

Scheme & Syllabus
of
Bachelor of Technology
Petroleum Engineering

From III to VIII Semester

For students admitted in session 2017-18

University Teaching Departments
Rajasthan Technical University, Kota



RAJASTHAN TECHNICAL UNIVERSITY KOTA
B. Tech. Petroleum Engineering Scheme
For
University Teaching Departments

SEMESTER III		Course Title	L	T	P	Marks		
						IA	EX	Total
SN	Subject Code	Theory Papers						
1	3PEU01	Drilling-Technology-I	3	1	0	50	100	150
2	3PEU02	Basic Petroleum Geology	3	0	0	50	100	150
3	3PEU03	Fluid Mechanics	3	0	0	50	100	150
4	3PEU04	Fundamentals of Geophysics	3	0	0	50	100	150
5	3PEU05	Drilling Fluids and Cementing Technology	3	0	0	50	100	150
6	3PEU06	Advanced Engg. Mathematics-I	3	1	0	50	100	150
TOTAL			18	2	0	300	600	900
Practical and Sessional								
7	3PEU07	Basic Petroleum Geology lab	0	0	3	50	25	75
8	3PEU08	Fluid Mechanics Lab	0	0	3	50	25	75
9	3PEU09	Drilling Fluids and Cementing Lab	0	0	2	50	25	75
10	3PEU10	DBMS Lab	0	0	2	50	25	75
11	3PEU12	Discipline & Extra Curricular Activity	0	0	0	-	-	50
TOTAL								350
GRAND TOTAL			18	2	10	200	100	1250

R.V. Sunny

24/11/16

22-11-16

23-11-16

23/11/16

Chairman (Exam. UD)
Rajasthan Technical University Kota
Anil K Mathur



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W. of 25/01/17

Semester- IV		Course Title	C	Hrs./Week			Marks		
SN	Subject Code			Theory Papers	L	T	P	IA	End Term Exam
1	4PEU1 4PEU06	Advanced Engineering Mathematics-II	4	3	1	0	50	100	150
2	4PEU2 01	Basic Reservoir Engineering	4	3	1	0	50	100	150
3	4PEU3 02	Fundamentals of Well Logging Technology	3	3	0	0	50	100	150
4	4PEU4 03	Petroleum Production Engineering -I	3	3	0	0	50	100	150
5	4PEU5 04	Petroleum Exploration & Prospecting	3	3	0	0	50	100	150
6	4PEU6 05	Surveying	2	2	0	0	50	100	150
		Practical and Sessional							
7	4PEU7	Reservoir Engineering Lab	2	0	0	3	50	25	75
8	4PEU8	Petroleum Exploration and Prospecting Lab	1	0	0	2	50	25	75
9	4PEU9	Applied Numerical Methods (Sessional)	1	0	0	2	50	25	75
10	4PEU10	Surveying	1	0	0	2	50	25	75
11	4PEU12	Discipline & Extra Curricular activity	1	0	0	0	50	0	50
GRAND TOTAL			25	17	2	9	550	700	1250

L = Lecture, T = Tutorial, P = Practical, C = Credits

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06/01/2017

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Semester- V		Course Title	Hrs./Week				Marks		
SN	Subject Code		C	L	T	P	IA	End Term Exam	Total
1	5PEU1	Drilling Technology-II	4	3	1	0	50	100	150
2	5PEU2	Advanced Reservoir Engineering and Management	4	3	1	0	50	100	150
3	5PEU3	Applied Thermodynamics	3	3	0	0	50	100	150
4	5PEU4	Petroleum Production Engineering-II	3	3	0	0	50	100	150
5	5PEU5.1 5PEU5.2 5PEU5.3	Elective 1 1. Unit Operations for Petroleum Industry 2. Drilling System Design 3. Energy Management & Policy	3	3	0	0	50	100	150
6	5PEU6.1 5PEU6.2 5PEU6.3	1. Health Safety & Environment 2. Introduction to Nano-Science 3. Polymer Science and Technology	2	2	0	0	50	100	150
		Practical and Sessional							
7	5PEU7	Petroleum Production Engineering Lab	2	0	0	3	50	25	75
8	5PEU8	Advance Reservoir engineering(Sessional)	1	0	0	2	50	25	75
9	5PEU9	Heat Transfer lab.	1	0	0	2	50	25	75
10	5PEU10	Health Safety & Environment Lab.	1	0	0	2	50	25	75
11	5PEU12	Discipline & Extra Curricular activity	1	0	0	0	50	0	50
		GRAND TOTAL	25	16	2	9	550	700	1250

L = Lecture, T = Tutorial, P = Practical, C = Credits



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Semester- VI		Course Title	Hrs./Week				Marks		
SN	Subject Code		C	L	T	P	IA	End Term Exam	Total
1	6PEU1	Artificial Lift Techniques	4	3	1	0	50	100	150
2	6PEU2	Well Test Analysis	4	3	1	0	50	100	150
3	6PEU3	Offshore Drilling and Production Operations	3	3	0	0	50	100	150
4	6PEU4	Petroleum Refinery Engineering	3	3	0	0	50	100	150
5	6PEU5.1 6PEU5.2 6PEU5.3	1. Renewable Energy Resources 2. Oil & Gas Field Development 3. Oil & Gas Marketing and Management	3	3	0	0	50	100	150
6	6PEU6.1 6PEU6.2 6PEU6.3	1. Transportation of Petroleum Products 2. Fluidization Engineering 3. Multi-Phase Flow Practical and Sessional	2	2	0	0	50	100	150
7	6PEU7	Petroleum Product Testing Lab.	2	0	0	3	50	25	75
8	6PEU8	Separation Process Lab	1	0	0	2	50	25	75
9	6PEU9	Energy & Geopolitics Sessional	1	0	0	2	50	25	75
10	6PEU10	Comprehensive Petroleum Engineering (Sessional)	1	0	0	2	50	25	75
11	6PEU12	Discipline & Extra Curricular activity	1	0	0	0	50	0	50
GRAND TOTAL			25	17	2	9	550	700	1250

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Semester- VII		Course Title	Hrs./Week				Marks		
SN	Subject Code		C	L	T	P	IA	End Term Exam	Total
1	7PEU/1	Workover and Well Stimulation	4	3	1	0	50	100	150
2	7PEU/2	Enhanced oil recovery Techniques (EOR)	4	3	1	0	50	100	150
3	7PEU/3	Unconventional Hydrocarbon Resources	3	3	0	0	50	100	150
4	7PEU/4	Pipeline Engineering	3	3	0	0	50	100	150
5	7PEU/5.1 7PEU/5.2	1. Process Dynamics & Control 2. Fluid flow through porous media	3	3	0	0	50	100	150
		Practical and Sessional							
7	7PEU/7	Process Dynamics & Control Lab.	2	0	0	3	50	25	75
8	7PEU/8	Pipeline Design Sessional	1	0	0	2	50	25	75
9	7PEU/9	Report Writing	1	0	0	2	50	25	75
10	7PEU/10	Practical Training	4	0	0	4	150	75	225
11	7PEU/12	Discipline & Extra Curricular activity	1				50		50
		GRAND TOTAL	26	15	2	11	600	650	1250

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Semester- VIII		Course Title	Hrs./Week				Marks		
SN	Subject Code	Theory Papers	C	L	T	P	IA	End Term Exam	Total
1	8PEU1	Reservoir Modelling and Simulation	4	3	1	0	50	100	150
2	8PEU2	Natural Gas Engineering	4	3	1	0	50	100	150
3	8PEU3.1 8PEU3.2 8PEU3.3	1. Oil & Gas Processing Plant Design 2. Industrial Engineering Management 3. Petroleum Economics and Risk analysis	3	3	0	0	50	100	150
		Practical and Sessional							
7	8PEU7	Reservoir Modeling & Simulation Lab.	1	0	0	2	50	25	75
8	8PEU8	Comprehensive Viva	1	0	0	2	50	25	75
9	8PEU9	Seminar	4	0	0	4	150	75	225
10	8PEU10	Project	8	0	0	12	250	125	375
11	8PEU12	Discipline & Extra Curricular activity	1				50		50
		GRAND TOTAL	26	9	2	20	700	550	1250

P. K. Mathur

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B. Tech. Petroleum Engineering Syllabus
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3PEU1 ADVANCED ENGINEERING MATHEMATICS-I

Laplace Transform: Definition and existence of Laplace transform, properties and formulae, unit step function, Dirac Delta function, Heaviside function, inverse Laplace transform, Convolution theorem, application of Laplace transform to ordinary differential equation, solution of integral equations.

Fourier Transforms: Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations).

Z-Transform: Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.

Numerical Analysis: Interpolation, difference operators- forward, backward, central, shift and average operators, Newton's forward and backward interpolation formulae, Gauss's forward and backward interpolation formulae, Stirling's formula, Lagrange interpolation formula for unequal intervals. Inverse interpolation.

Numerical differentiation by Newton's, Gauss's and Stirling's formula. Numerical integration: Trapezoidal Rule, Simpson's 1/3 and 3/8 Rule.

Numerical solution of ODE of first order: Picard's method, Euler's method, Modified Euler's method, Runge-Kutta fourth order method, Milne's Method.

TEXT BOOKS:

1. Advanced Engineering Mathematics, Jain and Iyengar, Narosa Publications.
2. Engineering Mathematics for semesters III and IV, C.B. Gupta, Mc Graw Hill Education, India.
3. Advanced Engineering Mathematics, Denis Zill and Warren Wright, Jones & Bartlett India Private Limited.
4. Advanced Engineering Mathematics, O'neil, Cengage Learning, India.

REFERENCE BOOKS:



RAJASTHAN TECHNICAL UNIVERSITY KOTA
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1. Advanced Engineering Mathematics, Irvin Kreyszig, Wiley, India.
2. Advanced Engineering Mathematics, M. Greenberg, Pearson Education, India.
3. Advance Engineering Mathematics, Potter, Oxford, India.
4. Engineering Mathematics, Pal and Bhunia, Oxford, India.
5. Higher Engineering Mathematics, B. V. Ramana, Mc Graw Hill Education, India.
6. Numerical Methods for Scientific & Engineering Computation, Jain and Iyengar, Jain, New Age International Publication, India.
7. A First Course in Numerical Methods, Uri M Asher and Chen Greif, SIAM Publication, India.
8. Introductory Methods of Numerical Analysis, S. S. Sastry, PHI Learning, India.
9. Numerical Methods for Engineers, Chapra, Mc Graw Hill Education, India.
10. Engineering Mathematics, Paras Ram, CBS Publisher, India.

3PEU2 DRILLING TECHNOLOGY –I

Introduction to Oil & Gas Well Drilling: Well planning, Drilling techniques, Drilling Rigs in onshore, Offshore and deep sea environments, Types of wells.

Rotary Drilling Technique: Rig components & functions, Lay out of the rig

Drilling System: Hoisting System, Mud circulation System, Rotation, power System, Rig wire line system handling & storage.

Casing String & Drill String:

Casing types, Functions of different casing, Selection and design of casing, Drill string components,

Drill Bits: Drill bit types and function.

Geological considerations in Drilling:

Geo-technical order (GTO), Lithology of well, DST: Introduction & Application,

Advanced Techniques in Drilling:

Introduction to Directional drilling & other advanced techniques, MWD.

Drilling Problems and its Prevention:



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Well kick, blowout: Prevention and safety, Sloughing shale, Formation damage, Environmental issues, Thief zone, Lost circulation, Underbalance Drilling

Other Considerations While Drilling

Dog-legs, Side tracking and coring, Fishing

TEXT BOOKS:

1. Drilling Engineering-A complete well planning approach; Neal J. Adams; PennWell publishing Company; Tulsa, Okhlama.

REFERENCE BOOKS:

1. Drilling Well Completions by Carl Gatlin, PHI Publication
2. Applied Drilling Engineering; Adam T. Bourgyne Jr., Keith K. Milheim; SPE Casing design theory and practice; S.S. Rahman, G.V. Chilingarian; Elsevier

3PEU3 BASIC PETROLEUM GEOLOGY

Mineralogy and Petrology:

Minerals: General properties and their classification, properties of common rock forming minerals and clay minerals. Petrology: Introduction, classifications and descriptions of some common rocks.

