F. K.; Petroleum Geology; Allen and Unwin. 2000, 712 pp.
6. Biju Duvel. B, Sedimentary Geology: Sedimentary basins, Depositional Environments and Petroleum Formation. Technip, 2002. 658 pp.

312387 RESERVOIR ENGINEERING I

(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	**Examination Scheme:**
Lectures: 4 Hrs / week	Paper: 100 Marks

Objectives:

1. To understand a reservoir and know its properties.
2. To learn about basic rock and fluid properties relevant to petroleum reservoir.
3. To understand the causes of variation in the behavior of rocks and fluids.
4. To understand the drive mechanism of a reservoir.

SECTION – I

Unit 1: Reservoir Engineering and Rock Properties: (08 Lect.)

Reservoir: Definition, Overview: material balance, reservoir simulation, well testing, water flooding, enhanced oil recovery.

Porosity, Permeability, Relative permeability, horizontal, vertical permeability, Klinkenberg effect, Porosity- Permeability Relationship, Compressibility, Saturation: of oil, water and gas, Capillary pressure, wettability.

Unit 2: Fluid Properties (Oil, Water, and Gas): (08 Lect.)

Density, Viscosity, compressibility, formation volume factors, critical properties, classification of reservoirs according to fluids, phase behavior, Equation of state.

U nit 3: Fluid Flow in Porous Media: (08 Lect.)

Flow of Fluids through porous media, Radial and Cartesian Darcy equation, Laminar gas flow, Turbulent gas flow, Flow through fractures/vugs

SECTION – II

Unit 4: Drive Mechanisms and recovery factors: (08 Lect.)

Water drive, solution gas drive, gas cap drive, compaction drive and combination drive. Effect of rock properties and fluid properties on reservoir performance.

Unit 5: Reservoir Volumetrics: (08 Lect.)

Techniques for estimating initial oil and gas in place. Capillary pressure equilibrium and the vertical distribution of fluids. Initial pressure distribution and determination of oil- water and gas-water contacts.

Unit 6: Material Balance: (08 Lect.)

General material balance equations for different types of drive mechanism. Drive index and production characteristics.

Reference Books:

1. Ahmed, T.; Hydracarbon Phase Behaviour; Gulf Publishing Co.
2. Amyx J. W.; Bass D. M; and Whiting, R. L.; Petroleum Reservoir Engineering; McGraw Hill, Pub Co.
3. McCain W.D. Jr.; The Properties of Petroleum Fluids, 2nd Edition; Penn Well.
4. Tiab and Donaldson E.C.; Petrophysics; Gulf Publishing Co. 2003
5. Dandekar A Y, Petroleum Reservoir Rock and Fluid Properties, Taylor and Francis, 2006,
6. Holstein, E.D. (Editor), Reservoir Engineering and Petrophysics. V 5, In Lake L W (Editor) Petroleum Engineering Handbook, SPE International, 2007, 1689 pp.

312388 PETROLEUM PRODUCTION ENGINEERING I

(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs / week	Paper: 100 Marks
Practicals: 2 Hrs / week	Oral: 50 Marks

Objectives:

1. To develop a logical built up of the various facets of the oil and gas production technology.
2. To study PVT properties of oil & gas and Inflow Performance Relationship of wells.
3. To understand multiphase flow correlations and stimulation needs to improve well productivity.
4. To get familiarized with basic design aspects of artificial lift techniques, equipment, operational procedure for the successful completion and production.

SECTION – I

Unit 1: Gas Lift I: (08 Lect.)

Introduction, basic principles of gas lift, intermittent and continuous gas lift system. Unloading sequence

Gas lift valves, classification, valve mechanics and calibration. Selection merits and demerits of different categories of gas lift valves.

Unit 2: Gas Lift II (08 Lect.)

Gas lift design, basic principles of gas lift feasibility, design and operations, Examples of Mandrel Spacing Design Using IPO and PPO Valves. Design problems. Gas lift duals.

Gas lift optimization, Types of Gas lift installations. Operational and maintenance aspect of gas lift wells. Surface facilities for gas lift. Power requirement.

Unit 3: Electrical Submersible Pump: (08 Lect.)

Introduction, surface and subsurface components of ESP. Downhole equipment and surface installations. Detail design of all specifications. Total dynamic head, number of stages and horsepower requirement. Pumping unit, selection, and trouble shooting. Selection criteria for artificial lift. Jet pumping. Plunger lift. Chamber lift. Hydraulic pumping, Progressive Cavity Pumps

SECTION – II

Unit 4: Sucker Rod Pump: (08 Lect.)

