Structure and Syllabus

TE (Petroleum Engineering)

2015 Course

Savitribai Phule Pune University

(WEF 2017-18)

Savitribai Phule Pune University
Third Year Petroleum Engineering, 2015 course, Term – I
(W.e.f. Academic year 2017-18)

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312381	**Numerical Methods and Geostatistics**	4	--	2	30	70	50		--	**150**	**4**
312382	**Petroleum Geology I**	4	--	2	30	70	-	50	--	**150**	**4**
312383	**Well Engineering I**	4	--	--	30	70	--	--		**100**	**4**
312384	**Petroleum Production Engineering I:**	4	--	--	30	70	--	--		**100**	**4**
312385	**Reservoir Engineering I**	4	--	--	30	70		--	--	**100**	**4**
312386	**Petroleum Engineering Laboratory**	-	-	4	-	-	50	-	50	**100**	**2**
312387	**Skill Development**	--	--	2	--	--	-	--	50	**50**	**1**
312388	**Audit Course 3 Practices in Petroleum Industry I**										
Total of Semester – I		**20**	--	**10**	**150**	**350**	**100**	**50**	**100**	**750**	**23**

Note: For Audit courses, students are given certificates based on the assignments submitted by them.

Abbreviations: TW: Term Work, OR: Oral, PP: Passed (Only for Audit courses), NP: Not Passed (Only for Audit courses)

Savitribai Phule Pune University
Third Year Petroleum Engineering, 2015 Course, Term – II

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)						Credits
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
312389	**Petroleum Geology II**	4	--	2	30	70	--	50	--	**150**	**5**
312390	**Reservoir Engineering II**	3	1	2	30	70		--	50	**150**	**5**
312391	**Petroleum Production Engineering II**	3	1	2	30	70	-	--	50	**150**	**5**
312392	**Petroleum Field Instrumentation and Control**	3	--	2	30	70	25	--		**125**	**3**
312393	**Equipment Design and Drawing**	3	--	2	30	70	25	--	--	**125**	**4**
312394	**Seminar**	--	--	2			50	--	-	**50**	**1**
312395	**Audit Course 4 Practices in Petroleum Industry II**	-	-	-	-	-	-	-	-	--	--
Total of Semester – II		**16**	2	**12**	**150**	**350**	**100**	**50**	**100**	**750**	**23**

Note: For Audit courses, students are given certificates based on the assignments submitted by them.

Abbreviations: TW: Term Work, OR: Oral, PP: Passed (Only for Audit courses), NP: Not Passed (Only for Audit courses)

Important Notes

1. In-Semester Theory examination will be conducted approximately one and half month after the commencement of each semester

2. In-Semester Theory examination will be based on first three units from Syllabus and will be conducted by the Savitribai Phule Pune University.

3. Total time allotted for In-Semester Theory examination will be 1 hr.

4. Total time allotted for End-Semester Theory examination will be 2 hrs. 30 min.

5. Audit course 3 and 4 will be conducted in the first and second term of third year of Petroleum Engineering respectively. This is inclusive of submission of assignments based on sessions conducted by the industry professionals by way of workshop, guest sessions, soft skills workshops, and also by submitting report of mini project if given and industry tour report. Any value addition by the students such as completion of any online certificate course can also be considered under this. This should be submitted at the end of the term and successful submission should be given PP in the mark sheet and NP if not submitted or incomplete submission. The audit course should cover work equivalent to twenty hours in the term and submission should be in the form of a comprehensive report. Details are given in appropriate sections.

Term I

312381: NUMERICAL METHODS AND GEOSTATISTICS
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 4

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut.	Pract.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312381	Numerical Methods and Geostatistics	4	--	2	30	70	50	-	-	150

OBJECTIVES

1. To apply numerical techniques for different processes.
2. To learn finite difference techniques and optimization.
3. To understand basic principles of Geostatistics in autocorrelation.

COURSE OUTCOMES

After completing the course, the students should be able to

1. To apply finite difference techniques, interpolation, numerical integration in various engineering problems.
2. To apply numerical techniques for solving algebraic and differential equations encountered in petroleum engineering.
3. To solve initial and boundary value problems which do not have closed form solutions using numerical methods.
4. To apply the optimization techniques in planning and allocation of available resources.
5. To use statistical methods and regression analysis in analyzing and interpreting experimental data.
6. To use conformal mapping and bilinear transformations in petroleum engineering problems.

Unit-1 Numerical Methods and Interpolation (8 L)

Calculus of finite difference, finite difference operators, Newton's, Lagrage's, and Stirling's interpolation formulae

Numerical differentiation and integration, Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rule, error analysis.

Unit 2: Solution of Algebraic and Transcendental Equations (8 L)

Method of bisection, false position, Newton-Raphson method, method of successive approximation, convergence and stability criteria, solution of system of simultaneous linear equations, Gauss elimination method, Gauss-Seidel method.

Unit 3: Solution of Ordinary Differential Equations (Initial and Boundary Value Problems-IVP/BVP (8 L)

Euler's method, modified Euler's method, Runge- Kutta method second and fourth-order), polynomial method, power method.

Unit 4: Solution of Partial Differential Equations and Optimization (8 L)

Finite difference method, explicit and implicit methods, solution of one-dimensional heat flow problem

Basic concept of optimization, formation and solution of optimization problem, simplex method

Unit 5: Matrix Transformations (8 L)

Revision of matrices, finding inverse, Eigen values and Eigen vectors, linear independence of Eigen vectors, solution of system of equations using inversion method, power method, matrix transformations, reduction of matrix to diagonal form, quadratic forms, reduction of a quadratic to canonical form, stress and strain transformations, coordinate transformations.

Unit 6: Regression Analysis (curve fitting) and Statistics (8 L)

Linear regression, polynomial regression, multiple linear regression, non-linear regression

Review of measures of central tendency and dispersion

Statistical inference-tests of hypotheses, standard error and sampling distribution, procedure of hypotheses testing, tests of significance for large and small samples, chi-square test and goodness of fit, design of experiments.

Practical Course

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

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

Guidelines for Instructor's Manual

The Instructor's manual should include Aim, theory, procedure, figures, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal.

Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades.

Guidelines for conduct of laboratory course

- The laboratory exercises will be conducted in the departmental computer centre.
- The faculty will be details of laboratory component of the course in the first session along with rules for submission and continuous assessment.

Term Work:

The students should submit a certified journal for assessment of term work which is inclusive of all write-ups assessed continuously and signed by the faculty member.

Books:

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

312382: PETROLEUM GEOLOGY I
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 4

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pr.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312382	Petroleum Geology 1	4	-	2	30	70	-	50	-	**150**

OBJECTIVES

1. To understand basic principles of geology as a part of petroleum system.
2. To understand the relation between geologic processes and characteristics of sedimentary rocks.
3. To understand the spatiotemporal events in geological past

COURSE OUTCOMES:

After completing the course, the students should be able to

1. Recollect the concept of rock cycle and realize distribution of rocks on the surface of the earth
2. Realize and explain internal and external processes responsible for the dynamics of earth.
3. Comprehend rock deformation.
4. Understands the environment of deposition with knowledge of physical sedimentology.
5. Recognize variations in paleolife and their significance.
6. Recollect the geological time scale and important events with in.

