SAVITRIBAI PHULE UNIVERSITY PUNE

STRUCTURE AND SYLLABUS

BE (PETROLEUM ENGINEERING)

(COURSE – 2015)

W.e.f. 2018-2019

B. E. (Petroleum Engineering) Term – I

(W.e.f. Academic year 2018-19)

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credits
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total	
					In Sem.	End Sem.					
412381	Petroleum Exploration	4	-	2	30	70	-	50	-	**150**	**5**
412382	Formation Evaluation	3	-	2	30	70	-	-	50	**150**	**4**
412383	Well Engineering and Design	4	-	2	30	70	-	-	50	**150**	**4**
412384	Elective I	3	-	2	30	70	50	-	-	**150**	**4**
412385	Elective II	3	1	-	30	70	-	-	-	**100**	**3**
412386	Project Stage I	-	-	2	--	--	50	-	-	**50**	**2**
Total of Semester – I		**16**	**1**	**10**	**150**	**350**	**100**	**50**	**100**	**750**	**22**

Elective I	Elective II
a. Reservoir Simulation	a. Well Completion and Services
b. Mud Engineering	b. Non-Conventional Hydrocarbon Resources
c. Database Management in Petroleum Industry	c. HSE in Petroleum Industry
d. Flow Assurance	d. Natural Gas Engineering

B. E. (Petroleum Engineering) 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.					
412387	Petroleum Production Engineering III	3	-	2	30	70	-	-	50	**150**	**4**
412388	Improved / Enhanced Oil Recovery	3	-	2	30	70	-	-	50	**150**	**4**
412389	Elective III	3	-	2	30	70	50	-	-	**150**	**4**
412390	Elective IV	3	1	-	30	70	50	-	-	**100**	**4**
412386	Project	-	-	6			100		50	**150**	**6**
Total of Semester – II		**12**	**1**	**12**	**120**	**280**	**200**		**150**	**750**	**22**

Elective III	Elective IV
a. Basics of Subsea Engineering	a. Well Control Methods
b. Production Optimization and Enhancement	b. Petroleum Finance and Economics
c. Petroleum Refining	c. Project Finance and Management
d. Integrated Reservoir Management	d. Open Elective
Open Elective as a part of elective IV: Advanced Materials Environmental Impact Assessment Safety Engineering Coring and Core Analysis Piping Engineering.	

412381 PETROLEUM EXPLORATION

Teaching Scheme:	**Examination Scheme**:
Lectures: 4 Hours/week	In Semester 30
Practical: 2 Hours/week	End Semester 70 Marks
Credits: 5	Practical: 50 Marks

Objectives:

To understand the philosophy of oil exploration
To learn the principles of different methods used in petroleum exploration.
To learn and understand intelligent system for storage of reservoir data
To understand the principles used in developing a geological model for basin analysis.

Course Outcomes

After completing this course the student will be able to

1. Understand and apply geological and geophysical methods for the evaluation of subsurface formations.
2. Apply knowledge of seismic data acquisition, processing and procedure for interpretation
3. Apply pattern recognition for interpretation of seismic data for the understanding of stratigraphy and seismic facies analysis
4. Develop awareness of principles of basin analysis in the recognition of petroleum system
5. Understand and apply basic statistical principles in the development of geological model
6. Calculate the hydrocarbon resources and uncertainties associated with different parameters.

Unit I: Introduction to Exploration Methods – I: (8)

Geophysical Exploration Techniques – Theory and working principles, Data acquisition, Data processing and Interpretation of Gravity and Magnetic Methods.

Theory and working principles, Data acquisition, Data processing and Interpretation of Electrical, and Radioactivity methods. Geochemical Methods and Data Analysis.

Unit II: Seismic Methods – I (8)

Theoretical background, data acquisition, data processing and migration. Interpretation procedure. Seismic impedance, AVO, DHIS

Unit III: Seismic Methods – II (8)

Interpretation of seismic signatures using pattern recognition, Seismic facies analysis, development of seismic stratigraphy.

Unit IV: Basin Analysis (8)

Basin classification, subsidence and thermal history, Understanding of petroleum system, continuous accumulation system.

Unit V: Integrated Geological Modelling (8)

Development of integrated geological model, Use of Geostatistics in autocorrelation, preparation of maps for different attributes.

Unit VI: Petroleum Resources Assessment (8)

SPE/SEG/AAPG terminology related to petroleum resources and reserves, Predicting petroleum resources, Prognostication, Estimation of Volumes of Hydrocarbon in Place, Risk analysis of exploration ventures.

Term Work:

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

List of Practicals:

1) Study of simple seismic sections (3 experiments).
2) Study of resistivity meter, gravimeter, and magnetometer.
3) Preparation of different subsurface maps.
4) Calculation of reserves using volumetric method.
5) Geological data analysis.
6) Exercises based on subsurface geological and geophysical data. (3 experiments manual-graphic and GIS).
7) Determination of total porosity and interconnected porosity and permeability.
8) At least one computer oriented exercise involving above.

Reference Books:

1) Enwenode Onajite, 2014, Seismic Data Analysis Techniques in Hydrocarbon Exploration, Elsevier, 232 pp
2) Guidelines for Application of the Petroleum Resources Management System, 2011, Joint publication of SPE, AAPG, WPC, SPEE and SEG
3) Luca Cossentino, 2001, Integrated Reservoir Studies, Technip, 328 pp.
4) McQuillin R., Bacon M., and Barclay W., "An Introduction to Seismic Interpretation", Gulf Publishing, 1984.
5) Petroleum Society of Canada, 1994, Determination of Oil and Gas Reserves, 394 pp.
6) Rao Ramchandra M.B.,1987, "Outline of Geophysical Prospecting", EBD Publishing.