Introduction, definition, purpose and types of artificial lift. Stable and unstable flowing conditions. Pumping unit, types and merit, designation, surface and subsurface equipment, working principle. Pumping cycle. Design of sucker rod string, Tapered rod string, polished rod load, counter balance design, torque calculation, plunger stroke, prime mover horsepower requirements. Dynamometer cards, application. Operating and workover problems of SRP wells.

Unit 5: Nodal System Analysis: (08 Lect.)

Introduction, inflow performance curves. Flow through porous media, directional conduit and horizontal pipe. Changes in flow conduit size. Functional nodes. Effects of different variables on production rates of a well. Graphical representation Pressure Traverse Curves

Unit 6:Well Stimulation: (08 Lect.)

Introduction, need and enhancement of well productivity. Identification of treatment. Limestone and standstone acidisation. Acidization job analysis. Laboratory investigation. Planning and job execution.

Hydraulic fracturing. Overview of principles. Types of fracturing fluids, additives and proppant. Well selection for stimulation job. Design, planning and execution of hydraulic fracturing. Other stimulation techniques.

Term Work:

Every student should carry out minimum eight exercises from the following list of practicals and submit a report of each experiment in the form of a journal. Analysis of data should be carried out using programming / excel based spreadsheet on computer wherever applicable.

Oral:

Oral examination will be based on term work submitted.

List of Experiments:

1. Estimation of fluid properties from different co-relations.
2. Study of PVT analysis.
3. Developing IPR's for producing oil and or gas wells.
4. Study of pressure losses in vertical tubing and evaluation of optimum tubing size.
5. Evaluating the pressure loss across choke.
6. Study and analysis of well stimulation job (Matrix Acdization).
7. Study and analysis of well stimulation job (Hydraulic Fracturing).
8. Study and design of sucker rod pump string.
9. Study and design of gas lift string.
10. To study and evaluate specifications for an electrical submersible pump.
11. Study of ESP

Reference Books:

1. Danish Ali; PVT and Phase Behavior of Petroleum Reservoir Fluids.
2. Economides M. J.; Hill A. D.; Economides C. E.; Petroleum Production Systems; Prentice Hall, Petroleum Engineering Series.
3. Brown K. E., "The Technology of Artificial Lift Methods" (All volumes), Pennwell Publications, Tulsa 1984.
4. Nind T, "Principle of Oil Well Production", McGrew Hill, 1981
5. Galambhor and Guo, "Petroleum Production Engineering a Computer Assisted Approach", 2007.

312389 NATURAL GAS ENGINEERING
(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hours/week	Paper: 100 Marks

Objectives:

1. To know about the properties of natural gas.
2. To understand salient features of a gas reservoir.
3. To be able to develop systems for natural gas production.

SECTION – I

Unit I: Properties and Measurement of Natural Gas: (08 Lect.)

Introduction to Natural Gas, origin of natural gas, other sources of gaseous fluids.

Phase behavior fundamentals, qualitative and quantitative phase behavior, vapor liquid equilibrium.

Equation of state, critical pressure and temperature determination. Gas compressibility, viscosity and thermal conductivity, formation volume factor.

Unit II: Gas Reservoir Performance and Gas flow measurement: (08 Lect.)

Fundamentals of gas flow in conduits, fundamentals of fluid flow in porous media, inflow performance curves, outflow performance.

Gas flow measurement, fundamentals, Methods of measurements, Orifice meters equation, turbine meters, Selection, Recording charts, Uncertainties in flow.

Unit III: Flow of Gas in Production Tubing (08 Lect.)

Introduction, gas flow fundamentals, vertical and inclined single phase flow of gas, calculating flow and static bottomhole pressure, gas flow through restrictions.
Temperatures profiling in flowing gas systems.

SECTION-II

Unit IV: Natural gas Processing (08 Lect.)

Gas liquid separations, dehydration processes, absorption and adsorption by gas permeation.

Desulfurization processes, solid bed sweetening process, physical and chemical absorption processes, Acid gas removal. Integrating natural gas processing.

Unit V: Gas Compression (08 Lect.)

Introduction, types of compressors, Selection, Thermodynamics of compressors, Design fundamentals for reciprocating, centrifugal and rotary compressors (single and multistage), Use of Mollier diagrams.

Unit VI: Gas Gathering and Transport (08 Lect.)