Stratigraphy: principles of stratigraphy; introduction to paleontology, fossils and their mode of preservation, significance as indices of age and climate; concept of index fossils, broad stratigraphic subdivisions and associated rock types of important coal belts and oil fields of India

Structural Geology:

Brittle and Ductile deformation of rocks. Concepts of plate tectonics and plate motion. Attitude of planar and linear structures. Salt domes, Unconformities, folds, faults and joints - their nomenclature, classification and recognition. Forms of igneous intrusions - dyke, sill and batholith. Effects of folds, faults & salt domes on strata and their importance in exploration activities.



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Sedimentology: Sedimentary processes, textures, structures, Classification: Clastic and carbonate rocks, evaporites, coal and oil shales. Tectonics & basin formation. Basin analysis
Sedimentary Environments: Concept of sedimentary environments. Environmental parameters and their control. Classification of environments. Facies model and environmental reconstruction. Role of environmental analysis in petroleum exploration.

Petroleum geology

Physical and chemical characteristics of crude oil, Origin of oil, source rock and maturation. Outlines of early diagenesis, catagenesis and metagenesis. Migration of oil: mechanism, pattern and barriers. Reservoir rocks and cap rocks. Entrapment of oil:-types and mechanism. Accumulation of oil and gas. Geology of prospective basins of India.

TEXT BOOKS

1. Engineering and General Geology, Parbin singh, Katson Educational Series, 2008
2. Geology of Petroleum, A.I. Levorsen, CBS Publisher, 2nd Edition, 2006.

REFERENCE BOOKS

1. Element of petroleum geology, Richard C. shelley, Second Edition, 1998
2. Petroleum Formation and Occurrence, B. P Tissot, D. H. Welte, Springer-Verlag. Berlin Heidelberg NewYork Tokyo 1984.
3. Geological Techniques for Petroleum, Sahay B, Rai A. and Ghosh M.

3PEU4 FLUID MECHANICS

Properties of fluids; Classification; Ideal fluid, Newtonian and Non-Newtonian fluids; Newton's law of viscosity. Pascal's and Hydrostatic law, manometers. Types of manometer

Fluid Statics: fluid pressure and its measurement.

Fluid Kinetics: Continuity equation; types of flow.

Fluid dynamics: One dimensional equation of motion; Bernoulli's equation; application; application of Bernoulli's equation. Friction losses in pipe flow, valves and fittings, k-values, sudden expansion and contraction, pipe flow problems Nozzle. Introduction to laminar &



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turbulent flow. Velocity Distribution for turbulent flow, concept of Reynolds number & friction factor.

Flow through Pipes – Darcy – Weisbach's equation. Head loss in pipes. Pipes in series/ Parallel.

Classification, basic construction and application of different types of pumps.

Pump: Centrifugal pump, Principles and application in Bernoulli's theorem Types of Pump:

Axial pumps, Gear pump, Plunger Pumps Vane pump, Reciprocation pump and Screw pump.

Characteristic Curves of Pumps. Valves, types of valves.

Flow Metering: Metering of fluids; orifice meter, venturimeter, pitot tube, rotameter,

Notches, Gas flow meters, coefficient of discharge.

TEXT BOOK

1. McCabe, W.L., Smith, Julian C. & Harriett, Peter, "Unit Operations of Chemical Engineering", McGraw Hill, New Delhi, 7/e, 2005

REFERENCE BOOK

1. Dr. P N Modi Dr. S M Seth Hydraulics and Fluid Mechanics - Standard Books House
2. Engineering Fluid Mechanics, Kumar K.L., S Chand
3. R.K Bansal, Fluid Mechanics and Hydraulic Machine. S Chand

3PEUS FUNDAMENTALS OF GEOPHYSICS

Gravity: Units of gravity, Spheroid and Geoid, Lacoste- Romberg and Worden gravimeters. Gravity survey, Gravity anomalies. Gravity data reduction Drift, latitude, Elevation and Free-air correction.

Free air & Bouguer anomalies. Regional and residual separation. Interpretation of gravity anomalies. Delineation of faults, folds, intrusive bodies, grabens and horst structures, Bouguer gravity anomaly for sedimentary basins. Application of gravity methods.

Magnetic Method: Basic concepts and definitions. Elements of Earth's magnetic field. Variation of magnetic field over the Earth. Magnetometers: Flux-gate & Proton precession. Field procedure and reduction of magnetic data Aeromagnetic surveys. Interpretation of magnetic



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anomaly map: Delineation of faults, folds, intrusive bodies, grabens and horst structures, magnetic anomaly for sedimentary basins

Seismic Methods: Seismic Waves: Body and surface waves; velocity and attenuation, reflection, refraction and diffraction. Seismic energy sources. Seismic detectors: Geophone and Hydrophone.

Refraction methods: Horizontal beds (two layer cases). Field procedure, Static and Dynamic corrections. Interpretation of refraction data. Application of seismic refraction method

Reflection methods: Geometry of reflection ray path. Horizontal & dipping beds (two layer cases). Time distance relationship, Multiples, seismic noise and their cause.

Methodology for 2D & 3D reflection survey: Different kinds of spread geometries, end on, slit spread, crooked line profiling. Common depth point shooting and its advantages. Different 3D geometries with Swath shooting and cross spreads

Seismic data processing: Flow chart for 2D processing and their discussion.

TEXT BOOKS

1. Fundamentals of Geophysics, Lowri, W., Cambridge University Press. (1997).

REFERENCE BOOKS

1. Introduction to Geophysical Prospecting, Dobrin M.B., New York, McGraw-Hill, Inc.
2. Applied Geophysics, Telford, W.M., Geldart L.P., Sheriff, R.E., Keys, D.A. (1990).
3. Basic Exploration Geophysics, Robinson, E.S. and Coruh C., John Willey and sons, New York, 1998.
4. York, 1998.
5. Planning Land 3-D Seismic Surveys, Andreas Cordsen, Mike Galbraith, and John Peirce Society of Exploration Geophysicists, Tulsa, 2000.

3PEU6 DRILLING FLUIDS AND CEMENTING TECHNOLOGY

Introduction to Drilling Fluids: Overview of drilling fluids, Basic functions, properties, maintenance and treatments of drilling fluids,

Classification, types and applications of drilling fluids:



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Water based, oil based, emulsion based, polymer based, surfactant based, foam based and aerated drilling fluids, Criteria of selection of drilling fluid additives and salinity of drilling fluids.

Drilling fluid calculations.

Cements: Cementing & cement slurry: objectives of cementing, oil well cements.

Classification of cement, slurry design, slurry additives, factors influencing cement slurry design.

Cementing Methods: Primary cementing, stage cementing, liner cementing, plugging, squeeze cementing techniques in practice. Deep well cementing, squeeze jobs, prevention of gas channeling, HT-HP environments, analysis and techniques of evaluation of cement job.

Characteristics of good quality cementation. Cementing calculations

TEXT BOOKS:

1. Drilling Fluids Processing Handbook, Gulf publishing company

REFERENCE BOOKS

1. Azar, J. J., G. Robello Samuel; Drilling Engineering, Penn Well.
2. Drilling Mud and Cement Slurry Rheology Manual; Gulf Publishing Company.
Smith.P.K' Cementing' SPE Publications 2nd Edition 1976

3PEU7 PETROLEUM GEOLOGY LAB

1. Study of physical properties of the minerals
2. Study of physical properties of the rocks
3. Identification of minerals in hand specimen
4. Identification of rocks in hand specimen
5. Study of thin section of Minerals, rocks and microfossils
6. Interpretation of geological structures from surface geological maps.
7. Interpretation of geological structures from borehole data
8. Preparation of structural contours
9. Preparation of isopach & isochore maps of reservoir facies
10. Finding oil-water contact from borehole data



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11. Development of panel diagram from borehole data
12. Calculation of oil reserves in defined structures
13. Identification of Geological features through wooden Models
14. Field visits for Geological structures, stratigraphy and sedimentological Exposure.

3PEU8 FLUID MECHANICS LAB

1. Reynolds experiment for Laminar, transitional and turbulent flow identification, through
2. Reynolds apparatus
3. Verification of Bernoulli's Equation through Bernoulli's Theorem Apparatus.
4. Determination of coefficient of Discharge for Orifice, Venturimeter through Venturimeter and orifice meter test rig.
5. Estimation of losses through pipe fitting, sudden enlargement and contraction frictional
6. Pressure drop in Circular pipes.
7. Verification of Darcy's Law through Darcy apparatus.
8. Demonstration of Gas-Liquid Multiphase flow regimes in horizontal and vertical flow through pipe and Numericals based on Lockhart Martinelli equation
9. To Study Construction, Working of Centrifugal, Reciprocating, Gear and Plunger Pumps through test rig
10. To Study Pitot tube apparatus and cavitation apparatus in a pipe flow.

3PEU9 DRILLING FLUIDS AND CEMENTING LAB

1. Measurement of mud weight
2. Measurement of mud density.
3. Measurement of mud plastic viscosity.
4. Measurement of gel strength.
5. Determination of filtration loss
6. Determination of Sand content
7. Determination of consistency of cement slurry.

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8. Determination of the setting points of the cement based slurries.

3PEU10 DBMS LAB

Objectives: At the end of the semester, the students should have clearly understood and implemented the following:

1. Stating a database design & application problem.
2. Preparing ER diagram
3. Finding the data fields to be used in the database.
4. Selecting fields for keys.
5. Normalizing the database including analysis of functional dependencies.
6. Installing and configuring the database server and the front end tools.
7. Designing database and writing applications for manipulation of data for a standalone and shared data base including concepts like concurrency control, transaction roll back, logging, report generation etc.
8. Get acquainted with SQL.

In order to achieve the above objectives, it is expected that each students will chose one problem. The implementation shall being with the statement of the objectives to be achieved, preparing ER diagram, designing of database, normalization and finally manipulation of the database including generation of reports, views etc. The problem may first be implemented for a standalone system to be used by a single user. All the above steps may then be followed for development of a database application to be used by multiple users in a client server environment with access control. The application shall NOT use web techniques. One exercise may be assigned on creation of table, manipulation of data and report generation using SQL.

Suggested Tools:

For standalone environment, Visual FoxPro or any similar database having both the database and manipulation language may be used.



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For multi-user application, MYSql is suggested. However, any other database may also be used.
For front end, VB.Net, Java, VB Script or any other convenient but currently used by industry may be chosen.

Indicative List of exercises:

1. Student information system for your college.
2. Student grievance registration and redressal system.
3. A video library management system for a shop.
4. Inventory management system for a hardware/ sanitary item shop.
5. Inventory management system for your college.
6. Guarantee management system for the equipments in your college.

3PEU12 DECA



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Fourth Semester B. Tech Petroleum Engineering

4PEU1 ADVANCED ENGINEERING MATHEMATICS-II

Complex Analysis: Differentiability and Analytic functions, Cauchy-Riemann equations (Cartesian and Polar forms), Harmonic functions. Conformal mapping.

Complex Line integral, M-L inequality, Cauchy theorem, Morera's theorem, Cauchy integral formulae, Taylor series and Laurent series.

Singularities and Zeros, residues at poles and infinity, residues at isolated essential singular point, Cauchy residue theorem, evaluation of real definite integrals and improper integrals.

Special Functions: Legendre's function, Rodrigues formula, generating function, Simple recurrence relations, orthogonal property.

Bessel's functions of first and second kind, generating function, simple recurrence relations, orthogonal property.

Statistics & Probability: Basic concepts of probability, conditional probability, Baye's theorem.

Random variable and distributions: Discrete and continuous random variables, Moments, Expectation, Moment generating function, Binomial, Poisson and Normal distribution.

TEXT BOOKS:

1. Advanced Engineering Mathematics, Jain and Iyengar, Narosa Publications.
2. Advanced Engineering Mathematics, Denis Zill and Warren Wright, Jones & Bartlett India Private Limited.
3. Introduction to Probability and Statistics, Seymour Lipschutz and John J. Schiller, Mc Graw Hill Education, India.
4. Advanced Engineering Mathematics, O'neil, Cengage Learning, India.