Unit 1: Petrology: (8 L)

Geology in Petroleum industry: an overview

Mineralogy, Identification and physical properties of minerals. Introduction to Igneous, sedimentary and metamorphic rocks. Rock cycle.

Unit 2:Dynamic Earth (8 L)

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

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

Unit 3: Structural Geology: (8 L)

Rock deformation and deformation structures, Principles and experimental studies. Measurement and plotting of attitude of beds. Folds: analysis, classification and mechanism of fold formation. Joints

and Fractures. Faults: analysis, classification and mechanism of formation. Sealing and non-sealing faults.

Unit 4: Physical Sedimentology and Environment of Deposition: (8 L)

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

Depositional environments: Broad overview, classification, Sedimentary facies.

Unit 5: Applied Paleontology: (8 L)

Marine depth zones and fossils. Index fossils, mega and microfossils fossils, trace fossils.

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

Unit 6: Stratigraphy: (8 L)

Principles of Stratigraphy, Wilson cycle. Unconformity, Transgression-regression. Geological Correlation,

Geological Time Scale, Important Events, Outline of Indian Geology. Introduction to Sedimentary Basins of India.

Practical Course:

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

List of Experiments:

1. Study of properties and identification of important rock forming minerals and rocks in hand specimens (minimum six practical sessions).
2. Study of important sedimentary structures and textures.
3. Study of topographic sheets
4. Study of Geological maps. At least six maps.
5. Introduction to petrological and binocular stereomicroscope and study of carbonate and clastic rocks under microscope.
6. Study of important fossil forms.

Guidelines for Instructor's Manual

The Instructor's manual should include Aim, theory, procedure, figures, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal.

Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades.

Guidelines for conduct of laboratory course

The faculty will be details of laboratory component of the course in the first session along with rules for submission and continuous assessment.

Practical examination will be based on the experiments carried out as a part of experiments carried out throughout the term. The students shall be allowed to appear for examination only after submission of certified journal.

Books:

1. Arthur Holmes; Principles of Physical Geology; Chapman and Hall.
2. Kunt Bjørlykke; Sedimentology and Petroleum Geology; Springer Verlag. 2009
3. Sengupta S. M.; Introduction to Sedimentology; Oxford and IBH Publishing Company.
4. Shelly R. C.; Introduction to Sedimentology; Academic Press. Second edition, 2015
5. Nichols Gary: Sedimentology and Stratigraphy. Wiley Blackwell. Second edition. 2009.

312383: DRILLING ENGINEERING
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 4

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	T	Pr.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312383	Drilling Engineering I	4	-	-	30	70	-	-	-	**100**

OBJECTIVES

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

COURSE OUTCOMES

After completing the course the students should be able to demonstrate,

1. Knowledge of drilling rig power system, hoisting system, rotary system, and circulation system.
2. An ability to Identify, formulate, and solve simple engineering problems related to drilling operations, drilling fluid, downhole problems etc.
3. Knowledge of well control equipment, directional drilling, importance of coring, fishing operations.
4. To be able to design simple casing and design cement slurry for cementation.
5. To work on laboratory equipment to measure drilling fluid properties, Rheology, Cement slurry properties etc.
6. Calculation of pressure losses in drill string and optimization of hydraulics.

Unit-1: Drilling Rig (8L)

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

Advantages and disadvantages of top drive system.

Unit-2: Drilling Operations and Difficulties (8 L)

Downhole drilling problems and solutions, factors affecting rate of penetration, drill off test, bit section, IADC classification of bit, dull bit gradation, circulation system, mud pumps, numerical related to mud pumps of circulation system, problems concerned with drilling fluid and drill pipe

stuck up, geometry of a stuck pipe. Hole problems (lost circulation, kick etc)

Unit-3: Drilling operations: Well control, Coring and Fishing **(**8 L)

Well control equipment BOP, Introduction to directional, horizontal and multilateral drilling techniques. Types of well, Down hole motors, survey equipment, RSS, coring operations, Fishing tools and operations. Terminology used in directional wells and basic mathematics used in directional wells (DMS to Dec. Deg, co-ordinate system).

Unit-4: Casing and Cementation (8 L)

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

Unit-5: Drilling Fluids/ Mud engineering (8L)

Drilling fluid, functions, types, compositions, properties of mud, Field test, Rheology, Additives and contamination, Selection of drilling fluids and mud, Conditioning equipment, Mud calculations, Hydrostatic pressure, Volume, Weight related calculations during drilling.

Unit-6: Hydraulics (8 L)

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

Books

1. Gatlin C., 1960, Petroleum Engineering, Drilling and Well Completions, Prentice Hall. 341 pp.
2. Rabia H, 1985, Oil Well Drilling Engineering, Graham Trotman Ltd., 322 pp.
3. Azar, J. J, G. and Robello Samuel. 2007, Drilling Engineering, Penn Well. 471 pp.
4. Smith. D.K, 1990, Cementing' SPE Monograph Series, Vol. 4, 2nd Edition, 264 pp.
5. Mitchel R F (Editor), Drilling Engineering, In Petroleum Engineering Handbook Volume 2 , SPE Publication, 2007, 770 pp
6. Bourgoyne A. T, Millheim K K, Chenevert M E and. Young F S; 1991, Applied Drilling Engineering, SPE Text Book Series, 508 pp

312384: PETROLEUM PRODUCTION ENGINEERING I: (T. E. PETROLEUM ENGINEERING 2015 COURSE) Credits 4

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)				
		Lect.	Tut	Pr.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312384	Petroleum Production Engineering I	4	-	-	30	70	-	-		**100**

OBJECTIVES

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

COURSE OUTCOME

After completing the course, the students should be able to demonstrate.

1. Knowledge of surface facility equipment and facilities for production and separation of hydrocarbons
2. Knowledge of different types of bottom hole production tools and their utility
3. Understanding of multiphase flows and their equations for production operations
4. Understanding of different completion methods
5. Understanding of Inflow Performance Relationship
6. Understanding of important well problems and possible workover operations

Unit 1: Surface Production Equipment and Facilities: (8 L)

Well equipment, typical wellhead assembly and attachments, Casing hangers, Seal assembly, Typical Christmas tree assemblies, Components and design considerations of wellhead equipment and choke, Introduction to subsea production system, Subsea wellhead and completion aspects, Surface Safety Valve, choke sizing.

Unit 2: Bottom-hole Production Tools and equipment: (8 L)

Production tubing, API grades, Design considerations of a production tubing.