Gas gathering system, steady state flow in simple pipeline system, steady state and non steady state flow in pipelines, solution for transient flow, Pipeline economics.

Installation, operation and trouble shooting of natural gas pipelines.

Reference Books:

1) Beggs, D, H, Gas Production Operations. Edition Technip. 1984
2) Ikoku, Chi, "Natural Gas Production Engineering", John Wiley and Sons, 1984.
3) Kumar Sanjay, "Gas Production Engineering", Gulf Publishing Company, TX, USA, 1987.
4) "Gas Processes Suppliers Handbook", USA, 1980.
5) Lee, J, Wattenbarger, R. A., "Gas Reservoir Engineering", Society of Petroleum Engineers, TX, USA, 1996.

312390 PETROLEUM EQUIPMENT DESIGN AND DRAWING

(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs / week	Paper: 100 Marks
Practical: 2 Hrs / week	TW: 25 Marks

Objectives:

1. To understand the fundamental concepts of equipment and machinery design.
2. To make student aware of different equipment and machineries used in petroleum industry.
3. To study different forces and stresses to be considered in the design process and to understand drawing related national and international standards and practices followed.

SECTION - I

Unit 1: Fundamentals of Design: (08 Lect.)

Steps in design activity. Selection of material. Theories of failure. Stress concentration and factor of safety. Creativity in design activity. Use of standards and codes in design activity. design of shaft, keys and coupling. .

Unit 2: Design of Mechanical Drive Components applied to petroleum equipments (08 Lect.)

Design of belt drives. Types of pulleys, Design of pulleys (crown & travelling block) Wire ropes- advantages, construction, classification, factor of safety (wire rope sheaves drums), stresses in wire ropes. Classification of chains, power transmitting chains, power calculations. Design consideration for chain and gear drives, Bevel gears. (Rotary system). Power transmission on a rig.

Design principles applied to rig equipments. Design consideration for hoisting and rotary system. Design of simple band, band & block brakes (draw works) and introduction to bearing's and clutches.

Unit 3: Pumps & Compressor (08 Lect.)

Selection of pumps and valves. Specification of pumps, valves, performance curve, system pump interaction, two pumps in parallel & series (flow sheet) and compressors – reciprocating ,rotary, centrifugal, reciprocating cylinder sizing. Cooling & lubricating system.

Introduction to hydraulic and pneumatic circuit and their components. Introduction to mud circulation system & equipments, Types of springs(compression helical – shale shaker) , Design consideration for pipeline used in oil and gas transportation.

SECTION - II

Unit 4: Design of Pressure Vessel: (08 Lect.)

Design of shell. Design of head. Types of sealing materials and gaskets. Design of flanges. Design of nozzles. Classification and Design consideration of separators.

Unit 5: Design of Heat Exchanger and Reaction Vessel: (08 Lect.)

Design of shell (external pressure). Design of jackets and coil. Design of heat exchanger. Nomenclature and types of heat exchangers.

Unit 6: Design of Mixing and Storage System: (08 Lect.)

Design consideration for mixing. Types of agitators. Design of agitation system components.

Storage of hydrocarbon fluids, Introduction to oil and gas storage facility. Types of storage tank and their design considerations. Design of fixed roof cylindrical storage tank. Liquids, liquefied gases, highly volatile HC, solids, and sulphur containing fluids.

Oral:

Oral examination will be based on detail design and drawing assignments from above syllabus carried out as a part of the term work.

List of Design Exercises:

1. Design of power transmission component.
2. Design of rotary pump / valve.
3. Design of pressure / reaction vessel.
4. Design of storage tank.
5. Design of heat exchanger.

(A) At least two detailed design assignments and their respective drawings concerned with the design should be drawn on A-0 drawing sheet.
(B) At least one assignment using design software.

Reference Books:

1. Arnold Ken and Stewart Maurice; Surface Production Operations volume -I, Design of Oil Handling Systems and Facilities; Gulf Publishing Company, Houston, Texas.
2. Bhandari V. B.; Design of Machine Elements; Tata McGraw Hill.
3. Joshi M. V.; Process Equipment Design; MacMillan.
4. Kennedy John N.; Oil and Gas Pipeline Fundamentals second edition; PennWell Publishing Company Tulsa, Oklahoma.
5. Khurmi R. S. and Gupta G. K.; A Text Book of Machine Design; Eurasia Publishing House (Pvt.) Ltd., 1994.
6. Galambhor and Guo, “Petroleum Production Engineering a Computer Assisted Approach”, 2007.