REFERENCE:

1. Advanced Engineering Mathematics, Irvin Kreyszig, Wiley, India.
2. Advanced Engineering Mathematics, M. Greenberg, Pearson Education, India.
3. Advance Engineering Mathematics, Potter, Oxford, India.
4. Engineering Mathematics, Pal and Bhunia, Oxford, India.
5. Higher Engineering Mathematics, B.V. Ramana, Mc Graw Hill Education, India.
6. Complex Variables and Applications, J.W. Brown & R.V. Churchill, Mc Graw Hill Education, India.
7. Probability and Statistics, Murray Spiegel, John Schiller, R. Alu Srinivasan, McGraw Hill Education, India.
8. Engineering Mathematics, Paras Ram, CBS Publisher, India.

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4FEU2 BASIC RESERVOIR ENGINEERING

Fundamental concepts: Introduction to Hydrocarbon Reservoir, Fluid pressure regimes
Fundamentals of rock properties: Porosity & Permeability: Types & Determination, Permeability in Series & parallel combination of beds Fluid saturation, Wettability, surface and interfacial tension Capillary Pressure, Permeability, rock compressibility,
Flow of Fluids through Porous Media : Darcy's law, single and multiphase flow, linear, radial & spherical flow, steady state & unsteady state flow, GOR, WOR equation
Phase behavior
Equations of States (EOS), Reservoir fluid sampling, PVT properties determination and their significance, Laboratory PVT Analysis
Reservoir Drives: Different reservoir drive mechanisms and recovery factors
Reserve estimation: Different reserve estimation techniques: Volumetric, MBE, decline curve analysis, Hydrocarbon Reserves & Its Classification.

BOOKS:

1. Reservoir Engineering Handbook by Tarek Ahmed, Gulf publishing.
2. Basics of reservoir Engineering by R. Cosse, Editions Technip Publication
3. Fundamentals of Reservoir Engineering by L.P. Dake, Shell learning & development, Elsevier publication

4PEU3 FUNDAMENTALS OF WELL LOGGING TECHNOLOGY

Well logging Technique:- Its role in Hydrocarbon exploration & production. Borehole environment

Wireline logging Methods: SP and Resistivity logs (focused resistivity, Lateral logs, MSFL, Induction log), Radioactive logs, Acoustic logs (principles, types of tools and applications). Evaluation of CBL/ VDL, USIT, SFT, RFT.

Production Logging: Introduction, type of tools, principles, limitations and applications.

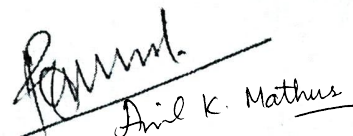
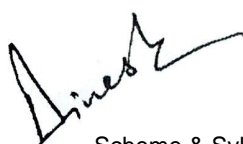
Special Type of Logging Tools: Casing inspection tools (principles, application and limitation), Formation micro scanner (FMS), DSI, NMR logging principles. Logging in high-angle wells.

Log Interpretation and Analysis Techniques.

Standard log interpretation methods. Cross-plotting methods: neutron-density, sonic-density and sonic-neutron etc. Clean sand interpretation. Concepts of invasion – RXO, Tornado charts. Shaly sand interpretation.

BOOKS

1. Open Hole Log Analysis and Formation Evaluation by Richard M. Bateman
2. Modern Open Hole Log Interpretation, John. T. Dewan
3. Well Logging Data Acquisition and Application O&L Serra ISBN-978295156125, TECHNIP.
4. Handbook of Well Log Analysis, S.J. Pirson
5. Log Interpretation Principles and Applications, Schlumberger Educational services.



4PEU4 PETROLEUM PRODUCTION ENGINEERING-I

Surface Production Equipment: Well wellhead assembly and attachments, Casing hangers, Christmas tree assemblies, Valves, Components and design considerations of wellhead equipment and choke, Surface Safety Valve.

Subsurface Production Equipment: Sub Surface Safety Valve, choke sizing, Bottom-hole chokes and regulators, Circulation devices, Expansion joints, Safety joints, Landing nipples, Production packers,

Well Completion Engineering: Well completion Techniques & procedure, Well completion fluid, Well perforation, Perforation fluid, Packer fluid, Well activation, Factors affecting perforation efficiency

Inflow performance relationship: 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.

Work over & Well stimulation:

Workover system, workover rigs and selection, Coiled tubing unit, Wire-line operations, Workover & completion fluids - types & selection, Well stimulation techniques: Hydraulic fracturing & Acidizing. Sand control techniques

BOOKS:

1. Production Operations Vol.- 1 & Vol. 2, Thomas O. Allen & Alan P. Roberts.
2. Surface production Operation Vol.-1 & Vol. 2, Ken Arnold & Maurice Stewart
3. Well Completion and Servicing, D. Perrin, Editions Technip

4PEU5 PETROLEUM EXPLORATION AND PROSPECTING

Geochemical Methods

Introduction to Petroleum Geochemistry, Theories of origin of petroleum, Biomass composition, Sedimentary organic matter, Transformation of sedimentary organic matter into kerogen. Migration and accumulation of oil and gas, Biomarkers, Stable isotopes, Source rock characterisation and evaluation, Oil to oil and oil to source correlation, gas to gas and gas to source correlation, Surface indications of subsurface oil and gas accumulations, Surface geochemical prospecting methods.

Seismic Data Interpretation:

Introduction to seismic data interpretation, Study of seismic section and other geological aspects of prospecting, Structural analysis through seismic. Time to depth conversion & its limitations and strength. Seismic stratigraphic interpretation.

Reservoir Geophysics: Introduction to multi component seismic survey. Application of 3D and 3C seismic data in reservoir studies. AVO: types, classifications & importance. Vertical Seismic Profiling (VSP): acquisition, processing and interpretation.

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BOOKS

1. The Nature of Digital Seismic Processing, Roy O. Lindseth, Calgary, Alberta, Canada
2. Seismic Stratigraphy, Basin Analysis and Reservoir Characterization, (Handbook of Geophysical Exploration: Seismic Exploration, vol. 37) Paul C.H. Veeken; Elsevier.
3. Seismic Data analysis, OZ Yilmaz, Society of Exploration geophysicist, Tulsa 2000
4. Petroleum Formation and Occurrence, B. P Tissot, D. H. Welte, Springer-Verlag. Berlin Heidelberg New York Tokyo 1984.

4PEU6 SURVEYING

Introduction to Surveying: Objective of surveying and its importance, Classification, principles of surveying, Application of Surveying in various fields of Engineering.

Linear & Angular measurements: Methods and Techniques. Theory and characteristics of electromagnetic waves, radio waves, infra red, laser waves, principle of distance measurement with EDMs.

Theodolite: The essentials of transit theodolite, definition and terms, temporary adjustments, measurement of horizontal and vertical angles, different operations and sources of error, theodolite traversing, Omitted Measurements.

Total Station: Principle, working and construction. Corrections to be applied.

Leveling instruments: Definition, different type of leveling instruments, curvatures and refraction corrections, reciprocal leveling, errors in leveling and problem solving, Contouring

Plane Table Surveying: Principle and Methods in brief.

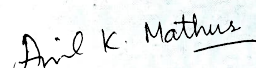
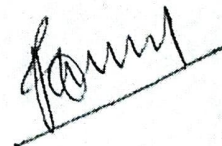
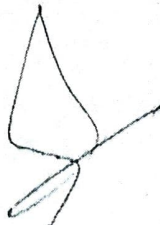
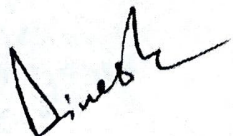
Global Positioning System (GPS): Theory, principles and applications **GIS:** Introduction to GIS, Its application in mapping.

TEXT BOOKS

1. Basic Surveying: Walter S. Whyte, R. E. Paul, Elsevier Science & Technology

REFERENCE BOOKS

1. GPS for Land Surveyors, Jan Van Sickle, Denver, Colorado, USA, CRC Press, Third Edition.
2. Surveying Vol. I B.C. Punmia
3. Surveying Vol. II B.C. Punmia



CTICALS

37 RESERVOIR ENGG. LAB

1. Determination of porosity of rock samples by Helium Porosimeter
1. Determination of permeability using Gas Permeameter.
2. Determination of permeability using Liquid Permeameter.
3. Determination of surface tension of various Petroleum fractions.
4. Determination of porosity of rock samples by saturation method.
5. Study of Ternary phase diagram with oil fraction/water/alcohol.
6. Study of computation of Amount of initial gas in place and gas reserves using production vs. time data and decline curve analysis method,
7. Study of computation of permeability and skin Using chart scanner and a recorded bottom hole, built-up chart and production data before shut down

4PEU8 EXPLORATION AND PROSPECTING LAB

Petroleum Geochemistry:

1. Study of Rock-Eval logs to identify source rock sequences
2. Study of geochemical parameters of oil and gas to correlate petroleum pools
3. Study of surface microseep anomaly maps to prioritise prospects

Seismic data analysis:

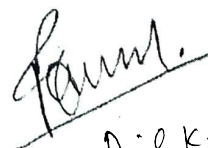
1. Horizon picking
2. Map building & Seismic well log tie.

Well log analysis & Interpretation

1. Identification of fluid types & bed boundaries by logs
2. Computation of porosity of the formation using porosity logs
3. Find out the lithology of given data using cross plot.
4. Computation of Volume of shale from integrated approach.
5. Find out hydrocarbon saturation from Archie equation & Indonesian Equation.

4PEU9 APPLIED NUMERICAL METHODS (SESSIONAL)

1. Numerical solution of non-linear algebraic and transcendental equation by bisection, iteration, false position, secant and Newton Raphson methods.
2. Numerical solution of system of linear simultaneous equations by Gauss elimination and Gauss Seidel methods.
3. Interpolation by Lagrange's interpolation formula.
4. Numerical evaluation of definite integral by Trapezoidal, Simpson's 1/3rd, Simpson's 3/8th, Weddle and Gaussian quadrature formulae.
5. Numerical solution of first order ordinary differential equation by Euler's, Modified Euler's, second and fourth order Runge-Kutta, Adams-Moulton and Milne's method



10 SURVEYING

1. Measurement and adjustment of included angles of traverse using prismatic compass.
2. To determine the reduced levels using Tilting Level.
3. To determine the reduce levels in closed circuit using Dumpy Level.
4. Prepare contour map by levelling.
5. Measurement of horizontal angle.
By method of repetition.
By method of Reiteration.
6. Study of Global Positioning System (GPS) and measurement with GPS.
7. Study of total station and measurement with total station.

Note : Above exercise must be performed using Total station to the maximum possible extent.

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RAJASTHAN TECHNICAL UNIVERSITY KOTA
B. Tech. Petroleum Engineering Syllabus
For
University Teaching Departments

Fifth Semester B.Tech Petroleum Engineering

SPEU1 DRILLING TECHNOLOGY-II

Directional Drilling : Objectives, Types of deflection tools, tool orientation, Directional well profiles, Well path deflection & correction.

Down Hole Motors : Positive displacement motors and Turbo-drills –motor description, Power calculation and applications.

Horizontal Well Drilling : Horizontal well objectives and selection, Different profiles, Drilling techniques, Slant Hole Drilling : Objectives and selections, Well profiles and applications.

Down the Hole Well Surveying : Well surveying objectives, surveying methods, Surveying Analysis methods and calculations for well coordinates.

Measurements While Drilling: Objectives of MWD/ LWD; MWD tools, Telemetry system and data interpretation.

Special Methods of Drilling : Aerated drilling, Under-balanced drilling, Overbalanced drilling, HPHT Drilling, Plasma drilling, Top drive drilling, Re-entry drilling, Jet Drilling, Extended reach drilling, Multilateral drilling, Slim hole drilling, Coil tubing drilling.

Well Control: Primary, Secondary, Tertiary well control operational procedures, well control methods well control kill sheet, kick pressure analysis, Special conditions and problems, BOP control unit, Accumulator calculations, BOP stack testing's, Snubbing, Stripping.

BOOKS

1. Drilling & Casing Operations, Jim Short, J.A., Penwell Publishing Company, Oklahoma
2. Well Design Drilling & Production, Craft B.C., Prentice Hall 1962
3. Applied Drilling Engineering, Bourgoyne A.T, Millheim K K, Chenevert M E and Young F. S., SPE textbook series, 1991
4. Horizontal and Directional Drilling, Carden, R. S., Petroskills, 2007,
5. Working Guide to Drilling Equipment and Operations, Lyons W, Gulf Professional Publishing, 2010,
5. Well Engineering and Construction, Rabia, H., Gulf Publishing

SPEU2 ADVANCE RESERVOIR ENGINEERING & MANAGEMENT

Relative permeability: Fractional flow. Well performance – inflow performance, tubing performance.