412382 PETROLEUM FORMATION EVALUATION

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hours/week	In Semester 30 marks
Practical: 2 Hours/week	End Semester 70 Marks
Credits: 4	Oral: 50 Marks

Objectives:

To understand purpose, principles and applications of different logging tools.
To apply quick look methods of log interpretation.
To analyze open hole logs and integrate log and core data to obtain properties of rocks and fluids.

Course Outcomes

After completing this course the student will be able to

1. Apply different logging methods for the evaluation of subsurface formations
2. Apply principles of mud logging in the recognition of oil and gas show
3. Apply principles of physics in the recognition and calculation of different parameters of formations
4. Apply quick look interpretation methods in the evaluation of hydrocarbon recognition
5. Interpret broad depositional environment from log signatures
6. Develop awareness of recent developments in the evaluation of formations.

Unit I: Well Logging Principles I (8)

Introduction to logging: Open hole, Cased hole. Logging practice and equipment. The logging environment, empirical relationships between different zones and fluids.

Types of electrical logs: Principles, Brief descriptions and applications.

Unit II: Well Logging Principles-II: (8)

Nuclear Radioactive and Sonic Logging: Principles: Brief descriptions and applications. Application of drilling time data.

Dipmeter, borehole imaging

Cement bond evaluation logs such as Temperature, CBL- VDL, Other miscellaneous logging techniques such as Caliper, Temperature, Perforation, Depth, rate etc.

Unit III: Log Interpretation I (8)

Introduction, Qualitative and quantitative log interpretation techniques. Coring, Core analysis and DST as direct methods of evaluation.

Quick look interpretations, Evaluation of Shaly formations. Calculation of reservoir parameters, Identification of reservoir fluids and lithology, Introduction to cross-plots, Data processing using computer (qualitative study of some typical programs. Detailed corrections etc. are not expected).

Unit IV: Log Interpretation II (8)

Identification of various geological features such as lithology, thickness, depositional environments and Stratigraphy using logs.

Detection of overpressure.

Movable hydrocarbons and residual oil saturation.

Unit III: Core Analysis (8)

Coring and core analysis objectives, Core handling, well site procedures, and preservation methods

Sidewall coring and wireline fluid sampling. Special core analysis sample selection and statistical data analysis

Core-log correlation.

Unit VI: Mud Logging: (8)

Mud Logging Principles, Detection and evaluation of oil and gas shows. Salient features of logging in deviated wells. Logging in oil muds, Logging programs. MWD, LWD

Oral

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

List of Practicals:

1) Evaluation of porosity, saturation, shaliness etc. from logs. (3 practicals).
2) Experiments based on log interpretation, preparation and evaluation of log cross-section (3 practicals).
3) Interpretation of depositional environment (3 exercises)
4) Correlation using logs
5) Use of any standard log interpretation software.

Reference Books:

1) Asquith George & Krygowski Daniel, 2004, Basic Well Log Analysis. USA. AAPG,
2) Lynch E. J., 1976, "Formation Evaluation", EBD Edition.
3) Rider, M. H., "The Geological Interpretation of Well Logs" John Wiley Publishing Company
4) Log Interpretation, Vol. I to IV and Document VIII; Schlumberger, 1979.
5) John H. Doveton, 2014, Principles of Mathematical Petrophysics, Oxford University Press, 273 pp.
6) Stefan M. Luthi, 2001, Geological Well Logs: Their Use in Reservoir Modelling, Springer, 381 pp.

412383 WELL ENGINEERING AND DESIGN

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hours/week	In Semester 30 marks
Practical: 2 Hours/week	End Semester 70 marks
Credits:4	Oral: 50 Marks

Objectives:

1) To learn design aspects of drilling equipment, techniques, operational procedures for vertical, directional drilling and construction of well bore.
2) To know about well planning and drilling cost evaluation and modern drilling practices.

Course Outcomes:

After completing this course the student will be able to

1. Understand basic components of drilling engineering for well planning and design
2. Design the well using different parameters
3. Understand well control methods and signatures of well in stability
4. Know and apply codes for well design
5. Understand rig hydraulics
6. Apply rheological concepts for cement jobs

Unit-I: Well Planning and Design (8)

Objective, Input data, Drilling programme preparation, Type of well, Prospect, GTO, Casing policy and design – Pore pressure, Fracture gradient prediction, Direct indirect method, Casing seat / depth selection, Casing design criteria, Burst, Tension, Collapse, Bi-axial loading etc combination string.

Unit-II: Directional and Multilateral Drilling (8)

Definitions, Reasons, Reservoir aspect, types, well planning, Design of optimum well bore trajectory, Planning kick off, Deflection tools, Whipstock, Akop, RSS, Bending forces on casing, Torque-drag, Torquosity calculations and Measurements, Survey tools, Survey methods, MWD, Gyroscope, orientation of deflection tool, BHA design, anti-collision.

Unit-III: Well Control (8)

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.

Unit-IV: Drill String Design (8)

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

Unit-V: Rig Hydraulics (8)

Optimization of bit hydraulics, Nozzle size calculation using graphical methods, Bingham plastic – Laminar, Turbulent flow annular hydraulics, Drilling fluid-Case studies and recommendations.

Unit-VI: Cement Rheology and Drilling Economics (8)

Drilling economics and costing, Drilling economics, Cost analysis and predictions AFE calculations.

Cement rheology, case studies, field problems related to lost circulations squeeze jobs, Linear cementation.

Oral

Every student should carry out minimum seven exercises from the following list of practical's and submit a report of each experiment in the form of journal. This will form the basis of term work assessment. Analysis may be carried out using available software wherever possible.