PETROLEUM FIELD INSTRUMENTATION AND CONTROL

(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:
Practical: 2 Hrs / week

Examination Scheme:
Practical: 50 Marks

Objectives:

1. To understand the fundamentals and principles of Process Control and field instrumentation.
2. To understand the construction, working, performance characteristics and applications of various instruments.
3. To understand the recent trends in Petroleum Field Instrumentation & Control.

SECTION – I

Unit 1:Introduction: (03 Lect.)

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 2:Process Instrumentation: (03 Lect.)

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

Unit 3:Petroleum Field Instrumentation: (03 Lect.)

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

SECTION - II

Unit 4:Elements of Process Control: (03 Lect.)

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.

Unit 5:Introduction to Controllers: (03 Lect.)

Working mechanism of pneumatic, hydraulic and electronic controllers, Alarm systems, on-off controller. Limit switches. Solenoid valves. Characteristics of control valves.

Unit 6:Process Control of Petroleum Field Operations: (03 Lect.)

Applications of controls for drilling, separation, transportation and storage of oil and gas operations.

DCS. SCADA. Introduction to Ladder Logic Logics for safe shutdown and startup.

Term Work:

Every student should carry out minimum eight exercises from the following list and submission of journal, which will form the term work. Analysis of data should be carried out on computers wherever possible.

List Experiments:

1. To determine control valve characteristics.
2. To determine transient response of first and second order systems.
3. To determine response of feedback control loop using PID controller: Three practical.
4. To determine controller tuning parameters using open loop response.
5. To determine static and dynamic characteristics and to understand calibration of a temperature measuring instrument.
6. To determine static a dynamic characteristics and to understand calibration or a level-measuring instrument.
7. To determine static and dynamic characteristics and to understand calibration of a flow-measuring instrument.
8. To determine static and dynamic characteristics and to understand calibration of a pressure-measuring instrument.
9. To learn to use user interfaces of SCADA and PLC with reference to a simple control scheme.
10. To determine characteristics of mass flow meter.
11. To determine characteristics of optical pyrometer.

Reference Books:

1. Bela Liptak; Instrument Engineer's Handbook; Chilton Book Co.
2. Coughanowr D.R.; Koppel L.B.; Process System Analysis and Control; McGraw Hill.
3. Eckman D. T.; Industrial Instruments; Wiley Eastern.
4. Harriot P.; Process Control; Tata McGraw Hill Ed.
5. Mian M. A.; Petroleum Engineering Handbook Vol. I and II; Penwell Books.

312392 SEMINAR

(T. E. Petroleum Engineering 2008 Course)

Teaching Scheme:	**Examination Scheme:**
Tutorial: 2 Hrs / Week	Term Work: 50 marks

Seminar should be based on a detailed study of any topic related to Petroleum Engineering (preferably the advanced areas / application) and the topic should preferably be relevant to the curriculum.

It is expected that the student collect information from reference books, journals and Internet. The report submitted should reveal the student's internalization of the collected information. Mere compilation from the net and other resources is discouraged.

Format of the Seminar report should be as follows:

1. The report should be neatly written or typed on white paper. The typing shall be with normal spacing and on one side of the paper (A-4 size).
2. The report should be submitted with front and back cover of card paper neatly cut and bound or spirally together with the text.
3. Front cover: This shall have the following details.
    a. Title of the seminar report.
    b. The name of the candidate with roll number examination seat number at the middle.
    c. Name of the guide below the candidate's details.
    d. The name of the institute and year of submission on separate lines at the bottom.
4. Seminar approval sheet.
5. The format of the text of the seminar reports:

    The report shall be presented in the form of a technical paper. The introduction should be followed by literature survey. The report of analytical or experimental work done, if any, should then follow.

    The discussion and conclusions shall form the last part of the text. They should be followed by nomenclature and symbols used followed by acknowledge the bibliography should be at the end. References should be written in the standard format. SPE format for Petroleum Engineering be followed in giving references.

    The total number of typed pages, excluding cover shall be about 25 to 30 only. All the pages should be numbered. This includes figures and diagrams.

    Two copies of the seminar report shall be submitted to the college. The candidate shall present the seminar before the examiners. The total duration of presentation and after-discussion should be about 30 minutes. (25 min + 5 min. Audience can ask questions only if the examiner permits. Such questions will not have any bearing on marks).

    The assessment for the subject shall be based on
    1. Report submitted.
    2. Presentation.
    3. Discussion.