Material balance equation: Generalized Oil & Gas MBE and its modifications, applications

Reservoir drive mechanism: Water drive, partial water drive, depletion drive, gas cap drive, gas expansion, solution gas, rock drive, gravity drainage, combination. Decline curves for drive types, predicting reservoir drive mechanism, Drive Mechanism and recovery factors, production


Ritesh Palidar




Anil K. Mathur



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behaviour of oil & gas reservoirs, Performance prediction of depletion drive, gas cap drive, water drive and combination drive

Water influx : Classification of aquifers, steady and unsteady state water influx models, Reservoir pressure maintenance techniques, their advantages and limitations

Well performance: Vertical and horizontal oil wells. Vertical and horizontal gas wells

Gas and water coning: Coning in vertical wells, breakthrough time and after breakthrough performance, coning in horizontal wells, breakthrough time

Petrophysics: Core analysis and petrophysical measurements, core cutting and plug preparation, core gamma logger, laboratory methods and techniques, petrophysical parameters and their significance.

Reservoir Management: Reservoir management process, reservoir management team, downhole monitoring and acquisition, management of continuous data stream, integration of data to subsurface model, immersive visualization systems, intelligent completions, rigless intervention, improved performance through field life. Benefits of reservoir management – case examples.

BOOKS

1. Advance Reservoir Engineering by T. Ahmed, P. D. McKinney, Elsevier.
2. Fundamental of Reservoir Engg by L.P Dake
3. Petroleum Reservoir Engg by Amyx, McGraw Hill 1998 .
4. Applied Petroleum Reservoir Engineering ,Craft B.C and Hawkins M.F , Prentice Hall Engle wood cliffs, N J1991

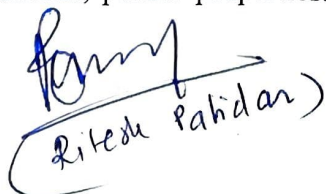
5PEU3 APPLIED THERMODYNAMICS

Introduction and First law: The scope of thermodynamics, dimensions and units, measures of amount or size, force, temperature, pressure, work, energy and heat. The first law of thermodynamics and other basic concepts, Joules' experiment, internal energy, energy balance for closed systems, thermodynamic state and state functions, equilibrium, the phase rule, The reversible process, constant volume and constant pressure process, enthalpy, heat capacity.

The second law of thermodynamics: statements of the second law, heat engines, thermodynamic temperature scales, entropy. Entropy changes of an ideal gas, mathematical statement of the second law, entropy balance for open systems, Calculation of ideal work, the third law of thermodynamics. Classification and performance of internal combustion engines.

Refrigeration and Liquefaction: the Carnot refrigerator-V and T-S diagrams. Analysis of air standard cycles. Carnot cycle, Vapour-compression cycle, Choice of refrigerant, absorption refrigeration, the heat pump, liquefaction process. Vapour- Liquid Equilibrium: The nature of equilibrium, the phase rule VLE – Quantitative behaviour, VLE by modified Raoult's Law, VLE from k-value correlations.

Solution thermodynamics: theory, fundamental property relation, the chemical potential and phase equilibria, partial properties. Ideal-gas mixtures, fugacity and fugacity coefficients, pure


Ritesh Pahidan




Anil K. Mathus



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species, species in solution, generalized coefficient, the ideal solution, excess properties. Application ; liquid phase properties from VLE data, models for the excess Gibb's energy, Property changes of mixing, heat effects of mixing processes

Chemical Reaction Equilibria: The reaction coordinate, application of equilibrium criteria to chemical reactions, the standard Gibbs Energy change and the equilibrium constant, Effect of temperature on the equilibrium constants, relation of equilibrium constants to composition, Equilibrium conversions for single reactions, phase rule and Duhem's theorem for reacting systems.

BOOKS

1. Introduction to Chemical Engineering Thermodynamics, Smith, J. M. and Van Ness H. C., McGraw-Hill, 6/e 2003.
2. Thermodynamics of Hydrocarbon Reservoirs, Abbas Firodabadi, McGraw-Hill Publishing, 1999.
3. Rao, Y.V.C. "Chemical Engineering Thermodynamics", Universities Press, India 2/e, 2001.
4. Kyle; B.G., "Chemical and Process Thermodynamics"; Prentice Hall, New York, 3/e, 1999
5. K V Narayanan Chemical Engineering Thermodynamics, PHI Learning, 2004.

5PEU4 PETROLEUM PRODUCTION ENGINEERING-II

Oil Surface Production Facilities: Gathering and collection of oil and gas: GGS, CTF and GCS - layout, equipment, sequential treatment, process flowsheet, and safety features.

Field Processing of Oil & Gas: Flash and stage separation of oil & gas, Separator types. Design of Oil & Gas separators, working principle. Demulsification, dehydration, stabilisation and desalting of crude oil.

Demulsification of crude oil emulsion: Theory of emulsion and demulsification, Methods of emulsion breaking- Thermal methods, Mechanical methods- free water knock out drums, production traps or three phase separator, desalters. Electrical methods, Chemical methods- mechanism, chemical (demulsifier) selection. mixing / agitation. dosage, factors affecting demulsifier efficiency. Equipment, Process, Produced water treating system for disposal

Dehydration and desalting of crude oil: Method, process, equipment.

Natural gas processing: Types of natural gases, Contaminations. Natural gas processing plant- layout, various units and their functions. various processes. recovery of useful products

Surface facilities for water injection: Water injection plant. source of injected water, layout, equipment, process. Maintenance of injection water quality.



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Storage of Petroleum and Petroleum Products: Types of storage system, Design of storage tanks as per API and ASTM codes, construction, working principle, safety features

Metering and Measurements: Metering of oil & gas, Orifice and other metering devices and systems. Multiphase flowmeter. Sampling and Testing of crude oil. Water and sediment determination.

Problem well analysis: Problems in oil / gas well- lower producing rate, increased water production, increased gas production, mechanical problems, Reasons

Formation damage: Mechanical mechanisms: Fines migration, Solid invasion, Phase trapping, Mechanical damage, Perforation induced, Chemical mechanisms: Rock-fluid interaction (clay swelling, clay deflocculation, wettability alteration), Fluid-fluid interaction (Paraffin, Asphaltene, Hydrates, Scales, Emulsions), Biological mechanisms (Polymer secretion, Corrosion, Souring). Formation damage during drilling, casing, cementing, completion, production initiation, well stimulation, hydrofracturing, acidization, cleaning of tubing, casing and wellbore, well servicing or workover, production, water or gas injection,

BOOKS

1. Surface Production Operations, Volume 1 & 2, Second Edition: Ken Arnold; Maurice Stewart, Gulf Professional Publishing; Edition-1999,
2. Production Operations Vol.- 1 & Vol. 2, Thomas O. Allen & Alan P. Roberts.
3. Well Completion and Servicing, D. Perrin, Editions Technip

ELECTIVES:

5PEU5.1 UNIT OPERATION FOR PETROLEUM INDUSTRY

Conduction: Introduction to unit operation and its application in petroleum engineering. Heat Transfer and its application, Modes of heat transfer one dimensional and two dimensional, heat rate equations, Theory of insulation, critical radius calculations, types of insulation material, conduction through slab, cylinder and sphere.

Convection: Convective heat transfer, natural and forced convection, co/counter/cross current contacting for heat transfer, individual and overall heat transfer coefficient, Fouling factor, Heat transfer with and without phase change conditions.

Heat Exchange equipment: Introduction to double pipe, shell and tube exchangers, condensers, extended surface equipment.

Evaporation- Type of evaporators and their applications single and multiple effect evaporators, operation of forward- backward and mixed feed operations,

Mass transfer and its application: Analogies in transfer process, basic concept of diffusion and interphase mass transfer. Mass transfer theory film theory Penetration and surface renewal theory

Distillation: Rectification, reflux ratio, calculation of numbers of plates by McCabe Thiele method, optimum reflux ratio

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Basic introduction to absorption, liquid liquid extraction, leaching
Drying: Equilibrium mechanism theory of drying, drying rate curve.
Introduction to filtration Sedimentation and settling.

BOOKS

1. Process Heat Transfer, Kern, D. Q. McGraw Hill USA
2. Unit Operation of chemical engineering, Mc Cabe, W.L. Smith, J C and Harriot, P., McGraw Hill 1993
3. Mass transfer operation. Treybal, R.E. Kogakusha, McGraw Hill 1980.
4. Transport Process and Separation Processes Principles (Includes Unit Operations) 4th Ed, Geankopis, C. J., Prentice Hall
5. Principles of Unit Operations, Foust, A.S., Wenzel, L.A., Clump, C.W., Naus, L

5PEU5.2 DRILLING SYSTEM DESIGN

Drilling Rig Selection and Design: Environmental loading and stability of rig. Design of Block and Tackle System, Design of Draw works Drum, Top drive drilling.

Casing Design: Conventional and conditional Casing Design Practices, Deep well strings,

Design practices for high inclined, Horizontal and Slanted wells: Liner design and setting, Casing Buckling and Well Head Loads: Casing landing practices, Buckling criteria and Calculation of well head loads. Casing while drilling.

Drill String Design: API classification, Design criteria MOP, Various loading conditions, Fatigue bending of pipe, Critical rotary speed, Drill string vibrations, Tangent point, Drill collar tangent length, Bit side force with respect to directional drilling aspect.

Mud Hydraulics Design: Rheology of drilling fluids and compatibility to borehole conditions, Hydraulic horse power and Rig horse power calculations. Jet impact force, Hydraulics design in High inclines wells. Bit Hydraulics, Bottom drive hydraulics design.

Rotary System Design: Design and performance of Kelly drive, Bottom Drive and Top Drive Systems.

BOOKS

1. Drilling Engineering-A complete well planning approach; Neal J. Adams; PennWell publishing Company; Tulsa, Oklahoma.
2. Drilling Well Completions by Carl Gatlin, PHI Publication
3. Applied Drilling Engineering; Adam T. Bourgyne Jr., Keith K. Milheim; SPE Casing design theory and practice; S.S. Rahman, G.V. Chilingarian; Elsevier

5PEU5.3 ENERGY MANAGEMENT & POLICY



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Marketing policy for oil & Gas: Markets for oil, gas, coal, electricity and renewable energy, resources and alternate fuels. Legal and policy aspects of supply and trading in energy.
Regulations of energy industries: Industry privatization. International context of liberalization of energy markets. Land acquisition policy.

Modeling techniques for supply and demand: market structure, transportation models, game theory, futures markets, environmental issues, energy policy, energy regulation, input/output models, linear and nonlinear programming models, energy conservation, and dynamic optimization. Development of appropriate models and their application to current issues in energy markets. Energy audit.

BOOKS

1. Introduction to the global oil and gas business by Samuel A. Van Vactor, Pennwell Publication, 2010

2. Energy Management Handbook by Wayne C. Turner, Steve Doty

SPCU6.1 HEALTH SAFETY & ENVIRONMENT

Importance of Safety

Industrial safety and loss trends, safety and environmental concerns, development of industrial safety and loss prevention approaches – loss prevention. Total loss control, quality assurance, total quality management, concept of hazard system. The characterization of hazards, hazard sources and their realization.

Safety Hazards

Major process hazards: self-heating, flame propagation, limits of flammability, explosion, detonation and deflagration, toxic materials. Dosage, acute and chronic effects, threshold limits, fire, explosion and toxic release, effects of hazards.

Building a Safe Environment

Parameters determining probability and consequence of hazards, occupational health and hygiene, personal safety methods, work permit, material safety data sheet.

Hazard identification: use of hazard indices, hazard and operability studies

Hazard Control: Major hazard control, legislation and laws, case studies of major hazard events.

Impact on Air

Air pollution: major pollutants, meteorology, lapse rate, dispersion, engineering control of air pollution. Safety aspects of H₂S leakage from oil and gas fields. Air pollution causes, remedies in fertilizer plants, petrochemical plants etc.

Impact on Water

Water pollution: physical, chemical and biological water quality parameters, pollution by oil spills. Ground water pollution near oil dispensing stations.