Subsurface control equipment, Sub-Surface Safety Valve, Bottom-hole chokes and regulators, Circulation devices, Expansion joints, Safety joints, Landing nipples, Polished bore receptacles, Blast

joints, Flow couplings, Sliding Sleeve Doors, Production packers and its types, Working setting mechanism, Seating and Unseating of packer. Length and force changes in tubing.

Unit 3: Inflow Performance Relationship (IPR) (8 L)

Reservoir considerations in well design, Flow through porous medium around the wellbore,

Introduction to inflow performance, Productivity index. PVT properties of oil, water and gas. Flow efficiency, Darcy's Law, Formation damage diagnosis of Skin effect, IPR in case of different drive mechanism. Vogel IPR equation, Standing's extension. Fetkovich approximation. Exercises based on above topic.

Unit 4: Multiphase Flow (8 L)

Introduction, brief review of reservoir aspects, flow regimes during vertical and horizontal flow, critical production rate and remedial measures to decrease in production. Optimum production rate.

Overall production system, pressure loss in tubing, multiphase flow regimes. Poettmann and Carpenter method. Gilbert's correlations. Optimum GLR. Heading cycle. Choke performance, types of chokes,

Unit 5: Well Completion Engineering: (8 L)

Objectives, Types of well completion with sketches,

Well completion procedure, Well completion fluid, Well activation, Swabbing and circulation, Well perforation, Perforation fluid, Packer fluid, Factors affecting perforation efficiency, Well killing and well control during completion, Factors to be considered in well completion,

Introduction to intelligent well completion. Completion for horizontal and multilateral wells. Study of Drill Stem Testing and Repeat Formation Testing operations.

Unit 6: Workover Operations: (8 L)

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

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

Books

1. Allen Thomas, and Alan Roberts; 1989, Production Operations, Volume 1 and 2; 3rd. Edition, Oil and Gas Consultants International, Inc. 303 pp. and 363 pp.
2. Cholet H, 2000, Well Production Practical Handbook; Technip Editions; France, 540 pp.
3. Danish Ali, 1998, PVT and Phase Behavior of Petroleum Reservoir Fluids. Elsevier, 400 pp.
4. Gatlin C.; Petroleum Engineering, Drilling and Well Completions; Prentice Hall.
5. Mian M. A, 1992, Petroleum Engineering: Handbook for Practicing Engineer Vol. I and II; Pennwell Books.

312385: RESERVOIR ENGINEERING I
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 4

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pr.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312385	Reservoir Engineering I	4	-	-	30	70		-	-	**100**

OBJECTIVES

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

COURSE OUTCOMES

After completing the course, the students should be able to demonstrate,

1. Understand the rock properties and reasons for variation
2. Understand and explain the properties of fluid
3. Understand the phenomenon of presence of multiphase flow system in porous media and equations for the calculation of parameters
4. Gain insight into vapor – liquid, liquid – solid phase equilibrium
5. Understand and explain different drive mechanisms and factor of primary recovery
6. Calculate reserves of oil and gas by volumetric and material balance

Unit – 1 Rock Properties (8 L)

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

Unit – 2 Reservoir Rock Properties-II (8L)

Capillary pressure, Calculation of capillary pressure, Drainage and Imbibition Process, Effects of hysteresis, J- Leverett function, transition zones and fluid distribution, Capillary number, Calculation of permeability from pressure data, Pore Size Distribution, pore doublet model

Relative Permeability concepts, two and three phase relative permeability, Relative permeability ratio,

Unit – 3 Reservoir Fluid Properties (8 L)

Composition of reservoir fluids and identification, fluid sampling, PVT oil studies, PVT gas studies, oil properties, Gas properties, Equations of state for ideal gases and real gases, Gas Compressibility factor and compressibility charts, vapor liquid equilibrium (VLE), formation water and hydrates.

Unit – 4 Fluid Flow in Reservoirs (8 L)

Introduction, Darcy's Law, radial steady state and pseudo steady state fluid flow, well flow in a grid, non-Darcy flow, Poiseuille's law, Multiphase flow at different scales, Darcy's law for multiphase flow, fractured reservoirs, Buckley-Leverett equation, applications

Unit – 5: Natural Drive Mechanisms for hydrocarbon Reservoirs (8 L)

Introduction, undersaturated oil reservoirs, dissolved gas expansion, natural drive mechanism, generalized material balance equation, material balance for oil and gas, oil saturation calculation in oil zone, water entries, gas reservoir drainage.

Unit 6: Reserves Estimation (8 L)

Different methods of calculation of Original Oil in Place and Original Gas in Place, Drive index and production characteristics, Balance as a straight line, Material Balance for water drive Reservoirs, SPE terminology of reserves. Deterministic and stochastic approach

Books

1. Craft B C and Hawkins M F, 1991, Applied Petroleum Reservoir Engineering, 2nd edition, Prentice Hall, 431 pp
2. Pierre Donnes, 2010, Essentials of Reservoir Engineering, Editions Technip, France, 410 pp.
3. Dake L P, 1994, The Practice of Reservoir Engineering, Developments in Petroleum Science, 36, Elsevier, 568 pp.
4. Tiab D, and Donaldson E.C., 2012, Petrophysics; 3rd edition, Gulf Publishing Co, 956 pp.
5. Dandekar A Y, 2011, Petroleum Reservoir Rock and Fluid Properties, Taylor and Francis.
6. Tarek Ahmed, 1989, Hydrocarbon Phase Behaviour, Contribution in Petroleum Geology and Engineering, Gulf Publication, 424 pp.

312386: Petroleum Engineering Laboratory
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 2

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pract	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312386	Petroleum Engineering Laboratory	-	-	4	-	-	50	-	50	**100**

COURSE OBJECTIVES

1. To get familiarize with the operational aspects related drilling, production and reservoir engineering.
2. To understand and analyze the problems related to drilling, production and reservoir engineering and develop methodology to solve them.

COURSE OUTCOMES

After completing the course, the students should be able to demonstrate,

1. Basic aspects of properties of reservoir rocks and fluids.
2. Use of excel and software in the calculation of properties of rocks and fluids.
3. Different components of drilling rigs.
4. Different methods for the calculation of properties of mud.
5. Construction and correlation of IPR curves.
6. Well intervention procedure in improving productivity for a well.

COMPONENT I: Reservoir Engineering

Every student should carry out any eight experiments from the following experiments.

1. Demonstration of Procedural part of core analysis and understanding importance of accuracy and precision in experimental work
2. Resistivity measurement for a rock sample.
3. Determination of contact angle on different surfaces with various fluids.
4. Determination of capillary pressure.
5. Study of fluorescence.
6. Determination of radioactivity in rocks.
7. Porosity Determination
8. Permeability Determination

9. Relative Permeability plots using excel.
10. Physical significance of poroperm relationship, manual calculations and calculations using spreadsheet.
11. Experimental determination of vapor – liquid equilibrium for binary mixtures.
12. Determination of Joule Thomson Coefficient.
13. Experimentation on Porous media – Effect of Curvature.
14. Determination of Bubble Point and Dew Point of multi-component mixtures using ASPEN / HYSYS or similar software
15. Calculation of reserves using different methods
16. Application of reservoir modeling software to determine initial oil in place
17. Writing of a code or program and mathematical algorithm as a problem - solving application in petroleum reservoir engineering.