List of experiments:

1) Well construction, GTO, Drilling cost analysis and Predictions.
2) Rig hydraulics – optimization
3) Drill string design and calculation
4) Casing seat selection, casing policy and design
5) Cementation job – work over, lost circulation
6) Well control methods and engineering calculations, kill sheet
7) Directional drilling and derivation control
8) Computer programming / simulation application to drilling engineering
9) Compressive strength test of cement by NDT

Reference Books:

1) Adams N.1985; Drilling Engineering: A Well Planning Approach, Penwell Publishing Company. 849 pp.

2) Bourgoyne A. T, Jr. Adam T. Millheim, Martin E. Chenevert, Jr. F. S. Young.1986; Applied Drilling Engineering, SPE Text Book Series.508 pp.
3) Grace, Robert D, Cudd, Garden Shurjen, 1994; Advanced Blowout and Well Control, Gulf Publishing Company. 414 pp.
4) Rabia H.1995; Well Engineering and Construction. 640 pp.
5) Mitchel Robert L (Editor), Drilling Engineering. V 2, 2007, In Lake L W (Editor) Petroleum Engineering Handbook, SPE International, 770 pp.
6) Lapeyrouse Norton J, 2002, Formulas Calculations for Drilling, Production, and Workover, Gulf Professional Publishing, 234 pp.

Elective I 412384 a RESERVOIR SIMULATION

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hours/week	In Semester 30 Marks
Practical: 2 Hours/week	End Semester 70 Marks
Credits:4	Term Work: 50 Marks

Objectives:

1. Understand the basics of reservoir simulation and its bigger picture.
2. Understand the physical and mathematical principles used in simulating the reservoirs.
3. Understand the importance of relevant data and its types in reservoir simulation for effective future production prediction
4. Understand the working principles of a commercially available reservoir simulator.

Course Outcomes:

After completing this course the student will be able to

1) Understand and evaluate the basic data required for construction of a reservoir simulation model.
2) Develop awareness of the mathematical techniques at the back-end that are used in simulation.
3) Display knowledge of various types of boundary conditions and their impact in simulation.
4) Apply different types of solution techniques to constructed models.
5) Understand the basics of a commercially available reservoir simulator and its types, along with the input data required.
6) Assess case studies in reservoir simulations and critically learn from them.

Unit I: Simulation-I (8)

Introduction and overview; need for reservoir simulation; selecting reservoir rock and fluid properties data; reservoir model components, discretization concepts – temporal and spatial discretization; time steps and grids.

Unit II: Simulation-II (8)

Introduction; 1D, 2D and 3D type models, derivation of diffusivity equations; derivation of flow equations; Taylor series; forward, backward and central difference; finite difference techniques; error terms, time and space derivatives.

Unit-III: Simulation-III (8)

Implicit and explicit formulation of difference equations; stability, convergence and consistency; Dirichlet and Neumann conditions; discretization of diffusivity equation, definition of transmissibility and flow coefficients; numerical approximations.

Unit-IV: Simulation-IV (8)

Review of relative permeability and capillary pressure fundamentals; introduction to IMPES method, assumptions of IMPES method; pressure and saturation solutions using IMPES method.

Unit-V: Simulation-V (8)

Introduction to commercial reservoir simulators; black oil simulators, compositional simulators; thermal simulators; reservoir gridding and local grid refinement; data requirement and well placement; history matching; forecasting future performance.

Unit-VI: Simulation-VI (8)

Types of wells in reservoir simulations; well specifications; simulation of different types of reservoirs; case studies; mini-projects; numerical pertaining to reservoir simulation and numerical techniques.

Practicals:

Each practical consists of inter-connected practical sessions intended to make the students aware of the capabilities of a commercial package

Black oil simulation (Practical 1 – 4)
Compositional model simulation (Practical 5 – 8)
Thermal simulation (Practical 9 – 12)

Reference Books

1) Abou-Kassem, J . H . , Farooq Ai, S.M., Islam, M.R.2006, Petroleum Reservoir Simulation – A Basic Approach, Gulf Publishing Company,
2) Holstein E (Editor), 2007, Reservoir Engineering and Petrophysics, Petroleum Engineering Handbook, Volume III, 1659 pp
3) Khalid Aziz and Antonin Settari, 2006, Petroleum Reservoir Simulation, Applied Science Publisher, London, 476 pp.
4) Mattax, Dalton, 1990“Reservoir Simulation”, SPE Series, USA, 184 pp.

Elective I 412384 b MUD ENGINEERING

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hours/week	In Semester 30 Marks
Practical: 2 Hours/week	End Semester 70 Marks
Credits: 4	Termwork: 50 Marks

Objectives:

1. This course is designed to teach both the theory and practice of the design, decision-making processes, and the use of mud in the planning and implementation of drilling programs.
2. To get familiarized with equipment used in drilling fluid and completion fluids and practices nature of difficulties and actions to be taken.
3. To learn fundamental equations and calculations used in mud engineering

Course outcomes:

After completing this course the student will be able to

1. Describe the use of drilling and completion fluids as well as explain dangers and environmental problems associated with them.
2. Conduct, analyses on drilling mud, complete mud calculations for drilling and completion jobs and describe the equipment used for handling drilling mud and completion fluids
3. Identify, formulate, and solve simple engineering problems related to drilling and completion fluids problems etc.
4. Work on laboratory equipment to measure drilling fluid and completion fluid properties, Rheology, etc.

Unit-I: Drilling Fluids (8)

Overview of drilling fluids: functions, types, compositions, properties of mud. Drilling fluid Rheology, annular hydraulics, filtration and volume calculation. Mud calculations, Hydrostatic pressure, Volume, Weight related calculations during drilling.