Pollution Control

Remediation of the environment, engineered systems for water purification, sludge treatment and disposal. Water pollution causes and remedies in oil production sites, refiners and in production of petrochemicals,

HSE laws, regulations and norms in respect of petroleum industry



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BOOKS

1. Daniel A. Crowl chemical Process Safety Fundamental with Application Prentice Hall International Series
2. Loss Prevention in the Process Industries, Less, F. P., 2nd ed. Butterworth Heinemann, UK,
3. Environmental Engineering; Peavy, H. S., Rowe, D. R. and Tchobanoglous, G., McGraw Hill.
4. Chemical Process Safety, Sanders, R. E., Butterworth Heinemann, UK
5. Critical Aspects of Safety and Loss Prevention, Kletz, T. A., Butterworth Heinemann, UK.
6. Stefan Orszulik Environmental Technology in Oil Industry – Springer.

5PCU6.2 INTRODUCTION TO NANO-SCIENCE

Introduction: Fundamental concept, size, quantum effect, size Moore's law, Band gap, photon, Different interactions at nanoscale (electrostatic, Van der Waals, hydrophobic, hydrogen bonding, dipole dipole).

Nanostructured Materials Classification: Zero dimensional, One dimensional, two dimensional and three dimensional nanomaterials. Advanced materials such as quantum dots, polymeric nanoparticles, Carbon nanotubes, Graphene, Aerogels;

Application of nanomaterials: Nano Catalyst in refinery diesel oxidation catalyst and petrochemical, crude production, nano material in exploration and production as a smart fluid, drilling fluid etc.

Properties of Nanomaterials: Surface to volume ratio; Surface properties of nanoparticles; mechanical, optical, electronic, magnetic, thermal and chemical properties of nanomaterials. Size dependent properties, size dependent absorption spectra, Shape impact on properties of nanomaterials.

Nanomaterials synthesis: Top down and bottom up approach, Chemical methods (sol-gel technique, metal reduction, chemical vapor deposition, combustion technique.) Mechanical methods (Grinding, lithography, Microfluidics). Preparations of catalysts, Regeneration of catalysts.

General Characterization Techniques:

Beam probe Methods (SEM, TEM, XRD), Scanning Probe Methods (AFM, STM), BET area analyzer, UV-vis Spectroscopy.

BOOKS

1. Introduction to Nanoscience by G.L. Hornyak, J. Dutta, H.F. Tibbals, A.K. Rao, CRC Press
2. Chemistry of nanomaterials : Synthesis, properties and applications by CNR Rao et.al.
3. Nanochemistry: A chemical approach to nanomaterials by G. A. Ozin, A. C. Arsenault, L. Cademartiri, RSC Publishing
4. Processing & properties of structural nanomaterials - Leon L. Shaw (editor)
5. Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.
6. Nanoscale materials -Liz Marzan and Kamat.
7. Nano: The essentials by T. Pradeep, Tata McGraw Hill.

5PCU6.3 POLYMER SCIENCE AND TECHNOLOGY



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B. Tech. Petroleum Engineering Syllabus
For
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Classification of polymers, Linear branched and cross-linked polymers, Molecular weights of polymers. Polydispersity and Mol. Wt. distribution in polymers. Random, alternate, block and graft co-polymers, polymer characterization techniques, polymer degradation. Kinetics of chain & Step polymerization, techniques of molecular weight control.
Initiators, Chain transfer agents, Inhibitors. Techniques of polymerization. Bulk, Solution, Suspension & Emulsion polymerization.
Introduction to polymer rheology, Newtons law of viscosity, viscometris plots, rheometers. Rheological models, theory of viscoelasticity, Heat distortion temperature.
Basic concept of polymer processing: Compounding methods, Extrusion moulding, Injection moulding. Blow moulding, Rotational moulding. Introduction to fibre reinforced plastics.

BOOKS

1. Kumar, A., "Fundamentals of Polymer Engineering", 2/e, Marcel Dekker, New York, 2003
2. Gowariker, V.R., Viswanathan, N.V. and Sreedhar, J., "Polymer Science", New Age International (P) Ltd, New Delhi, 1986.
- 3.. Odian, G., "Principles of Polymerization", John Wiley & Sons Inc, New York, 1991.
- 4.. Tager, A., "Physical Chemistry of Polymers", Mir Publishers, Moscow, 1978.
- 5.. Perepechko, I.I., "An Introduction to Polymer Physics", Mir Publishers, Moscow, 1981.
6. Billmeyer, F. W. "Textbook of Polymer Science", John Wiley & Sons, New York, 1984.

PRACTICAL AND SESSIONAL

5PEU7 PETROLEUM PRODUCTION ENGINEERING LAB

1. Measuring the density.
2. Measuring the specific gravity and API gravity.
3. Measuring the viscosity using Brookfield Viscometer
4. Measuring the viscosity using U – tube Viscometer
5. Determination of the water in crude oil by distillation
6. Determination of the water in crude oil by the centrifuge.
7. Determination of the total salts content of crude oil by conductivity method.
8. Determination of natural gas composition using GC chromatography

5PEU8 ADVANCE RESERVOIR ENGINEERING (SESSIONAL)

Study related to the following

- 1 Special Core Analyses (degree of moisture, capillary pressure, electrical abilities and relative permeability)
- 2 Petrophysical measurements (capillary pressure curves, resistivity measurements and compressibility)

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B. Tech. Petroleum Engineering Syllabus
For
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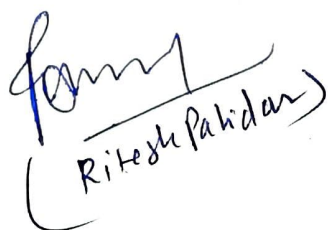
- 3 Core and plug preparation: Introduction to the machines for the various steps of core preparation including core slabbing, core plugging and trimming. Also sand/shale analysis and depth matching through the use of core gamma logger will be introduced.
4. Cleaning and saturation determination. The available instruments for core cleaning as well as saturation determination will be introduced. This includes extraction/distillation method for core cleaning (Dean Stark), drying and heating for saturation determination (Retort Oven)
5. Porosity: An introduction to core porosity and various methods of its measurements. Describing Hg porometer and KeyPhi instruments for porosity measurements.
6. Resistivity. Introduction for the rock conductivity measurements at surface for pressure and at overburden pressure.
7. Surface and interfacial tension. An introduction to various methods of measurements.
8. Capillary pressure. Introduction to capillary measurement methods under drainage and imbibition.

5PEU9 HEAT TRANSFER LAB

1. To Measure the thermal Conductivity of Liquid and solid.
2. To measure the thermal conductivity of liquid and solid (linear model).
3. To measure the transfer conductivity measurements in linear and radial method.
4. To Measure the Emissivity of the Test plate Surface.
5. To Determine Stefan Boltzmann Constant of Radiation Heat Transfer.
6. To Determine the Surface Heat Transfer Coefficient for Heated Vertical Cylinder in Natural Convection.
7. Determination of Heat Transfer Coefficient in Drop Wise & Film Wise condensation.
8. To Study of Performance of Simple Heat Pipes
9. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
10. To determine the total thermal conductivity and thermal resistance of the given compound resistance in series.
11. Testing and performance of different heat insulators.
12. To understand the importance and validity of Engineering assumptions through the lumped heat capacity method.

5PEU10 HEALTH SAFETY & ENVIRONMENT LAB

1. Toxicity, Physiological, Asphyxiation, respiratory and skin effect of Petroleum Hydrocarbons (including mixtures), sour gases (e.g. Hydrogen sulphide and carbon monoxide etc) with their thresh-hold limits.
2. Effect of corrosive atmosphere and additives during acidizing, sand control and fracturing jobs etc.


(Ritesh Pakidan)






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Safety System:

1. Hazards analysis, developing a safe process, failure mode analysis, safety analysis (API-14C) safety analysis function evaluation chart (synergic approach).
2. Manual & atmospheric shut down system, blow down systems.
3. Gas detection system
4. Fire detection and suppression systems.
5. Personal protection systems & measures.
6. HSE Policies, standards & specifications
7. Disaster & crisis management.

Environment:

1. Environment concepts, impact on eco-system, air, water and soil.
2. The impact of drilling & production operations on environment, Environmental transport of petroleum wastes.
3. Offshore environmental studies, offshore oil spill and oil spill control.
4. Oil mines regulations and other environmental legislations.

5PEU12 DECA



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Sixth Semester B.Tech Petroleum Engineering

6PEU1 ARTIFICIAL LIFT TECHNIQUES

Introduction: definition and purpose of artificial lift, Inflow performance principles and descriptions of Artificial lift methods: Gaslift – continuous and intermittent; Chamber lift, Electrical submersible pumping, Sucker rod pumping; Progressive cavity pump; Plunger lift; Hydraulic pump – piston & jet type.

Reservoir Aspect of Artificial Lift: Skin, permeability determination, IPR curves, absolute open flow potential (AOF) of well. Stimulation and work-over jobs and optimization of fluid flow. Manipulation of sweep efficiency, mobility ratio, GOR and water cut. Selection of suitable artificial lift method

Gas lift design: Continuous Gas Lift, Intermittent Gas Lift, Type of Installations, Gas Lift valve Mechanics, other common valve types, selection of Gas Lift valve, Reverse flow check valve, merits and demerits of different categories of gas lift valves, Plunger lift operation

Sucker Rod pump Design: Sucker rod pumping system, pumping units, sub-surface pump, sucker rod string, gas and tubing anchors, Skinner bar. Well Head Equipment .Selection of SRP installations.

Electric Submersible pumping: Centrifugal electric submersible pumping system (ESP), Application, surface components, standard performance curves, Total Dynamic Head. Recent advances in Electrical Submersible Pumping.

BOOKS

- 1 Principles of Artificial Lift; Niadri Kumar Mitra and Adesh Kumar; Allied Publishers Pvt.Ltd.
2. High Rate Artificial Lift, Clegg, J. D., SPE 1988
3. Well Performance, Golan, M & Whitson, C. H., (IHRDC, Boston)
4. Surface Operations in Petroleum Production, Chilingarian GV
5. Petroleum Fluid Flow Systems, Boyd, O.W.
6. Well Design Drilling and Production, Craft, Holden and Graves
7. The Technology of Artificial Lift Methods, Brown, K E., SPE

6PEU2WELL TEST ANALYSIS

Principles of Fluid Flow: Principles of Fluid Flow for steady state, semi steady state & non steady state conditions. Steady State Flow Tests (Indicator Diagram) and Gas Well Tests, Diffusivity Equation. Derivation & Constant Terminal Rate Solution


Ritesh Pahidar





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Pressure Transient Tests: Analysis and Pressure Draw-down Tests, Pressure buildup test, reservoir limit test (RLT), Multiple well testing, Wireline formation testing. Wireline formation Testing while drilling, Interference testing, Pulse testing, Multirate testing

Drill stem test: Operation, Their analysis and interpretation.

Well-test analysis by use of type curves: Fundamentals of type curves, Ramey's type curve, McKinley's and Gringarten et al type curves. Decline curves; Arps equation, Harmonic, Hyperbolic, and Exponential Decline curves.

Gas well testing: Basic theory of gas flow in reservoir, Flow-after-flow test, Pseudo Pressure, Pseudo time, AOF, isochronal, modified isochronal, interpretation and analysis, Isochronal test

BOOK

1. Well Testing, Lee, J., SPE
2. Advances in Well Test Analysis, Earlougher, Jr., R.C., SPE
3. Pressure Build Up and Flow Tests in Wells, Mathews, C.S. & Russell, D. G., SPE
4. Modern Well Test Analysis, Horne, R.N., Petroway

6PEU3 OFFSHORE DRILLING AND PRODUCTION OPERATIONS

Physical Environment

Overview of physical ocean environment, geotechnical aspect - seafloor marine soils, composition and properties of sea water, seawater corrosion, offshore rigs, floating drilling vessels. Fixed offshore structures, wind, wave, current and other forces acting on offshore structures.

Field Operations: Station keeping, conventional mooring system, spread mooring system, design considerations, operations, equipment and functions, Dynamic positioning system: components, working. Floater well control, shut in procedures, well kill operations, subsea well head, BOP Stack.