COMPONENT II: Drilling Engineering

Every student should carry out minimum six exercises from the following list

1. Study of rotary, hoisting system and power transmission system on a drilling rig.
2. To determine mud density, marsh funnel viscosity and pH of given drilling fluid sample. Sand and liquid content in drilling fluid sample.
3. Mud rheology test to determine viscosity, gel strength of yield point using Fann viscometer.
4. Measurement of filtration behavior and wall cake building properties using dead weight hydraulic filtration for low pressure, low temperature test and to rest resistivity of each component.
5. Total cation exchange capacity of the drilling fluid.
6. Thickening time test and study of atmospheric pressure consistometer.
7. Compressive strength test of cement.
8. Methylene blue test (MBT)
9. Use of software/spreadsheet in the calculation.

COMPONENT III: Production Engineering

Every student should carryout minimum six exercises from one to eight from the following list. Exercises nine and ten are mandatory. Analysis of data should be carried out using programming spreadsheet on computers wherever applicable.

1. Study of wellhead equipment, Christmas tree, flow control and typical procedure to open and shut-in a well.
2. Working and functions of various down hole equipment, tools their installation, operational aspect and application.
3. Application of multiphase flow correlation and construction of IPR - VLP plots.
4. Study of well completion procedure for a typical well configuration and well completion design considerations.
5. Analysis of pressure and temperature effects on tubing, packer setting mechanism and calculation of unseating force acting on a production packer.
6. Drill Stem Testing, its procedure, interpretation and applications.
7. Repeat Formation Testing, its procedure, interpretation and applications.

8. Typical well intervention procedure with objectives and job specifications to improve the productivity for a given wellbore.
9. Application of well production modeling software to construct IPR-VLP plot and its sensitivity analysis.
10. Writing of a code or program and mathematical algorithm as a problem - solving application in petroleum production engineering.

The three components together will form a journal with three index sheets signed by the concerned faculty member for the assessment of term work and the certified journal should form basis for oral examination.

Guidelines for Instructor's Manual

The instructor's manual should be prepared separately for individual component of this laboratory course and should be named as Drilling Engineering, Production Engineering and Reservoir Engineering.

The Instructor's manual should include Aim, theory, procedure, figures, observations, calculations and results for every experiment.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal. Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades, mentioned in the journal sheet and also in the record.

Guidelines for conduct of laboratory course

The faculty will give details of laboratory components of the course in the first session along with rules for submission and continuous assessment.

Practical examination will be based on the experiments carried out as a part of experiments carried out throughout the term. The students shall be allowed to appear for examination only after submission of certified journal.

Books

1. Tiab D, and Donaldson E.C., 2012, Petrophysics; 3rd edition, Gulf Publishing Co, 956pp.
2. Dandekar A Y, 2011, Petroleum Reservoir Rock and Fluid Properties, Taylor and Francis.
3. Rabia H, 1985, Oil Well Drilling Engineering, Graham Trotman Ltd., 322pp.
4. Allen Thomas, and Alan Roberts: 1989, Production Operations, Volume 1 and 2; 3rd.Edition, Oil and Gas Consultants International, Inc. 303 pp. and 363 pp.

312387: SKILL DEVELOPMENT
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 1

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pract	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312386	Skill Development	-	-	2	-	-		-	50	**50**

OBJECTIVES

1. To develop employable skills amongst the students.
2. To develop awareness and hands on practice on software available in Petroleum Engineering.
3. To understand and develop an area of interest for career development.

COURSE OUTCOMES

After completing the course, the students should be able to demonstrate,

1. An ability to use excel and software used to petroleum industry.
2. An ability to carry out effective search for given problem.
3. Ability to comprehend the given topic and develop a methodology to develop a solution.
4. An ability to realize code of ethics recommended by SPE International.

Guidelines for Instructor's Manual

The instructor's manual should be prepared for this laboratory course including different components given in the list below.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal. Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades, mentioned in the journal sheet and also in the record.

Guidelines for conduct of laboratory course

The faculty will give details of laboratory components of the course in the first session along with rules for submission and continuous assessment.

Oral examination will be based on the experiments carried out as a part of experiments carried out throughout the term. The students shall be allowed to appear for examination only after submission of certified journal.

Practical Course:

Every student shall perform following exercises and assignments and submit a journal which will be checked as continuous assessment.

1. Problem solving, Data plotting and analysis using spreadsheet related to different subjects of second year and third year of Petroleum Engineering as practised in the industry (Minimum three exercises).
2. Study of any one of the standard software in petroleum engineering with respect to data input, data analysis and interpretation (three exercises).
3. Creation of a comprehensive technical report from the given document/webinar, at individual level and in a group (Scribe report)
4. Awareness related to oil industry and companies involved at global scale and regional scale, Measuring Corporate Financial Performance and writing a brief one page report.
5. Global, Regional, and Local Industry Trends and Expectations, with reference to oil and gas using oil and gas search engines and preparation of term report, Group activity, approximately 10 pages.
6. Reading procedural part related to Health, Safety and Environment, understanding of environmental norms of India, Safety codes and standards (Regulatory Considerations), writing one case history.
7. Professional ethics recommended by SPE International, discussion on example.
8. To do patent search for a process/product and submit a report

312388: Audit Course 3
Practices in Petroleum Industry I

OBJECTIVE:

The objective of audit course is to expose students to different aspects of petroleum industry by organizing guest sessions on different topics on emerging areas, workshops on soft skills and personality development, industrial tours, mini projects, tutorials, assignments and also report based on internship carried out if any.

REQUIREMENTS FOR COURSE COMPLETION:

The students have to complete audit course as a part of curriculum. This can be divided into different components such as

1. Assignments given by faculty members based on the sessions conducted by industry professionals during the term.

2. Registration for any online course organized by recognized institute in India and outside like IITs, Stanford and MIT Course work and submit the assignments completed as a part of the course work.

3. Assignments completed as a part of learning of any professional software available in the department computer centre under the supervision of faculty members.

4. Report on the industrial visit carried out in the term,

5. Report of the workshop conducted on soft skills and personality development organized if any. This should include exercises given in the class and their analysis and solution.

6. If students are deputed to any activity including internship, paper presentation, technical workshop, seminars and guest sessions outside campus, then a brief technical report of the same should be considered as a part of audit course.

The students individually have to submit at least four of the above activities towards the end of the semester for assessment. The audit course should cover work equivalent to twenty hours in the term and submission should be in the form of a comprehensive report.

Successful completion of audit course will allow students to earn PP in the marksheet and NP if failed to complete the audit course.