Unit-II : Development of Drilling Fluid Technology (8)

Drilling fluid technology: Water base mud system, oil base/ invert emulsion mud system, overview, formulation, preparation & maintenance, Drilling Fluids Reporting & its preparation. Development of mud types or systems. Field test and its procedure (API standard) for water base and oil base/ invert emulsion mud system or synthetic base mud systems, Equipment used in lab for testing drilling fluids for e.g. high pressure high temperature fluid loss, dynamic fluid loss, shale testing equipment etc. Study of analytical testing methods involved in mud engineering. Current updates on research and development in Drilling fluids

Unit III: Basic Chemistry of Drilling Fluids and Rheology (8)

Mud chemistry, Clay mineralogy and the colloid chemistry of Drilling Fluids, polymers used in drilling fluids, types, uses and applications, filtration properties of drilling fluids, static filtration, dynamic filtration, surface chemistry of drilling fluids: surfactants, emulsions, oil wetting agents etc. Rheology: flow regimes, rheological models, hydraulics, rheological properties required for optimum performance

Unit IV: Mud Problems (8)

Hole problems related to drilling fluids, Hole cleaning, Stuck pipe, Lost Returns, differential sticking of the drill string, shale stability, key seating, cuttings accumulation, loss circulation corrosion and lubricity, PH & Alkalinity, Contamination etc.

UnitV: Completion, Workover and Packer Fluids (8)

Overview of completion fluids, formation damage, completion fluid types, properties, testing, displacement, filtration, system maintenance, coring fluids, packer fluids, types, tracers, trouble shoots. Current updates on research and development in Completion fluids.

Unit VI: Drilling Fluid Waste Management (8)

Significance of waste management in drilling operations processes used for controlling and disposing of drilled cuttings such as land farming, annular injection, and offshore requirements. Drilling fluid toxicity and testing. Toxic components in drilling fluid. The international recommendations for handling non-aqueous fluids are also covered.

Term work

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

List of experiments

1. Water base mud testing- To determine mud density, marsh funnel viscosity and pH of given drilling fluid sample. Sand and liquid content in drilling fluid sample.
2. Oil base mud testing- To determine mud density, marsh funnel viscosity and ES. Sand and liquid content in drilling fluid sample
3. Mud rheology test to determine viscosity, gel strength of yield point using Fann viscometer for water base mud or oil base mud system
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 for water base mud
5. HPHT fluid loss test for oil base mud system

6. Mud Circulation system.
7. Methylene blue test for water base mud or oil base mud system
8. Alkalinity, lime content for water base or oil base mud system
9. Total hardness, chlorides, Calcium and Magnesium estimation in water base mud or oil base mud.
10. Software learning and understanding based on mud engineering
11. Retort test for oil base mud and water base mud system
12. Demonstrate knowledge about instruments used for testing drilling fluids such as (Fann 70, Fann 90, particle plugging test, linear swell meter etc)
13. Case study related to drilling fluid, completion fluid etc

Reference Books:

1. ASME, 2005, Drilling Fluids Processing Handbook, Gulf Professional Publishing, 696 pp.
2. Rabia H, 1985, Oil Well Drilling Engineering, Graham Trotman Ltd.,
3. Ryen Caenn, H. C. H. Darley and George R. 2011, Gray, Composition and properties of Drilling and Completion Fluids, Sixth edition, Gulf Professional Publishing, 701 pp.
4. Skalle, 2011, Drilling Fluids Engineering, Ventus Publishing, 132 pp
5. Whittakar, Alun, 1985, Theory and Application of Drilling Fluid Hydraulics, The EXLOG Series of Petroleum Geology and Engineering Handbooks, Reidel Publishing Company, 210 pp.
6. Ray Taylor, 1986, Drilling Fluids

412384 C DATABASE MANAGEMENT IN PETROLEUM INDUSTRY

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hours/week	In Semester 30 Marks
Practical: 2 Hours/week	End Semester 70 Marks
Credits:4	Termwork: 50 Marks

Objectives:

1. To make the students understand the importance of handling data
2. To help students understand the basics of programming
3. To help students understand the basics of Microsoft Excel and Microsoft Access
4. To help students understand the basics of RDBMS
5. To help students understand effective system capable of handling large petroleum data

Course Outcomes

After completing this course the student will be able to

1. Develop simple programs to understand their utility in petroleum field
2. Handle the tools like excel and access for the efficient database analysis
3. Realize importance of RDBMS in problem solving related to subsurface analysis
4. Effectively design the attributes for implementation of project
5. Develop spatial data structures and models for different attributes
6. Apply autocorrelation and develop multivariate maps based on query operations

Unit 1: Programming (8)

Basic Introduction to a programming language (C, C++, VBA etc.), Basic and Intermediate Use of Microsoft Excel, Coupling of Microsoft Excel with VBA – Basics of Macros

Unit 2: Handling Excel and MS Access (8)

Basic introduction to Microsoft Access, Coupling of Access and Excel, Writing basic queries in Access, Writing small VBA codes for both Access and Excel, Functionalities of Access

Unit 3: RDBMS (8)

Basics of RDBMS, Basics of higher end databases – MySQL, Oracle, JavaDB, SQLite, SQL Server Express, Possible applications of database in the oil and gas industry

Unit 4: Spatial Data Models (8)

Introduction to GIS, Spatial Data Models, Spatial Data Structures, Spatial Data Inputs, Visualization and Query of Spatial Data.

Unit 5: Spatial Data Transformation and Auto Correlation (8)

Geostatistics in data handling, optimal interpolation, Spatial Data Transformations, Tools for Map Analysis, spatial analysis, creation of single and multiple maps.