Deepwater Drilling: Deepwater well construction problems and solutions, deepwater cementation, high temp- high pressure wells, casing and mud policy. Drilling logs, gas hydrate problems. Deepwater drilling operations,

Riser system: components, riser tensioners, heave compensator, emergency disconnect and hang off. Wellbore stability and rock mechanics, mud window for vertical, horizontal deep water drilling. ROV

Offshore structures: Fixed steel structures, Concrete Gravity Base Structures, TLPs, Semi - submersible and Floating Production systems, SPM, SPAR Application. Depths and design limitations. Installation of offshore platforms, Typical Platform Layout, Process flow diagram, Static and Rotary Equipment. Safety systems. deepwater completion, Subsea completion, planning production monitoring and control system.

BOOKS

1. Handbook of offshore engineering volume I and II, Chakraborty S.K, Elsevier, 2006, 1213

Ramesh
(Ritesh Pahida)

Anil

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pp.

2. IADC deepwater control guidelines.

3. Exxon Mobil, Floating Drilling School, Deepwater, 2002, 992 pp.

4. Construction of Marine and offshore structures, Benc Gerwick Jr. IDT ONGC Dehradun, Drilling operations manual

6PEU4 PETROLEUM REFINERY ENGINEERING

Cracking Process: Atmospheric and Vacuum Distillation. Thermal conversion processes. Conventional thermal cracking process. Visbreaking, Coking – Fluid coking, flexicoking, delayed coking etc.

Reforming: Catalytic conversion processes – fluid catalytic cracking, Hydrocracking, hydrogen production, Reforming.

Purification process: Alkylation, Polymerization process of crude oil. Isomerisation and Hydrotreating processes crude oil.

Crude oil Evaluation : Evaluation of crude oil for LOBS (Lube oilbase Stock). Steps in preparation of LOBS, deasphalting.

Solvent Extraction: Types of solvents available and their comparison, dewaxing. Hydro finishing of LOBS Hydrogenation processes for LOBS production.

BOOKS

1. Petroleum Refinery Engineering, Nelson N.L., McGraw Hill Book Co., 1985

2. Petroleum Refining Technology and Economics', James H. G. and Glenn E. H. 4 ed., Marcel Dekker, Inc., 2001

3. Petroleum Refining, Waquier, J.P., Vol .I and II, 2 ed., Technip, 1995

4. Petroleum Processing Handbook, Mcketta S.S., Marcel Dekker, Inc., 1992

5. Modern Petroleum Refining Processes, B.K.Bhaskara Rao, 5 ed.Oxford and IBH Publishing Co. Pvt. Ltd., 2007

ELECTIVES

6PEU5.1 RENEWABLE ENERGY RESOURCES

Sustainable Development: Global warming, Climate change, Social consequences, Sustainability, Responding to Climate change- Mitigation and Adaptation, Global concern and commitment- historical perspective and current scenario, National Action Plan on Climate Change, Paris Agreement on Climate Change, Sustainable Development Goals, India's INDC. Carbon management-carbon emissions, carbon credits, clean development mechanism, carbon sequestration, Water management, Waste management.

Solar Energy: Solar radiation, solar thermal energy systems: active and passive systems, concentrating collectors, solar flat plate collector, solar thermal energy storage, photovoltaic cells

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and their arrangements. Global scenario, Solar energy potential of India, Current scenario and future targets

Biomass Energy: Energy from biomass and solid wastes: thermal route-pyrolysis and gasification, biochemical route-ethanol production, refuse derived fuel.

Biofuels, Jatropha, Bio-diesel, Biogas production and storage. Examples of failures and successes of biofuels, say with case studies of Brazil and USA. Indian scenario on biofuels

Wind Energy: types of turbines and principles of operation, OTEC, Wave and tidal energy, Geo-thermal energy, hydrothermal energy. Case Studies of India and Netherlands

Fuel Cells: Fuel cells, basic design, types Hydrogen Energy, Economics of hydrogen production methods and storage and transportation. Applications

Energy management: Energy efficiency, Energy audit, Energy conservation. Energy policy. Examples of Electric vehicles as part of energy and transportation policy of India, California and Brazil

BOOKS

1. Principles of Solar Engineering, Kreith, F. and Kreider, J.F., McGraw-Hill, 1978
2. Solar Energy Handbook, Kreider, J.F. and Kreith, F., McGraw-Hill 1981.
3. Alternative Energy Sources, T.N. Veziroglu, Vol 5 and 6, McGraw-Hill, 1978.
4. Non-conventional Energy Resources, Khan, B.H., Tata McGraw Hill, New Delhi, 2008.
5. Solar Energy: Principles of Thermal Collection and Storage”, Sukhatme, S.P., Tata McGraw-Hill, NewDelhi, 1984.
6. Solar Engineering of Thermal Processes, Duffie, J. A. and Beckman, W. A., John Wiley
7. “Renewable Energy, Sorensen, B., Academic press, New York, 2/e, 2000.

6PEU5.2 OIL & GAS FIELD DEVELOPMENT

Reserves: Proved, proved subeconomic and inferred reserves. Classification of reserves -: Proved: Categories A, B, C1; Proved subeconomic – Category Z; and inferred: Category C2. SPE/WPC definitions and classification of reserves:- Proved, unproved, probable and possible reserves. Estimation : Volumetric estimation of in place reserves.

Development of Oil & Gas Fields: Selection of development scheme, economic aspect of development of oil and gas fields. Production variants, performance prediction, Recovery factor, Stages of preparation of development plans. Computation of economic indices viz. Capital investment, payout period, IRR, Profile, Economic life etc. Analysis of different variants based on technical and economic considerations. Economic development of Marginal fields.

BOOKS

1. Cole, F.W. 1961, Reservoir Engineering Manual, 2nd Edn. Gulf Eng Co, Huston, Texas.
2. Advance Reservoir Engineering by T. Ahmed, P. D. McKinney, Elsevier.
3. Craft, B.C. and Hawkins, F.W. 1959. Petroleum Applied Reservoir Engineering practice Hall, New Jersey
4. Oil and Gas Pipeline Fundamentals:- Kennedy
5. Oil and Gas Field Development – Sant Kumar

6PEU5.3 OIL AND GAS MARKETING AND MANAGEMENT

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Natural Gas: What is Natural Gas, Measuring Natural Gas, Pipeline quality natural Gas Demand, Supply & Storage of natural gas: Gas production, Source of demand in India, The supply system, Pipeline Operations & Network, Storage of Natural Gas, Liquefied Natural Gas. Plant & Operations, Gas Sales Pattern in India, Gas Pipeline Regulations in India, Gas Trading, Gas Pricing

Coal Bed Methane: Introduction, Present status of Coal Bed Methane, CBM Storage and sales, CBM Pricing in India

Crude Oil: Crude oil/ specification, Measuring/ Custody transfer of Crude Oil, Crude Oil Transportation, Crude Oil Production in India, Crude Oil refineries, Products from Crude Oil International & National Institutions of Oil & Gas: API, OPEC, OECD, OADB, DGH, PNGRB, CHT, PII, PPAC, PCRA

Petroleum Contracts: NELP - Role & Background, Types of Contracts and fiscal components, Production sharing contracts in India, Crude Oil trading and pricing, CBM Contracts, HELP

BOOKS

1. Carrol John, Natural Gas Hydrates: A guide for engineers, Gulf Publications, 2003.
 2. Farooqi Ali, S M, Jones S A and Meldau R F, Practical Heavy Oil Recovery, SPE, 1997, 434.
 3. James T. Bart is, Frank Camm, David S. Ortiz, Producing liquid fuels from coal: Prospects and policy issues. NETL, DOE, USA, 2008, 198 p
- A Guide to Coal Bed Methane Reservoir Engineering, Published by Gas research institute Chicago, Illinois USA

6PEU6.1 TRANSPORTATION OF PETROLEUM PRODUCTS

Transportation of petroleum & petroleum products. Basics of Pipeline construction, operation and protection. Pump and compressor stations.

Instrumentation and Control, Metering and measurements of oil and gas.

Traffic management, Fire and safety rules. Indian and Global supply scenario of petroleum and petroleum products.

Product quality control. Bulk distribution and handling-domestic, commercial and industrial. Storage of petroleum products in fixed installations. Standards and regulations.

Role of International oil companies and OPEC pricing mechanism. Administered and market determined, pricing mechanism in India.

Conservation of petroleum & its products. Spot and other market control mechanism.

BOOKS

- 1 Offshore Pipeline Design, Analysis and Methods, Mouselli, A. H. Pennwell Books, Tulsa, Oklahoma
2. Surface Production Operations, Arnold, Ken and Stewart, Maurice Volume I and II, Gulf Publishing Company, London.

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3. Modeling of Oil Product and Gas Pipeline Transport, Lurie Mikhail, Wiley, 2008
4. Subsea Pipelines and Risers, Young Bai and Quang Bai, Elsevier Publishing, 2005
5. Production and Transport of Oil and Gas, Szilas, A. P, Part B: Gathering and Transport, Development in Petroleum Series, 18 B, Elsevier, 1986,

6PEU6.2 Fluidization Engineering

Introduction; Industrial Applications of Fluidized Beds; Height of Fluidized bed. Fluidization and Mapping of Regimes. The Dense Bed: Distributors, Gas Jets, and Pumping Power; Bubbles in Dense Beds; Bubbling Fluidized Beds. Entrainment and Elutriation from Fluidized Beds; High-Velocity, Fluidization; Solid Movement. Mixing, Segregation, and Staging; Gas Dispersion and Gas. Interchange in Bubbling Beds. Particle-to-Gas Mass and Heat Transfer; Conversion of Gas in Catalytic Reactions; Heat Transfer between Fluidized Beds and Surfaces; The RTD and Size Distribution of Solids in Fluidized Beds, Circulation Systems. Design for Physical Operations; Design of Catalytic Reactors. The Design of Non catalytic Gas-Solid Reactors.

BOOKS

1. Kunii, D. and O. Levenspiel, "Fluidization Engineering", Butterworth – Heinmann Edn. 2, 1991.
2. Rowe, P.N. and J.F. Davidson, "Fluidization", Academic Press, 1971
3. Leva, M., "Fluidization", McGraw Hill Book Co. New York, 1959.
4. Perry, R.H.; Green, D.W. (Eds.) "Chemical Engineers Handbook", Edn. 7, McGraw Hill Book Co. Singapore, 1997

6PCU6.3 MULTI-PHASE FLOW

Multiphase Flow: Scope and significance of multiphase flows, Dimensionless numbers in multiphase flows; Flow Pattern and Flow Regimes. Fluid-Solid System, Fluid-Fluid Systems, Solid-Fluid-Fluid systems.

Flow Classification: Two-phase Co-current flow of Gas-Liquid, Gas-Solid and Liquid-Liquid, Upward and Downward Flow in Vertical pipes. Suspensions of Solid and their transport in Horizontal Pipes. Drag Reduction Phenomena, Laminar, Turbulent and Creeping Flow Regimes.

Mixing Power Correlations - Theories of Intensity and Scale of Turbulence. Calculation of Circulation Velocities and Power Consumption in Agitated Vessels for Newtonian and Non-Newtonian Fluids. Blending and Mixing of Phases. Power requires for aeration to suspend to an Immiscible Liquid or Solids in Slurry Reactors, Prediction of optimum speed of Impeller Rotor and Design Criteria for Scale up.



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Quantification Of Flow System - Prediction of Holdup, Pressure Drop and bubble size in pipe flow, Lockhart –Martinelli Parameters, Bubble Column and its Design aspects; Flow through Packed Bed and Fluidized Bed, Minimum Carryover Velocity. Holdup Ratios, Pressure Drop and Transport Velocities and their prediction. Solid-Fluid Conveying and Settling.

Flow In Three - Phase Systems - Gas, solid and Liquid Composites Slurries in Horizontal Pipes, Flow through Porous Media of Composite Mixtures, Prediction of Holdup, Pressure Drop and throughput velocities in three – phase system. Design of Multiphase Contactors involving Solids, Liquids and Gases.