Term II

312389: PETROLEUM GEOLOGY II
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 5

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312387	Petroleum Geology II	4	-	2	30	70	-	50	-	150

OBJECTIVE

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

COURSE OUTCOME

After completing the course, the students should be able to demonstrate

1. An ability to know and explain properties of hydrocarbons and associated water.
2. An ability to apply component of petroleum system
3. An ability to classify the sedimentary basins based on classical concept
4. An ability to recognize lateral and vertical variations in sedimentary sequence
5. An ability to apply classification of sedimentary basins to Petroliferous Basins of India
6. An ability to prepare different subsurface maps

Unit 1: Composition and Properties of Hydrocarbons: (8 L.)

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

Unit 2: Origin and Migration of Hydrocarbons: (8 L)

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

Unit 3: Hydrocarbon Traps and Seals: (8 L)

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

Unit 4: Basin Analysis I (8 L)

Introduction to the concept of Basin Analysis. Classification, Lateral variations. Sedimentary Basins: Concept of sedimentation models, classification and development. Heat flow analysis, development of petroleum system/

Unit 5: Basin Analysis II (8L)

Introduction to the Geology of Petroliferous Basins of India. Distribution of Petroleum in time and space. Important world occurrences. Geology of Deepwater Deposits. Mapping subsurface structures, Seismic and sequence stratigraphy, use of modelling in hydrocarbon generation and exploration.

Unit 6: Well Site Geology: (8 L)

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

Guidelines for Instructor's Manual

The instructor's manual should be prepared for this laboratory course including different exercises given in the list below.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal. Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades, mentioned in the journal sheet and also in the record.

Guidelines for conduct of laboratory course

The faculty will give details of laboratory components of the course in the first session along with rules for submission and continuous assessment.

Practical examination will be based on the experiments carried out as a part of practical course carried out throughout the term. The students shall be allowed to appear for examination only after submission of certified journal.

Practical Course:

Submission of certified journal containing Practicals mentioned below with continuous assessment throughout the semester. The journal will be divided into three parts.
Part I:

1. Simple structural problems to find attitude and thickness of subsurface formations (at least 10).
2. Surface and subsurface geological maps including structure contour (3 examples), Isochore (3 examples), percent sand/shale/carbonate (at least 2).
3. Preparation of a reservoir model from given well data
4. Preparation of lithology and composite log, preparation of Correlation charts.
5. Description of cuttings, core and interpretation of data.

Part II:

1. Geology of Petroliferous Basins of India, general introduction on classification of sedimentary basins of India focusing on category I basins (producing basins).

Part III:

1. Geological Tour Report (optional, if conducted).

Books

1. Selley, R.C. 1998: Elements of Petroleum Geology, Academic Press.
2. Kunt Bjorlykke; Sedimentology and Petroleum Geology; Springer Verlag.
3. Leverson A. I.; Petroleum Geology; Freeman Press.
4. North F. K.; Petroleum Geology; Allen and Unwin. 2000, 712 pp.
5. Kunt Bjorlykke, 2010, Petroleum Geoscience: From Sedimentary Environment to Rock Physics, Springer, 518 pp.
6. Tearpock D J, and Bischke R E, 2010, Applied Subsurface Geological Mapping. Second edition, Prentice Hall. 676 pp.

312390: RESERVOIR ENGINEERING II
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 5

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312388	Reservoir Engineering II	3	1	2	30	70		-	50	**150**

OBJECTIVES

1. To understand the nature of hydrocarbon reservoirs.
2. To be familiar with pressure transient analysis
3. To understand pressure distribution in a reservoir.
4. To understand decline curve patterns for producing reservoirs

COURSE OUTCOME

After completing the course, the students should be able to demonstrate

1. An ability to understand and apply flow in porous media and related equations
2. Understanding and applying of basic well tests knowledge.
3. An ability to analyze and interpret data for oil and gas wells.
4. An ability to develop decline curve model
5. Understanding of different types curves available in literature, their utility and applicability in different conditions

Unit 1: Introduction and diffusivity equation (8 L)

Flow in porous media, steady-state and pseudo-steady state concepts, diffusivity equation derivation, boundary equation, dimensionless variables, Ei solution to diffusivity equation, and other solutions to the diffusivity equation.

Unit 2: Build – Up Tests (8 L)

Pressure build-up test, Pressure drawdown test, Variable rate buildup and flow tests: Their analysis and interpretation. Effect of reservoir heterogeneities and boundaries on well responses.

Unit 3: Gas Well Testing (8 L)

Gas Well Testing: Pseudo Pressure, Pseudo time, AOF, isochronal, modified isochronal, interpretation and analysis.

Unit 4: Other Tests (8 L)

Interference tests, pulse tests, horizontal well test, their interpretation and analysis. Drill Stem Test, Operation, Their analysis and interpretation.

Unit-5: Analysis of well tests using Decline Curves (8 L)

Fundamental of type curves, Ramsey's type curve, Mackinley's type curve, Bourdet-Gringarten's type curve, Arp's equation, Production data acquisition, cataloging and retrieval, Decline curves, Fetkovich, Blasingame type curves. Harmonic, Hyperbolic, and Exponential Decline curves.

Unit 6: Reservoir Simulation (8 L)

Introduction, Transmissivity, Permeability, Transmissibility, Matrix of connection values, Finite element equation, Black oil model, compositional model, saturation functions, pressure functions, conducting reservoir simulation study

Practical

Every student will perform minimum of 6 experiments using manual plotting / spreadsheets / standard software from the following list and submit the journal.

1. Pressure build-up test
2. Pressure drawdown test
3. Drill Stem Test
4. Gas well test
5. Interference/Pulse test
6. Multi-rate pressure build-up and flow
7. Decline curve analysis -Arps method
8. Decline curve analysis -using type curves

The students shall solve numerical problems given as assignments in the class as a part of tutorial and also for home studies and submit the same as a part of journal. At least five tutorials are necessary.

Guidelines for Instructor's Manual

The instructor's manual should be prepared for this laboratory course including different components given in the list above.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal. Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades, mentioned in the journal sheet and also in the record.

Guidelines for conduct of laboratory course

The faculty in charge will give details of laboratory components of the course in the first session along with rules for submission and continuous assessment.

Oral Examination

Oral examination will be based on the experiments carried out as a part of experiments carried out throughout the term. The students shall be allowed to appear for examination only after submission of certified journal.