Unit 6: Project Design (8)

Design of project using available database for subsurface mapping and correlation, Environmental assessment. Petroleum industry case studies

Applications of different software used in Petroleum Industry.

Term Work:

Every student should carry out experiments from the following list and submit the journal.

List of Practical:

1. Solve Pre-formulated Mathematical Models for Petroleum Engineering Operations Using C, C++ or Mathematical Software Packages (minimum 4 exercises)
2. Exercises based on subsurface geological and geophysical data. (3 experiments manual-graphic and GIS).
3. Digital image analysis using available software.
4. Design of attributes for efficient implementation of project in various applications in Petroleum Industry (3 experiments)

Reference Books:

1. Burrough, P A and McDonnel R A, Principles of Geographic Information System, Oxford Univerosty Press, 1998
2. Demers, M. N.: Fundamentals of Geographic Information Systems, John Wiley and Sons, 1999.
3. Longley, P. A., Goodchild, M. F. MaGuire, D. J. Rhind, D. W. Geographical Information Systems and Science, John Wiley and Sons, 2001.
4. Richards, J A, and Jia, X, Remote Sensing Digital Image Analysis, Springer-Verlag Berlin, 2006, 454 pp.
5. Timothy C. Coburn and Jeffrey M. Yarus, 2000, Geographic Information Systems in Petroleum Exploration and Development, AAPG Computer Applications in Geology, No. 4, 306 pp.

412384 D. FLOW ASSURANCE

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hours/week	In Semester 30 Marks
Practical: 2 Hours/week	End Semester 70 Marks
Credits:4	Termwork: 50 Marks

Course Objectives

1. To be aware of the challenges in transportation of hydrocarbons and their mitigation techniques.
2. To understand the behaviour of organic deposits in crude oil viz. waxes, asphaltenes and their impact on the transportation and production of hydrocarbons.

Course Outcomes:

At the end of the course, the student will be able to

1. Predict the phase behaviour of hydrocarbons under different operating conditions.
2. Perform slug handling and pressure surge analysis
3. Implement a thermal management strategy in pipelines transporting hydrocarbons
4. Predict the formation of paraffin waxes, asphaltenes and hydrates in crude oil
5. Apply the appropriate method for prevention and removal of organic deposits.

Unit – I Introduction to Flow Assurance (6)

Flow Assurance concerns and challenges ; Economic impact of Flow Assurance problems, components of typical Flow Assurance process ; Composition and Properties of Hydrocarbons ; Equations of State ; Phase behaviour of hydrocarbons, Compositional and Physical Characterization of Crude oil.

Unit – II Hydraulics in Flow Assurance (6)

Hydrocarbon flow, single phase and multiphase flow, Two phase flow correlations ; Slugging and Liquid Handling, Types of slugs, Slug prediction, detection and control systems ; Pressure surge analysis ; Hydraulic/Pressure drop calculations.

Unit – III Heat Transfer in Flow Assurance (6)

Buried pipeline heat transfer, Temperature prediction along the pipeline in steady state and transient modes; Thermal management strategy like external coating systems, direct heating, pipe in pipe, etc; Insulation performance

Unit – IV Characterization and Formation Mechanisms for Organic Deposits (6)

Characterization, Formation mechanism, prediction and models for deposition and stability for wax (Paraffins), Asphaltenes and Gas Hydrates

Unit – V Organic Deposits Removal Methods (6)

Mechanical Removal Methods like Coiled Tubing, Pigging, Pressurization Depressurization, etc; Chemical Solvents and Dispersants, Other techniques like Ultrasonic, Laser Technology, etc, Bacterial Removal Methods

Unit – VI Organic Deposits Prevention Methods (6)

Heating in Wellbore and Piping; Cold flow methods; Chemical inhibitors for waxes, asphaltenes and hydrates; Dehydration of Natural Gas; Special Materials and Coatings.

Term-Work

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

Exercises will be based on physical experimentation or simulation software

1. Determination of Wax Appearance Temperature (WAT)
2. Prediction of Paraffin wax deposition
3. Study of wax inhibition using chemicals
4. Wax remediation using unconventional methods like magnetic, ultrasonic methods, etc.
5. Prediction of Hydrate formation
6. Study of hydrate inhibition
7. Determination of Asphaltene content in crude oil
8. Determination of temperature profile in subsea pipelines
9. Calculation of insulation thickness for crude oil transportation pipelines
10. Performing Cool down calculations in subsea pipelines
11. Pressure drop calculations in crude oil transportation pipelines
12. Pressure surge analysis in pipelines
13. Prediction of slug formation during crude oil transportation

Reference Books

1. Bai, Y and Bai, Q. (2005). *Subsea Pipelines and Risers*. I Edition. Elsevier
2. Danesh, Ali. (1998). PVT and Phase Behaviour of Petroleum Reservoir Fluids. I Edition, Elsevier
3. Frenier, W. W., Zainuddin, M., and Venkatesan, R. (2010). *Organic Deposits in Oil and Gas Production.* Society of Petroleum Engineers.
4. Katz, Donald. (1959). Handbook of Natural Gas Engineering. I Edition. McGraw Hill Higher Education.
5. Yen, T.F and Chilingarian, G.V. (2000). *Asphaltenes and Asphalts, 2* from *Developments in Petroleum Science.* Volume 40 B, Elsevier
6. Dendy Sloan, Carolyn Ann Koh, Amadeu K. Sum, Norman D. McMullen, George Shoup, Adam L. Ballard, and Thierry Palermo (Editors), 2011, Natural Gas Hydrates in Flow Assurance, Gulf Professional Publishing, 213 pp.