BOOKS

1. Govier, G. W. and Aziz. K., “The Flow of Complex Mixture in Pipes”, Van Nostrand Reinhold, New York, 1972.
2. Wallis, G.B., “One Dimensional Two Phase Flow”, McGraw Hill Book Co., New York, 1969.
3. Brodkey, R. S., “The Phenomena of Fluid Motions”, Addison – Wesley, New York, 1967.
4. Hestroni, G., (Ed.) “Hand book of Multiphase systems”, Hemisphere Publishing, Washington, 1982


PRACTICAL AND SESSIONAL

6PEU7 PETROLEUM PRODUCT TESTING LAB.

1. Measurement of fire point- Flash point
2. Measurement of Cloud point
3. Measurement of pour point.
4. Measurement of Aniline point & Bromine number
5. Measurement of Reid Vapour Pressure
6. Measurement of Sulphur Content
7. Measurement of Carbon Residue.
8. Distillation of Petroleum and Petroleum products.
9. Measurement of surface tension by Tensiometer.
10. Measurement of surface tension by Platinum ring method.
11. Ternary phase diagram

6PEU8 SEPARATION PROCESS LAB

1. To determine diffusion coefficient of liquid vapour in air,
2. To study the mass transfer characteristics of a wetted wall column.
3. Liquid-liquid extraction in a packed column for co current and counter current flow of binary systems.
4. To study the absorption of a gas in a packed column and calculation of NTU and HTU.
5. Studies on solid-liquid extraction column. Studies on the sieve plate distillation unit.
6. Design of distillation Tower.
7. Air fuel ratio in a gas burner.


(Ritesh Palidar)





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8. Pyrolysis and characterization of pyrolysis products.

6PEU9 ENERGY & GEOPOLITICS SESSIONAL

1. Basic concepts of demand, supply and pricing; price and output determination under perfect competition, derivation of the supply function, price and output determination under monopoly, oligopoly, and monopolistic competition
2. Energy and society: Social, economic, political and environmental dimensions of energy
3. Major types and sources of energy at the global and at the national level
4. Reserves and resources of petroleum, coal and nuclear minerals: Globally and in India
5. Other resources of energy: Hydroelectric power, solar energy, wind, wave, and biomass based energy
6. Energy sources and power generation: Thermal, nuclear, hydroelectric, solar, wind and wave; relative merits and demerits including conversion efficiency, generation cost and environmental impact, clean coal initiatives
7. Power transmission and distribution
8. Carbon sequestration, coal gasification, CBM, Shale gas, gas hydrates: current status and future prospects
9. Solar energy, hydrogen energy, and fuel cells: current status and future prospects
10. Carbon credits and its impact on hydrocarbon business
11. International oil markets, developments of Indian oil industry
12. NELP (New Exploration Licensing Policy), Mines rules and regulations
13. Pipelines: Current status and future prospects
14. LNG, CNG and other forms of natural gas: global and Indian scenario
15. Global energy politics

6PEU10 COMPREHENSIVE PETROLEUM ENGINEERING (SESSIONAL)

6PEU12 DECA



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Seventh Semester B.Tech Petroleum Engineering

7PEU1 WORKOVER AND WELL STIMULATION

Workover: Introduction, Difference between reservoir problem v/s workover problem, Definition of workover, Types of workover.

Workover rigs: Types of workover rigs & their application for workover operations

Work over operations: Scraping, Well circulation, Shut-off, Squeeze cementing, Handling water and gas coning, Evaluation of workover jobs

Well stimulation: Hydraulic fracturing: Introduction, Fracture initiation and extension, Considerations in fracture stimulation, Production increase, Propping agents, Frac fluids- types, properties and modifications, Avoiding formation damage, Frac job design- selection of well, design parameters, specification of treatment design, basic design procedure, Hydraulic fracturing equipment, Planning and execution of frac job, Frac job performance, Frac job evaluation techniques,

Acidization: Introduction, Basic types, Well stimulation acids, Acid additives and their functions, Retardation of acids- gelled acids, emulsified acids, Iron control during acidizing, Fracture acidizing for carbonates- factors controlling acid reaction rate

Scale Removal: Scales, Scale deposition factors, Tendency to scale of various scale forming compounds, Identification of scales, Scale removal methods- mechanical, chemical, Scale prevention

Paraffin and Asphaltene: Chemistry of paraffin and asphaltene, Deposition mechanism, Removal of wax and asphaltene deposits, Preventing deposition.

Sand control: Theory, effect of well completion and production practices, control methods, gravel pack design considerations, inside casing gravel pack problems and techniques, open hole gravel pack techniques, screens for sand control; plastic consolidation, processes, techniques.

Surfactants: Characteristics, Use and action for well stimulation, Surfactant selection

TEXT BOOKS

1. Well Design Drilling and Production, Craft, Holden and Graves, Prentice Hall, 1962.

REFERENCE BOOKS

1. Well Control Problem Solutions, N J Adams
2. Petroleum Production Handbook, Thomas C Frick
3. Workover Well Control, Neal Adams
4. Petroleum Production Systems:- Michael J Economides (Daniel Hill)
5. Hydraulic Fracturing, Faust, G. C., SPE

7PEU2 ENHANCED OIL RECOVERY TECHNIQUES

Ramesh
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MS

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Introduction: Review of primary and secondary recovery, injection rate and pressures in secondary recovery. Flood Patterns and Coverage. Areal sweep efficiency, vertical sweep efficiency, displacement efficiency, mobility ratio, well spacing.

Flow of immiscible fluids through porous media. Continuity equation, equation of motion, solution methods Water flooding, Fractional flow equation,

Water flooding performance calculations: Frontal advance method, viscous fingering method, Stiles method, Dykstra-Parsons Method, Water for water flooding.

Chemical Flooding: Polymer flooding and mobility control processes, Micellar/ polymer flooding, phase behavior of micro-emulsions, phase behavior and IFT, wettability alterations, Alkali flooding.

Miscible Displacement Processes: Mechanism of miscible displacement, phase behavior related to miscibility, high pressure gas injection, enriched gas injection, LPG flooding, Carbon dioxide flooding, alcohol flooding.

Thermal Recovery Processes: mechanism of thermal flooding, hot water flooding, cyclic steam injection, estimation of oil recovery from steam drive, in-situ combustion, air requirement for in-situ combustion.

Microbial Enhanced oil recovery: Concept and relevance. Method. Constraints within reservoir environment, MEOR mechanism, MEOR strategies, advantages, disadvantages

TEXT BOOKS

1. Enhanced Oil Recovery, Lake, L.W., Prentice Hall

REFERENCE BOOKS

7PEU3 UNCONVENTIONAL HYDROCARBON RESOURCES

CBM: Introduction & present status of coalbed methane- Global and Indian Scenario. Generation of coalbed methane gas & its properties, properties of coal as reservoir rock & accumulation. Geological and petrographic influences on coal, pore geometry, micropore, mesopore and macropore, cleat system

Thermodynamics of coalbed methane: Sorption – principles, sorption isotherms – types and interpretation. CO₂, CH₄ and N₂ adsorption – desorption, hysteresis, Langmuir isotherm, Swelling of coal matrix isotherm construction. CH₄ content determination in coal seams.

Overview of Drilling and Production systems of coalbed methane wells. Selection of Artificial lift for CBM wells. Hydro-fracturing of coal seams. Treating and disposing produced water. Testing of coalbed methane wells.

Gas Hydrate: Introduction & present status of gas hydrates. Formation, accumulation and properties of gas hydrates. Thermodynamics, kinetics and phase behaviour of gas hydrates. Types of gas hydrate. Exploration of gas hydrate. Drilling and production systems of gas hydrate wells.



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Prevention & control of gas hydrates. Gas extraction from gas hydrates. Uses and application of gas hydrates

Shale Gas / Oil: Global Scenario of shale gas/ oil production. Nature, origin and distribution of Shale Gas/ Oil. Characterization of Shale for Production of Shale Gas/ Oil. Extraction methods of Shale gas/ Oil: development of current practices. Location and size of production areas: estimated reserves and economics. Environmental issues in shale gas exploration. Markets and Globus impact on energy scenario. Economic factor of shale gas/ oil production

BOOKS

1. Carrol John, Natural Gas Hydrates: A guide for engineers, Gulf Publications, 2003.
2. Farooqi Ali, S M, Jones S A and Meldau R F, Practical Heavy Oil Recovery, SPE, 1997, 434.
3. James T. Bart is, Frank Camm, David S. Ortiz, Producing liquid fuels from coal: Prospects and policy issues. NETL, DOE, USA, 2008, 198 p
4. A Guide to Coal Bed Methane Reservoir Engineering ,Published by Gas research institute Chicago, Illionis USA

7PEU4 PIPELINE ENGINEERING

Objective and scope of pipeline: As a means of fluid transportation with special reference to crude oil/gas/refined products.

Design of Pipeline: Factors influencing oil, gas and refined products as pipeline design; Hydraulic surge and water hammer; specific heat of liquids, river crossing; pipe size and station spacing etc.

Theory and different formulae of the flow of fluids : Basic equations for the flow of fluids through pipes; different flow equations for laminar and turbulent flow of compressible and incompressible fluids, Introduction to the flow of Non- newtonian fluids through pipes, multiphase flow and loop pipelines.

Construction of pipelines: materials; project specifications, general equipment specifications (Pipes, valves and fittings), Installation of expansion loops and thermodynamic tapping plant.


Pigging: pigging technology, pig launcher and receiver, intelligent pigging, types of pigs.

Offshore Pipeline: design and control of Sag and Over bend; description of stinger and riser, articulated stinger, construction of offshore pipeline; method of underwater welding Prevention of hydrates, wax & scales. Crude conditioning and use of additives to improve flow conditions.

Corrosion: protection and control; design of cathodic protection system, pipeline automation. City distribution network of oil/gas. Lease and custody transfer.

BOOKS

1. Piping Design Handbook: Macetta. John, M Dekar 1992, CRC Press.
2. Pipeline and Risers: Young Boi, Elsevier Ocean Engineering Book series 2001 Volume 3
3. Pipe Line Corrosion, Cathodic Protection: Parker M E and Peattie E G, Elsevier USA


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7PEU5.1 PROCESS DYNAMICS & CONTROL

First-order Systems: Introduction, Transfer Function, Linear Open-Loop Systems, , Transient response (step response, impulse response, and sinusoidal response) , response of first order systems in series. Non-interacting systems and interacting systems.

Second-order systems: Transfer function, step response, impulse response, k sinusoidal response, transportation lag.

Linear closed-loop Systems: Control System: components of a control system block diagram. Negative feedback and positive feedback, servo problem and regulator problem.

Closed-Loop Transfer functions: Overall transfer function for single loop systems, overall transfer function for set-point change and load change, multi-loop control systems. Transient Response of simple control systems: P and PI control for set point change and for load change.

Controller and final control element: Mechanism of control valve and controller, transfer functions of control valve and controllers (P, PI, PD, and PID). Examples of a chemical reactor control system. **Stability:** Concept of Stability, Stability criteria, Routh test for stability, Root Locus.

Frequency Response: Introduction to Frequency Response, Bode Diagrams for First and second order systems, Bode stability Criteria, Ziegler-Nichols and Cohen-coon Tuning rules.

Text Book:

1. Process Systems Analysis and control, Coughanowr, D.R., McGraw -Hill, 1991.
2. Chemical Process Control, Stephanopoulos, G, PHI,

Reference Books:

1. Process Instrumentation R.P.Vyas Dinut publication.
2. Process Modelling, Simulation and Control for Chemical Engineers, Luyben, W.L, McGraw Hill,
3. Process Control Principles and Application, Surekha Bhanot, Oxford Higher Education/Oxford University Press, 2008
4. Process Control, Peter Harriott, Tata McGraw-Hill Publishing Company, 1964

7PEU5.2 FLUID FLOW THROUGH POROUS MEDIA

properties of Reservoir Fluids: Chemical composition of oil and gas. Physical properties of reservoir fluids. Thermodynamics of reservoir fluids. Gas deviation factor, compressibility and formation volume factor. Density and viscosity of reservoir fluids under changing temperature and pressure. Dew point, saturation pressure, bubblepoint pressure. Concept of pseudo- temperature and pseudo-pressure. PVT analysis of reservoir fluids.

Introduction to Reservoir rocks and Geology

Physico-chemical properties of reservoir rocks. Rock compressibility. Rock texture and mineralogy. Absolute and effective permeability, relative permeability. Core analysis, Log

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interpretation

Static to Dynamic Model of Reservoir Saturation of reservoir fluids. Wettability of reservoir rocks. Capillary pressure behavior and its effect on different rock and fluid flow properties. Integrated rock-fluid modeling. Historical account of modeling reservoir permeability.