Books

1. Bourdarot, G, 1996, Well Testing, Interpretation Methods. Edition Technip.
2. Chaudhry Amanat U, 2004, Oil Well Testing Handbook, Gulf Professional Publishing, 699 pp.
3. Earlougher, R.C., 1997 "Advances in Well Test Analysis", Monograph Series, SPE,
4. Holstein, E.D. (Editor), 2007, Reservoir Engineering and Petrophysics. V 5, In Lake L W (Editor) Petroleum Engineering Handbook, SPE International, 1689 pp.
5. Horn R A, 1995, Modern Well Test Analysis, A Computer Aided Approach, Petroway, Second edition, 257 pp.
6. Lee W. J. , 1982, "Well Testing", Textbook Series, SPE, Richardson, TX, USA,

312391: PETROLEUM PRODUCTION ENGINEERING II
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 5

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312388	Petroleum Production Engineering	3	1	2	30	70	-	-	50	150

OBJECTIVES

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

COURSE OUTCOMES

After completing the course, the students should be able to demonstrate

1. An ability to recognize and need for artificial lift technology
2. An ability to understand and apply basic principles of gas lift system and their classification
3. An ability to understand and apply operational and maintenance of has lift wells along with surface facilities
4. An ability to understand and apply other methods of artificial lift systems with awareness of their advantages and disadvantages
5. An ability to understand and apply inflow performance curves
6. An ability to understand and apply need of stimulation techniques and their types for enhancement in production

Unit 1: Nodal System Analysis: (8 L)

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

Unit 2: Gas Lift I: (8 L)

Introduction to various artificial lifting techniques and their classification. Screening criteria for various artificial lifting techniques. Introduction to basic principles of gas lift, intermittent and continuous gas lift system. Unloading sequence, Gas lift valves, classification, valve mechanics and

calibration. Selection merits and demerits, of different categories of gas lift valves.

Unit 3: Gas Lift II (8 L)

Gas lift design, basic principles of gas lift feasibility, design and operations, Examples of Mandrel Spacing Design Using IPO and PPO Valves. Design problems. Gas lift duals. Gas lift optimization, Types of Gas lift installations. Operational and maintenance aspect of gas lift wells. Surface facilities for gas lift. Power requirement.

Unit 4: Electrical Submersible Pump: (8 L)

Introduction, surface and subsurface components of ESP. Downhole equipment and surface installations. Detailed design of all specifications. Total dynamic head, number of stages and horsepower requirement. Pumping unit, selection, and trouble shooting.

Jet pumping. Plunger lift. Chamber lift. Hydraulic pumping, Progressive Cavity Pumps

Unit 5: Sucker Rod Pump: (8 L)

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

Unit 6: Well Stimulation: (8 L)

Introduction, need and enhancement of well productivity. Identification of treatment.

Limestone and sandstone acidization. Acidization job analysis. Laboratory investigation. Planning and job execution.

Hydraulic fracturing. Overview of principles. Types of fracturing fluids, additives and Proppant. Well selection for stimulation job.

Design, planning and execution of hydraulic fracturing. Other stimulation techniques.

The students shall solve numerical problems given as assignments in the class as a part of tutorial and also for home studies and submit the same as a part of journal. At least five tutorials are necessary.

Practical

Submission of journal containing above mentioned practical at the end of the term with continuous assessment throughout the semester.

1. Estimation of fluid properties using correlations.
2. Study of pressure losses analysis for a given petroleum production system
3. Analysis of petroleum production system for a typical well completion scheme.
4. Design of gas lift system.
5. Design of electrical submersible pumping system
6. Design of sucker rod pump system

7. Selection, hydraulics and design of acidic system for Matrix Acidization.
8. Selection, hydraulics and design of Hydraulic Fracturing.
9. Choke performance analysis.
10. Application of well production modeling software to select and design any one artificial lifting technique.
11. Writing of a code or program and mathematical algorithm as a problem - solving application in artificial lifting technique.

Guidelines for Instructor's Manual

The instructor's manual should be prepared for this laboratory course including different components given in the list above.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal. Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades, mentioned in the journal sheet and also in the record.

Guidelines for conduct of laboratory course

The faculty will give details of laboratory components of the course in the first session along with rules for submission and continuous assessment

Oral Examination

Oral will be conducted on the basis of the examination of students on certified journal which is inclusive of practical course and tutorials.

Books

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

312392: PETROLEUM FIELD INSTRUMENTATION AND CONTROL
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 4

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312390	Petroleum Field Instrumentation and Control	3	-	2	30	70	25	-	-	**125**

OBJECTIVES

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

COURSE OUTCOMES

After completing this course student will be able to

1. Select suitable sensor for required service.
2. Implement appropriate control strategy in order to ensure efficient operation.
3. Apply the basic principles of instrumentation and control for new fields.

Unit – 1: Fundamentals of Oil-field Instrumentation and Control (6 L)

Oil field instrumentation and control principles, basic measurements in drilling and production operations basic measurement terms, static and dynamic characteristics of measuring instruments, measurement system configuration, transducer elements, intermediate elements, calibration, signal conditioning elements, filtering and signal analysis, data acquisition and conversion (ADC,DAC), digital signal transmission and processing, indicating and recording element, industrial data communication (OSI, RS-232 interface standard, fiber optics, modbus, HART, AS-i, device net, PROFIBUS, foundation fieldbus, industrial Ethernet, TCP/IP), wireless communication systems (radio/microwave communication, industrial network security, wireless networks-VLAN, VPN.

Unit – 2: Temperature and Pressure Measurement Techniques (6 L)

Temperature measurement: Temperature scales, classification of methods of temperature measurement, temperature measurement using solid expansion (bimetal), liquid expansion, pressure

spring elements, resistance thermometer, thermistors, thermocouples, radiation sensors, solid state sensors, quartz sensors,

Optic fiber distributed temperature sensors (DTS), fiber Bragg grating temperature sensor (FBG), bottom hole temperature measurement using non-electronic ERD devices (electrical resonating diaphragm).

Pressure measurement: Fluid pressure measurement using manometers, elastic element gauges (Bourdon, bellows, diaphragm, capsule), transduction/electrical sensors, solid state devices, thin film sensors, piezoelectric transducers, vibration element sensors, dead weight tester.

Downhole measurement of absolute and differential pressure using silicon-on-insulator (SOI) sensor, optic fiber sensors.

Unit – 3: Liquid Level and Flow Measurement Techniques (6 L)

Level measurement: Liquid level measurement using direct and indirect methods, capacitance method, radiation method, ultrasonic method, radioactive method.

Acoustic fluid level measurement in flowing gas wells, fully automated fluid level measurement tool.

Fluid flow measurement: Head flowmeters (orifice, ventury, pitot tube, flow nozzle), variable-area flowmeters (rotameters), positive-displacement meters, turbine meters, electromagnetic flowmeters, ultrasonic method, thermal sensors, laser anemometers, coriolis mass flowmeter

Downhole fiber-optic multiphase flowmeter (MPFM), permanent downhole monitoring system (PDMS), measurement of component-wise gas-liquid mixture flow rate, inflow-control devices (ICD), in-well multiphase optical flowmeter, in-well strain-based flow measurement, real-time virtual flow measurement techniques.

Unit – 4: Fluid Density, Viscosity, pH, and Composition Measurement Techniques (6 L)

Density measurement: Downhole fluid density measurement using optical measurements (spectroscopy), vibrating rod sensor.

Viscosity measurement: In-situ density and viscosity sensor (DV), downhole viscosity measurement using vibrating wire sensor, continuous measurement of density and viscosity of drilling fluid.

pH measurement: Downhole pH measurement using optical spectroscopy, real-time downhole pH measurement.