Elective II 412385 WELL COMPLETION AND SERVICES

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hrs / week	In Semester 30 Marks
Tutorial: 1hrs/week	End Semester 70 marks
Credits: 4	

Course Objectives

1. To understand the geographic distribution of unconventional hydrocarbon resources
2. To understand characterization of source and reservoir rocks
3. To understand methodology to produce these reserves
4. To understand environmental consequences of producing these reserves

Course Outcomes

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

1. Recognize the concept of well completion and workover job for a wellbore.
2. Demonstrate well completion, well services and equipment's to improve production performance of a wellbore.
3. Acquaint with types of well completion.
4. Recognize and apply application of techniques to solve well productivity related problems.
5. Understand and apply problems related to well.

Unit – I : Introduction and Types (8)

Well control and barriers. The role of completion Engineer. Data gathering. Designing for life of well. Drilling, production and reservoir aspects of well completion. Skin damage. PI and IPR. Factors influencing completion design. Completion procedure. Types of well completions. Advantages and disadvantages. Completion tools and equipment's in surface and subsurface installations.

Unit – II : Operations and Tools (8)

Well completion fluids. Well activation, circulation and swabbing. Perforation. Types, geometry and size. Underbalanced and overbalanced perforating. Procedure. Well control during Completion. Wire line operations tools. Use of slick line, e-line and Coiled tubing unit in well completion job. Well completion in fracturing.

Unit – III: Types (8)

Material selection and tubing stress analysis in well completion. Well completion for horizontal and multilateral wells, injection wells and well completion in artificially lifting wells. Completion techniques for sand control. Screen types and design considerations. HPHT well completions. Completion for Unconventional hydrocarbon resources. Introduction to offshore and subsea well completion operations.

Unit – IV : Well Servicing (8)

Introduction to general well servicing and related operations. Operations on live wells. Well problem identification. Reasons for decline in well productivity. Problem well analysis. Types and method of well intervening. Impact of well operations on completion design. Workover planning.

Unit –V: Workover Operations (8)

Productive formation testing and bottom hole sampling. Operations to solve formation damage related problems and well services for mechanical problems of a wellbore. Removal of scale, hydrate, paraffin and sand during workover. Operations on killed wells. Squeeze cementation. Water and gas shut off jobs. Liquid unloading in gas wells. Fishing tools and jobs during production.

Unit –VI : Special Considerations (8)

Special cases. Typical well services and applications for horizontal and multilateral wells. Introduction to offshore and subsea well services and challenges. Problems and services for Unconventional hydrocarbon reservoirs and wells. Workover and completion rigs. Workover systems. Rig selection. Workover economics. Case studies on typical well completion jobs.

Reference Books

1. Wan Renpu, 2011, Advanced Well Completion Engineering, Third Edition, Elsevier
2. Thomas O. Allen and Alan P. Roberts, 1989, Production Operations: Well Completions, Workover, and Stimulation, OGCI, Tulsa, Volume 1 and 2,
3. Dennis Perrin, Michel Caron and Georges Gaillot, 1999, Well Completion and Servicing: Oil and Gas Field Development Techniques, Technip, 340 pp.
4. Schlumberger, 2001, Completion Primer, 129 pp.
5. Jonathan Bellarby, 2009, Well Completion Design, Developments In Petroleum Science, Volume 56, Elsevier, 711 pp.
6. Heriot- Watt University- Production Technology. Volume I and II

412385 C NON CONVENTIONAL HYDROCARON RESOURCES

Teaching Scheme:	Examination Scheme:
Lectures: 3 hours/week	In Semester 30 Marks
Tutorial: 1hrs/week	End Semester 70 marks
Credits: 4	

Objectives

1. To understand the geographic distribution of unconventional hydrocarbon resources
2. To understand characterization of source and reservoir rocks
3. To understand methodology to produce these reserves
4. To understand environmental consequences of producing these reserves

Course Outcomes

At the end of the course, the student will be able to

1. Recognise and apply the concept of continuous accumulation system.
2. Apply the concepts related to exploration and development of Shale Gas Reservoirs.
3. Apply the concepts related to exploration and development of Coal Bed Methane.
4. Understand and apply the concepts related to formation of gas hydrates.
5. Understand and apply different conversion processes for the production of hydrocarbons.
6. Demonstrate awareness related to environmental issues involved in the development of non-conventional hydrocarbon resources.

Unit 1: Non-Conventional Oil: (8)

Continuous Accumulation System

Introduction, geology of Heavy oil, extra heavy oil, Tar Sand and bituminous, oil shales, their origin and occurrence worldwide, resources, reservoir characteristics, new production technologies.

Unit 2: Shale Gas/ Oil Reservoir (8)

Introduction to shale gas & basin centered gas, tight reservoirs.

Shale gas geology, important occurrences in India, petrophysical properties, Development of shale gas, design of hydro fracturing job, horizontal wells, production profiles.

Unit 3: Coal Bed Methane (8)

Formation and properties of coal bed methane. Thermodynamics of coal bed methane. Exploration and Evaluation of CBM.

Hydro-fracturing of coal seam. Production installation and surface facilities. Well operations and production equipment.

Unit 4: Gas Hydrates (8)

Introduction & present status of gas hydrates. Formation and properties of gas hydrates, Thermodynamics of gas hydrates. Recovery methods.

Prevention & control of gas hydrates, Gas hydrates accumulation in porous medium. Gas extraction from gas hydrates.

Unit 5: Coal and Gas conversion to Oil (8)

Introduction, classification and principles, pyrolysis, theoretical aspect of processes involved in conversion.

Technological development of direct conversion and indirect processes and sustainability of conversions.