Modelling of flow:

Darcy's law, its boundary conditions and modification for petroleum system. Darcy's model, Bernoulli's model, Kozeny's model, Kozeny-Carman's model, Hydraulic Flow-Unit approach. Tortuosity & core analysis vs hyper-Darcy flow and its impact on well performance and reservoir stability.

Reservoir Flow Behaviour

Dynamic and static flow regimes of fluids in proximal part of wellbore and in distal parts of reservoir. Selective and fractional flow of reservoir fluids in porous media. Diffusivity equation and fluid front advancement.

LABS

7PEU7 PROCESS DYNAMICS & CONTROL LAB

1. To determine the time constant of a given thermometer and thermocouple
2. To study the open loop, three mode PID and two mode PD control
3. To study the working principle and calibration procedure of capacitance type level transmitter.
4. To obtain the step response of a single tank liquid level system to a step change in input flow and compare it with the theoretical response.
5. To study the inherent characteristics of control valve.
6. To study the theoretical time constant and damping coefficient of the manometer.
7. To study the interacting and non interacting mode of system.
8. To study the behaviour of an PID controller.
9. To study the tuning of controller using the Zeigler Nichols Method.
10. To study the stability of the system using the Bode Plot.

7PEU8 PIPELINE DESIGN SESSIONAL

Study of the following:

A: Onshore Pipeline Engineering

1. Introduction and over view of piping.



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PRACTICAL AND SESSIONAL

7PEU7 PROCESS DYNAMICS & CONTROL LAB

1. To determine the time constant of a given thermometer and thermocouple
2. To study the open loop, three mode PID and two mode PD control
3. To study the working principle and calibration procedure of capacitance type level transmitter.
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10. To study the stability of the system using the Bode Plot.

7PEU8 PIPELINE DESIGN SESSIONAL

Study of the following:

A: Onshore Pipeline Engineering

1. Introduction and overview of piping,
2. Piping basics, piping shape
3. Piping material, Pipeline materials selection, Steels used for line pipe, Compositional limitations, mechanical properties, grades Fabrication of line pipe – seamless, longitudinal welded, ERW, spiral Toughness and weld ability, Improving corrosion resistance Solid corrosion-resistant alloy pipe Internally clad pipe, New materials.
4. Pipeline design- Legislation and regulations, Development of pipeline design codes Design process, Detailed design: product categorization, locating pipelines, design pressures, factors, and stressing, Pipeline crossings, Pipeline valves, Other pipeline design considerations Surges/overpressures, Bends, Piping flexibility, Pipe protection, Fracture control Fluids and hydraulics.
5. Basics of welding, Types of welding process, Effects on line pipe of the welding process, Welding procedures, Inspection of welds
7. Piping components & types, Piping isometric, Selection of code & standards, Piping supports & hangers, P&ID, PFD diagrams, Piping insulation.

B: Offshore Pipeline Engineering

1. Subsea Field Components, Subsea structures, Subsea pipelines, rigid risers
2. Field Layout and pipeline route selection, Development options, Field architecture


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- Geotechnical and geophysical survey, Seabed feature and obstructions, Route selection
3. Pipeline systems (e.g. single pipe, piggybacked pipe, bundle and etc.) what pipeline system to use (pros and cons) Rigid riser systems, what riser system to use (pros and cons)
 4. Safety classifications 500m zone, Protection requirements, Trenching and back filling
 5. Overview of design codes for subsea pipeline design
DNV-OS-F-101, PD8010-2, API 1111, DNV-OS-F101 stain limits and ECA requirements
DNV-RP-F112 hydrogen induced stress cracking (HISC)
 6. Spanning Assessment (based on DNV- RP-F105) Freespan concept, Freespan response free span parameters, screening criteria and detailed assessment approaches Static response, In-line and cross-flow VIV, Direct wave fatigue, Combine VIV fatigue.
 7. On-bottom Stability (based on DNV-RP-F109), Hydrodynamics of current and wave. On-bottom stability concept, Stability assessment approaches (DNV-OS-F109). Absolute stability method (DNV-OS-F109). How to stabilize an unstable pipeline/tie-in spool.
 8. Expansion and tie-in spools, Expansion phenomenon, Expansion in single pipes, piggybacked pipes and pipe-in pipes, why do we need tie-in spools. What is the optimum size and layout of a tie-in spool.
 9. Lateral and Upheaval buckling and Crossing Design, Buckling phenomena Soil-pipe interaction, Lateral and axial friction Modeling of upheaval resistance of cohesive (clay) and granular (sand) soils Lateral buckling analysis (Hobbs approach and Finite Element Analysis)
Upheaval buckling analysis
 10. High Pressure - High Temperature (HP/HT) systems, HP/HT Pipeline systems, Challenges of design for HP/HT
 11. Installation methods, S-lay installation method J-lay installation method, Floating Stress limits of over bend and sag bend (DNV-OS-F101)
 12. Pre-commissioning, Pre-commissioning activities (hydrotest, cleaning, dewatering, conditioning and drying) Liquid/Gas pipelines, Pre-commissioning pigging.

7PEU9 REPORT WRITING

7PEU10 PRACTICAL TRAINING

7PEU12 DECA

Eighth Semester B.Tech Petroleum Engineering

8PEU1 RESERVOIR MODELING & SIMULATION



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8PEU1 **Introduction to General Modelling:** Introduction to concept geological modeling. Types of model and designing of various models depending on reservoir complexities, rock properties, fluid properties – concept of black oil model, compositional model.
Overview: Geological model and flow model and transition Introduction, Historical background, application of simulator, various types of models.
Flow Conditions: Single phase, two phase and multiphase flow equations for one, two and three dimension models, Mass balance equations.
Discretization and solution of Equations
Special Concept: Explicit and implicit, grid system, finite difference & finite element method, matrix solution, iterative method, stability
Reservoir model Solution Techniques: Implicit Pressure and Explicit Saturation, Pseudo-functions. Implicit pressure and implicit saturation (IMPIS).
Preview of numerical solution methods: Direct process, iterative process.
History matching
History matching, data preparation, Mechanics and parameters of match
Streamline simulation
Introduction to streamline simulation & comparison of conventional/Streamline simulation
Integration with Economics
Special Concept on Coning and Compositional Models simulation. Optimization using Economic and Techno-economic evaluation, Computation of economic indices viz.

8PEU2 **NATURAL GAS ENGINEERING**

Properties and Measurement of Natural Gas: 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.
Gas Reservoir Performance and Gas flow measurement: 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.
Flow of Gas in Production Tubing: Introduction, gas flow fundamentals, vertical and inclined single phase flow of gas, Calculating flow and static bottom hole pressure, Gas flow through restrictions. Temperatures profiling in flowing gas systems.
Natural gas Processing: 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.



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Gas Compression: Introduction, types of compressors, Selection, Thermodynamics of compressors, Design fundamentals for reciprocating, centrifugal and rotary compressors (single and multistage).

Gas Gathering and Transport Gas gathering system, steady state flow in simple pipeline system, steady state and non steady state flow in pipelines, solution for transient flow. Installation, operation and trouble shooting of natural gas pipelines.

TEXT BOOKS

1. Beggs, D, H, Gas Production Operations. Edition Technip. 1984

REFERENCE BOOKS

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

8PEU 3.1 OIL & GAS PROCESSING PLANT DESIGN

Oil desalting: Operation, variables, Heater treater design. Crude & Condensate Stabilization: LTX Stabilization. Oil & Gas Treatment: Oil desalter, emulsion treatment theory and practice, Emulsifiers &

Demulsifiers, Gravity Separation, coalescence, coalescing media, electrostatic coalescers.

Treating Equipment: pressure vessels - Vertical, horizontal, Electrostatic. Process heat duty, sensible heat of natural gas, water, heat transfer from fire-tube. Heat exchangers types, fluid placement, sizing, number of tubes.

Natural Gas Dehydration: (a) Glycol Process: operation, effect of variables, dew point depression, stage calculation. NTU – graphical and analytical methods, Absorber sizing. Lean oil absorption.

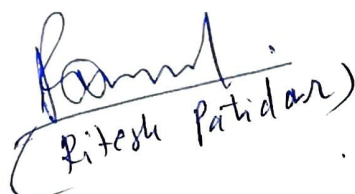
(b) Solid bed process: design & operation, effect of process variables, Regeneration and cooling calculations. Hydrocarbon recovery. (c) Hydrate formation & inhibition.

Natural Gas Sweetening: Acid gases, Toxicity, Pipeline specification. Solid-bed Process : Design, operation & effect of variables. Adsorbent selection.

Multistage Separation, Hengstebach's Flash calculation, stabilizer design. Amine and other absorptive process details

TEXT BOOKS

1. Gas Production Engineering – S. Kumar-Gulf publishing Co., 1987.
2. Production operations, T. O. Allen and A. P. Roberts, SPE – Vol - I 4-th edition.


Ritesh Patidar



Anil K. Mathus
Approved
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8PEU3.2 INDUSTRIAL ENGINEERING MANAGEMENT

Basic functions of Management – Planning, organizing, staffing, directing and controlling. Introduction to Industrial Engineering techniques.

Productivity: definition, measurement. Work study and its role in improving productivity of an organization. Types of production systems. Introduction to production planning and control

Concepts of Human Resource Management – Selection, Training & Development.

Finance Management – Capital Budgeting Techniques. Pay-back period, ARR, NPV, IRR, PI; Sources of capital; Cost concepts and Break-even analysis.

Project Management: Introduction, Network construction & identification of critical activities in CPM & PERT

TEXT BOOKS

1. Varshney, R.L. and Maheswari, K.L. 2006. Managerial Economics, 19th Edn., Sultan Chand & Sons., New Delhi.

REFERENCE BOOKS

1. Koontz, H. and Wehrich, H. 2007. Essentials of management, 7th Edn., Tata McGraw Hill, New Delhi.
2. Prasad, L.M. 2006. Organisational behaviour, 4th Edn., Sultan Chand & Sons, New Delhi.
3. Luthans, F. 2005. Organisational behaviour, 10th Edn., Mc-Graw Hill International Edn., Singapore.
4. Keat, P.G. and Young, P.K.Y. 2004. Managerial Economic, pears education Inc.

8PEU3.3 PETROLEUM ECONOMICS AND RISK ANALYSIS

Introduction to upstream economic analysis: energy overview of India. Time Value of Money, cash flow analysis, capital budgeting techniques, General probability, elements of oil and gas project cash flows.

Reserves classification methods: quantification, assessment of geosciences and reservoir engineering uncertainties.

Assessment of reserves: production and demand in international market. Reserves auditing. Accounting systems for oil and gas. Valuation of petroleum properties.

Inflation and cost escalation: oil market and OPEC, share of non OPEC countries in oil production, International oil and gas pricing mechanism.

Function of spot markets and marker crudes: Oil price uncertainty, market for gas; Gas sales contract; gas pricing; Exchange rate variation and influence on project economics; Risk associated with borrowing money; Partners – risks associated with partnerships Geopolitics.



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Sources of uncertainty and risk: Geology - concept of exploration success; Facilities – problems encountered in subsurface and surface;

Environmental issues: pertaining to oilfield development; Human failure; Government – imposition of changes to project; taxation, Concept and implications of demand elasticity; NELP

Risk Management: Sources of information to reduce uncertainty, Transferring risk – financial instruments and commodity trading

Diversification: Joint ventures, Scenario planning; relevant information in the context of decision-making; Simple Decision Methods, Sensitivity analysis. Decision analysis.

TEXT BOOKS

1. Petroleum Economics and Engineering, Abdel-Aal, H. K. Bakr, A. B. Al-Sahlawi, M. A,

REFERENCE BOOKS

1. Estimation and Classification of Reserves of Crude Oil, Natural Gas, and Condensate, Cronquist, C., SPE (2001)

2. International Exploration Economics, Risk, and Contract Analysis, Johnston, D, Pennwell

Practical and Sessional

8PEU7 Reservoir Modeling & Simulation Lab.

8PEU8 Compressive Viva

8PEU9 Seminar

8PEU10 Project

8PEU12 Discipline & Extra Curricular activity