Fluid composition measurement: Downhole fluid analysis (DFA) tool, downhole measurement of methane content and GOR.

Unit – 5: Fundamentals of Process Control (6 L)

Basic terms used in process control, input-output/ transfer function model of dynamic systems, dynamic behavior of first- and second-order systems, feedback control system (block diagram), control valves

(principle, types, characteristics, selection and sizing), ON-OFF controllers, classical feedback controllers (P,PI,PID), PID control of managed pressure drilling (MPD) operation, feedforward control, model predictive control (MPC), limit switches, solenoid valves,

Unit – 6: Drilling Automation and Smart/Intelligent Oil Fields and Telemetry (6 L)

Intelligent oil field using DCS, PLC's and SCADA, digital field development/implementation architecture, applications of lab-on-chip in oil fields, supervisory control, multilevel control approach in MPD, optimal control of drilling procedure, integrated subsea and topside control system, field optimization using gas breakthrough control (GBC).

Telemetry: Acoustic downhole telemetry systems, production controls through main wells telemetry, wired-pipe telemetry, and wireless downhole telemetry

Practical Course:

Every student shall perform minimum eight experiments from the following list and submit a journal which will form the term work.

1. Calibration of temperature measuring instruments (thermocouple, RTD)
2. Calibration of pressure gauge using dead weight tester.
3. Liquid level measurement using direct and indirect methods.
4. Liquid flow measurement using orificemeter and venturimeter.
5. Liquid flow measurement using rotameter.
6. Measurement of liquid density, viscosity, pH.
7. Dynamic response of mercury expansion thermometer.
8. Dynamic response of liquid column manometer.
9. Liquid level control using P, PI, PID controllers.
10. Study of DCS, PLC, and SCADA systems.
11. Study of advanced process control systems

Guidelines for Instructor's Manual

The instructor's manual should be prepared for this laboratory course including different components given in the list above.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal. Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades, mentioned in the journal sheet and also in the record.

Guidelines for conduct of laboratory course

The faculty will give details of laboratory components of the course in the first session along with rules for submission and continuous assessment

Term work assessment

The students will submit certified journal assessed continuously by the faculty members towards the end of semester for the assessment of term work marks.

Books

1. Rangan, Sharma, Mani, "Instrumentation Devices and Systems", Tata McGraw Hill Publications Co. Ltd.
2. George Stephnopoulos, "Chemical Process Control", PHI, Publications.
3. Bella G. Liptak, " Instrument Engineers Handbook-Process Measurement" Elsevier
4. Mian, M.A. (1992). Petroleum Engineering Handbook for the Practicing Engineer, Penwell Publishing Company
5. Eckman, D.P. (1952). Industrial Instrumentation. Wiley Eastern

312393: PETROLEUM EQUIPMENT DESIGN AND DRAWING
(T. E. PETROLEUM ENGINEERING 2012 COURSE)
Credits 4

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pract	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312391	Equipment Design and Drawing	3	-	2	30	70	25	-	-	125

OBJECTIVES

1. To understand the basic concepts of machine design.
2. To make student aware of different equipment and machineries used in petroleum industry.
3. To design equipment based on various codes and standards used in industry.
4. To test the equipment for safety against applied loads.

COURSE OUTCOMES

On completion of this course, the students will be able to

1. Design machine components and equipment's using design codes and standards.
2. Select suitable pumps and compressors for required service.
3. Design pressure vessels, and storage vessels for petroleum products.
4. Design drill string subjected to buckling.

Unit 1: Fundamentals of Design: (6 L)

Definition, classification of machine design, general considerations and general procedure of machine design, Petroleum equipment design considerations in drilling and production operations.

Brief review of stress, strain, modulus of elasticity, stress-strain curve, factor of safety, lateral strain, Poisson's ratio, stresses due to static loads, (direct stress, thermal stress, bending stress, torsional stress), biaxial stress system, compound/combined stresses-principal planes and stresses, strains, theories of failure, design stress.

Slope and deflection of beams, strain energy due to gradual, sudden and impact loads, design of struts (columns) subjected to axial and eccentric loads, buckling of long columns, calculation of buckling load using Euler's formula and Rankine formula, direct and bending stresses for eccentrically loaded short columns, effect of lateral forces and self-weight, resultant stress due to axial loads, uniaxial bending, concept of core of solid circular and rectangular sections.

Introduction to finite element method for two/three dimensional stress systems (basic concept, general steps, applications, advantages)

Unit 2: Design of Basic Machine elements (Shafts, Keys and Couplings) (6 L)

Shafts: Types of shafts, material used for shafts, torsion in shafts, power transmitted by shaft, torsion formula, bending and torsional stresses in shafts, design of shafts subjected to torsion, bending, and combined (bending + torsion), equivalent bending moment and twisting moment, shafts subjected to fluctuating loads, shaft design based on rigidity, comparison of hollow and solid shafts.

Keys: Types of keys, forces acting and stresses in key, design of sunk key based on shear and crushing.

Couplings: Classification of couplings, design of rigid couplings (sleeve type, split muff type, flange coupling).

Unit 3: Design of Mechanical Drive Components (Belt, Chain, Gear Drives) (6 L)

Belt Drives: Types of belt drives, types of belts, material used for belts, stresses in belts, belt speed, velocity ratio of belt drive, slip of belt, creep of belt, length of an open and crossed belt drive, power transmitted by belt drive, centrifugal tension, maximum tension, condition for maximum power transmission, initial tension in belt, V- belt and rope drives, classification and designation of wire ropes, factor of safety for wire ropes, stresses in wire ropes, design of wire ropes.

Chain Drives: Advantages and disadvantages over chain drives, classification of chains, housting and hauling chains, velocity ratio and factor of safety of chain drive, power transmitted by chain drive, maximum speed for chain.

Gear Drives: Types of gears and gear drives.

Types of bearings, clutches and brakes (mechanical and eddy current).

Unit 4: Design of Pressure Vessels, (6 L)

Pressure Vessels: Types of pressure vessels (thin and thick), codes and standards for pressure vessels , design stress, design criteria, corrosion allowance, basic parts of a pressure vessel, design of thin shells (cylindrical, spherical) subjected to internal and external pressure, types of heads or closures, design of vessel heads, high pressure vessels-construction, design of solid-walled vessels.

Unit 5: Design of Storage Vessels and supports (6 L)

Storage Vessels: Storage tanks for non-volatile and volatile liquids, loss mechanisms, fixed-roof tanks, variable volume tanks, design of rectangular and cylindrical storage tanks, storage of gases (spherical vessels or hortonspheres).

Vessel supports: Types, column supports, leg supports, skirt supports, saddle supports, and stresses due to dead weight, wind load, seismic load.

Unit 6: Design of Fluid Transport Equipment (6 L)

Piping and valves: Types of valves, pressure drop in valves, piping design for liquid, gas, and two-phase lines, choosing line size and wall thickness.