Unit 6: Environment and Economic Considerations (8)

Environmental considerations of unconventional oil and gas. Treating and disposing produced water, Economics of development

Reference Books

1. Carrol John, 2003, Natural Gas Hydrates: A guide for engineers, Gulf Publications, 289 pp
2. Farooqi Ali, S M, Jones S A and Meldau R F, Practical Heavy Oil Recovery, SPE, 1997, 434 pp.
3. James T. Bartis, Frank Camm, David S. Ortiz, Producing Liquid Fuels from Coal, Prospects and Policy Issues. NETL, DOE, USA, 2008, 198 pp
4. Warner, H.R., 2009, Emerging and Peripheral Technologies, Society of Petroleum Engineers, Handbook, Volume VI, 629 pp.
5. Pramod Thakur, Steve Schatzel and Kashy Aminian, (Editors), 2014, Coal Bed Methane: From Prospects to Pipeline, Elsevier,
6. Rafiqul Islam, M, 2014, Unconventional Gas Reservoirs: Evaluation, Appraisal, and Development, Gulf Professional Publishing, 615 pp.

412385 D HSE IN PETROLEUM INDUSTRY

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hours/week	In Semester 30 Marks
Tutorial: 1hrs/week	End Semester 70 marks
Credits: 4	

Objectives:

To understand impact of petroleum industry operations on environment.
To know the importance of safety, health and environment in Petroleum Industry.
To learn fundamental requirements for the safety, health, and environmental management system.

Course Outcomes

At the end of the course, the student will be able to

1. Understand different components of environmental assessment in petroleum industry.
2. Understand and analyse impact of drilling and production discharge.
3. Apply different methods of waste disposal and treatment for clean environment.
4. Understand the guidelines and apply the well abandonment procedure.
5. Understand the regulatory approaches and safety measures used in India.
6. Develop awareness related to safety aspects of petroleum industry.

Unit I: Basic Environmental compartments: (8)

Air pollution, Water pollution, Land pollution, Hazardous materials in relation to petroleum industry. HAZOP analysis, Environmental Impact of Gas flaring.

Sampling methods.

Unit II: Drilling and production discharge in the onshore and offshore areas (8)

Nature of onshore and offshore discharges, potential impacts on the environment, measuring toxicity, heavy metals, production chemicals, drilling fluids, produced water, air pollution, acoustic impacts, nuclear radiations etc. Sampling methods.

Accidental discharges.

Unit III: Waste disposal and treatment: (8)

Surface and subsurface disposal, treatment of water, solid material and air emissions. Oilfield waste management, effluent water treatment methods. Sampling methods.

Unit IV: Decommissioning of oil and gas installations: (8)

Legal framework of platform decommissioning, planning, abandonment phases.

Well abandonment procedure, well plugging guidelines.

Unit V: Regulatory Approaches and Safety Measures: (8)

Salient provisions in the oil mines regulation act in India related to management, drilling, production and transport. Protection against leakage and fire, care of machinery, plant and equipment.

Safety aspects during drilling, logging, production, transportation, handling etc. at onshore and offshore.

Emergency Response Plan (ERP), Regulatory requirements for ERP, Determination of initial planning zone, Development at the society, government and company level.

Unit VI: Other aspects: (8)

Occupational health hazards, Estimation of Total Petroleum Hydrocarbon (TPH) and suggested measures.

Safety systems and Risk management at offshore.

Legal framework for offshore operations. OISD guidelines.

Case studies of history of accidents in petroleum industry.

Reference Books:

1. Boyce, A. 1996, "Introduction to Environmental Technology", John Wiley and Sons,
2. Frank R. Spellman, 2013, Environmental Impacts of Hydraulic Fracturing, CRC Press, 462 pp.
3. Islam M R, M.M. Khan, and A.B. Chhetri, 2012, How Oil and Gas Can Be Environmentally Sustainable, Scrivener Publishing LLC, 612 pp.
4. Myer Kutz and Ali Elkamel, 2010, Environmentally Conscious Fossil Energy Production, John Wiley & Sons, 363 pp.
5. Orzu Orszulik, "Environmental Technology in oil Industry", Springer – Verlag, 1996.
6. Reis, J.C.1998, "Environmental control in Petroleum Engineering", Gulf publications, 287 pp.

412385 D. NATURAL GAS ENGINEERING

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hours/week	In Semester 30 Marks
Tutorial: 1hrs/week	End Semester 70 marks
Credits: 4	

Objectives:

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

Course Outcomes

After completing the course, the students will be able to

1. Understand the properties of natural gas.
2. Apply different measures in the recognition of reservoir performance.
3. Understand and apply flow behaviour of gas in production tubing
4. Conversant with different methods of processing of gas
5. Understand and apply gas compression fundamentals
6. Conversant with the system of gathering stations, modes of transportation and problems associated.

Unit I: Properties and Measurement of Natural Gas: (8)

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

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

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

Unit II: Gas Reservoir Performance and Gas flow measurement: (8)

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

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

Unit III: Flow of Gas in Production Tubing (8)

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.

Unit IV: Natural Gas Processing (8)

Gas liquid separations, dehydration processes, absorption and adsorption by gas permeation. Desulfurization processes, solid bed sweetening process, physical and chemical absorption processes, Acid gas removal. Integrating natural gas processing

Unit V: Gas Compression (8)

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

Unit VI: Gas Gathering and Transport (8)

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

Installation, operation and trouble shooting of natural gas pipelines.