Liquid transport equipment (Pumps) : Types, classification, generic types of centrifugal pumps, codes and standards for pumps, pump specific speed, multiple pump installations, reciprocating pumps, controlling pulsating flow, construction, working, power and efficiency calculations, characteristic curves, selection of pumps, mud circulation pumps

Gas transport equipment: Construction and working of fans, blowers, compressors, ejector and vacuum system.

Practical Course:

The following assignments should be submitted as a part of the term-work

1. Design and drawing of shaft, keys and couplings
2. Drawing of belt, chain, and gear drives.
3. Design and drawing of pressure vessels
4. Design and drawing of storage vessels
5. Drawing of pumps, and valves
6. Drawing of compressors.

(At least one assignment should be drawn using design software)

Guidelines for Instructor's Manual

The instructor's manual should be prepared for this laboratory course including different components given in the list above.

Guidelines for Student's Lab Journal

Laboratory journal should be completed on regular basis. Index, illustrations should be properly written. Assignments given over and above the practical topics should also be attached in the journal. Presentation in the journal should be neat.

Guidelines for Lab /TW Assessment

Assignment or practical work write-up should be submitted in the next laboratory session. Assessment should be carried out with grades, mentioned in the journal sheet and also in the record.

Guidelines for conduct of laboratory course

The faculty will give details of laboratory components of the course in the first session along with rules for submission and continuous assessments.

Term work assessment

The students will submit certified journal assessed continuously by the faculty members towards the end of semester for the assessment of term work marks

Books

1. R.S.Khurmi,J.K.Gupta, "A Text Book on Machine Design", Eurasia Publishing House (Pvt.) Ltd., New Delhi.
2. Mahajani, V V and S.B.Umarji, ".Joshi's, Process Equipment Design",Trinity Press, New Delhi.
3. S.D.Dawande, " Process Design of Equipments" , Central Techno Publications, Nagpur
4. Ken Arnold, Maurice Stewart, "Surface Production Operations, Volume 1", Gulf Publishing Company, Houston (Tx).
5. Stanly M. Walas, "Chemical Process Equipment- Selection and Design", Butterworth-Heinemann Series in Chemical Engineering,
6. Daryl L.Logan, "A first course in finite element method", Cenage Learning.

312394: SEMINAR
(T. E. PETROLEUM ENGINEERING 2015 COURSE)
Credits 1

Code	Subject	Teaching Scheme (Weekly Load in hrs.)			Examination Scheme (Marks)					
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total
					In Sem.	End Sem.				
312392	Seminar	-	-	2	-	-	50	-	-	50

COURSE OBJECTIVES

1. To develop good writing and communication skills.
2. To develop self-learning skills.
3. To develop an area of interest for long life learning.

COURSE OUTCOMES:

After completing the seminar, the students should be able to demonstrate,

1. An ability to recognize a problem/ topic of the area of interest
2. An ability to understand and analyze the problem /topic using extensive literature survey and systematic methodology
3. Ability to learn modern tools such as software for the handling of data and analysis
4. Practice skills of communication in front of varied audience.
5. An ability to prepare a technical report and present the same in front of the audience.
6. Ability to follow professional ethics by acknowledging original resource material

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

The student shall collect information from reference books, journals and internet to develop his/her own understanding of the topic and shall carry out a systematic methodology to analyze and evolve the topic using experimental work/software.

The report submitted should reveal the student's originality in writing from the collected information. Mere compilation from the net and other resources is discouraged.

The student shall submit a report for the seminar and present the same using the manuscript.

Format of the Seminar report should be as follows:

1. The report should be neatly written or typed on white paper. The typing shall be with normal spacing and on one side of the paper (A-4 size).

2. The report should be submitted with front and back cover of card paper neatly cut and bound or spirally together with the text.
3. Front cover: This shall have the following details.
   a) Title of the seminar report.
   b) The name of the candidate with roll number and examination seat number at the middle.
   c) Name of the guide below the candidate's details.
   d) The name of the institute and year of submission on separate lines at the bottom.
   e) Seminar approval sheet.

The format of the text of the seminar reports:

1. The report shall be presented in the form of a technical paper. The introduction should be followed by literature survey. The report of analytical or experimental work done, if any, should then follow.
2. The discussion and conclusions shall form the last part of the text. They should be followed by nomenclature and symbols used followed by acknowledgement bibliography should be at the end. References should be written in the standard format. SPE format for Petroleum Engineering be followed in giving references.
3. The total number of typed pages, excluding cover shall be about 25 to 30 only. All the pages should be numbered. This includes figures and diagrams.
4. Two copies of the seminar report shall be submitted to the college. The candidate shall present the seminar before the examiners. The total duration of presentation and after-discussion should be about 20 minutes. (15 min + 5 minutes for question0 answer session).

Text books, and/or reference material

Reference material includes various journals available in the Library, e-recourses such as "ONE PETRO" and other relevant material available.

Seminar – Reviews and Submission:

1. Review – I: during month of February (Compulsory) as per the Academic Calendar.
2. Review – II : The last week of March (Optional)
3. Seminar is an individual activity with separate topic and presentation.
4. Duration of presentation – 15 minutes
5. Question and answer session – 5 minutes

Seminar Evaluation Scheme: based on rubrics developed on following lines**:**

1. Relevance of Seminar topic.
2. Abstract writing.
3. Quality of Literature review and originality in writing.
4. Use of software and Ability to solve problem.
5. Investigation and interpretation skills.
6. Presentation quality and expression.
7. Understanding of problem through questions and answers session.
8. Professional ethics by acknowledging the source material and originality.

312395: Audit Course 4
Practices in Petroleum Industry II

OBJECTIVE:

The objective of audit course is to expose students to different aspects of petroleum industry by organizing guest sessions on different topics on emerging areas, workshops on soft skills and personality development, industrial tours, mini projects, tutorials, assignments and also report based on internship carried out if any.

REQUIREMENTS FOR SUCCESSFUL COMPLETION:

The students have to complete audit course as a part of curriculum. This can be divided into different components such as

1. Assignments given by faculty members based on the sessions conducted by industry professionals during the term.

2. Registration for any online course organized by recognized institute in India and outside like IITs, Stanford and MIT Course work and submit the assignments completed as a part of the course work.

3. Assignments completed as a part of learning of any professional software available in the department computer centre under the supervision of faculty members.

4. Participation in the case study competition organized by an institute and submission of the same after verifying correctness of solution from any faculty member.

5. Report of the workshop conducted on soft skills and personality development organized if any. This should include exercises given in the class and their analysis and solution.

6. If students are deputed to any activity including internship, paper presentation, technical workshop, seminars and guest sessions outside campus, then a brief technical report of the same should be considered as a part of audit course.

The students individually have to submit at least four activities inclusive of the above towards the end of the semester for assessment. The audit course should cover work equivalent to twenty hours in the term and submission should be in the form of a comprehensive report

Successful completion of reports will allow students to earn PP in the marksheet and NP if failed to complete the audit course.