Reference Books:

1) Bahaduri Alireza, 2014, Natural Gas Processing: Theory and Engineering Design, Gulf Publishing Company, 872 pp.
2) Boyun Guo and AIi Ghalambor, 2005, Natural Gas Engineering Handbook, Gulf Publishing Company, 456 pp.
3) Lyons Williams, Working Guide to Petroleum and Natural Gas Engineering, Gulf Publishing Company, 316 pp.
4) Ikoku, Chi, 1984, “Natural Gas Production Engineering”, John Wiley and Sons, 1984.
5) Kumar Sanjay, 1987,“Gas Production Engineering”, Gulf Publishing Company, TX, USA,
6) Lee, J, Wattenbarger, R. A., “Gas Reservoir Engineering”, Society of Petroleum Engineers, TX, USA, 1996.
7) Wang Xialu and Economides Michael, 2009, Advanced Natural Gas Engineering, Gulf Publishing Company, 400 pp.

412386 PROJECT STAGE I

Teaching Scheme:	**Examination Scheme:**
Tutorial: 2 Hours/Week	Term work 50 Marks
Credits: 2	

Objectives:

The project work aims developing problem solving skills by integrating their knowledge using systematic methodology for an investigations related to broad areas of discipline specific curriculum.

Course Outcomes

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

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

The project work shall be carried out in a group up to maximum of four students or even at an individual level.

The students shall work on some problem related to Petroleum Industry. The project topic shall be selected either by the students and approved by the faculty member ready to work as project guide or assigned by the department. The project work may be carried out as in house project or industry sponsored project. Industry sponsored projects shall be monitored and controlled by the faculty member of the department jointly with the supervisor from the industry.

The project work shall be inclusive of updated literature survey, some investigation work, computer simulation, design work and experimental work. No innovative idea shall be considered for the project.

The project work shall be divided in to two parts spread over two terms of final year of engineering. Project stage I shall be inclusive of problem identification and relevant updated literature survey and methodology to evolve solution for the same.

The students shall submit printed copy of project stage I and present the same in effectively.

Assessment shall be based on quality and originality of work submitted and presented.

412387 PETROLEUM PRODUCTION ENGINEERING III

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hours/Week	In Semester 30 Marks
Practicals: 2 Hours/Week	End Semester 70 Marks
Credits: 4	Oral: 50 Marks

Objectives:

To study separation and treatment of produced oil and associated surface facilities.
To study offshore production technology.
To understand well investigation techniques and remediation of well production problems.

Course Outcomes

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

1. Demonstrate working principle and design of separators
2. Illustrate various equipment and processes for the treatment on produced emulsion
3. Understand mechanism and factors of oil field corrosion and methods for prevention.
4. Understand and apply production logging operations.
5. Do problem well analysis and apply new techniques to sustain production rates
6. Comprehend emerging and peripheral technologies for lifelong learning.

Unit 1:Two Phase and Three Phase Separators & storage: (8)

Two phase oil and gas separation equipment, types, construction detail, working principle, internal sizing, theory of separation and detail design of separator. Three phase separators, types, construction detail, working principle, vessel internal and control equipment. Theory and sizing of three phase separator. LACT unit.

Surface facilities for water injection and maintenance of injection water quality. Filters, Vacuum towers. Review of fluid flow equations and pressure drop in piping

Unit 2:Treatment on Produced Emulsion Equipment and Process: (8)

Theory of emulsion and demulsifies, treating system, equipment, sizing and heat calculations. Electronic coalesces. Skimmer tanks, skimmer sizing equations and produced water treating system.

Crude stabilization unit. Introduction to environmental problems during separation (ETP) and solutions. GGS and CPF overall set-up, process flow sheets. Storage of crude oil. Types of tanks, Evaporation loss, safety systems. Introduction to safety during processing of oil and gas at onshore & offshore.

Unit 3: Oil field corrosion and corrosion treatment: (8)

Corrosion mechanism and influencing factors, corrosion preventive methods, chemical inhibitors, Cathodic protection, protective coating s and plastics, removal of corrosion gases and selection of appropriate materials for preventing corrosion.

UNIT 4: Wireline operations and Production logging (8)

Wireline operations and Procedures: Objectives, Surface equipment, Tool string and service tools, tubing conditioning tools, subsurface equipment. Basic procedures and safety requirements.

Production logging: Logging devices. Pressure and Temperature logging, radioactive tracer logging, spinner-flow meter logging. Introductory interpretation of logs.

Unit 5: Problem Well Analysis and remedies (8)

Inflow and outflow restrictions. Well Production problems: mechanical failure, critical wells with casing pressures, recompletions, plug and abandonment, workover economics.

Formation Damage: occurrence, significance of formation damage, basic cause, damage mechanisms, particle plugging within the matrix, formation clay effects, fluid viscosity effects, diagnosis of formation damage.

Scale deposition, causes, prediction of scaling tendency, scale removal and prevention methods. Paraffin and Asphaltenes, chemistry, deposition mechanism, removal methods and prevention.

Sand control theory and mechanism, effect of well completion and production practices, 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.

UNIT 6: Emerging, Peripheral Technologies and Production optimization. (8)

Multilateral and Intelligent-Well Completions. Subsea and Downhole Processing. Cold Heavy-Oil Production with sand. Oil shale & sands ultra-deep production methods. Methods of production optimization and control of produced of water & gas. Case studies

Every student should carry out minimum eight exercises from the following list of practicals along with minimum two drawing sheets on full empirical size and submit a report of each experiment in the form journal. This will form the basis for term work assessment. Analysis of data should be carried out using programming / excel based spreadsheet on computer wherever applicable.

List of Practicals:

1. Study of liquid and gas separation process and design of two-phase separators.
2. Three phase separation process and three phase separator design.
3. Water treating equipment - skimmer tank design.

4. Determination of injection water quality – salinity, turbidity, oxygen content.
5. Pressure loss evaluation for two phase flow in pipe line and optimization of line size.
6. A detailed exercise on pipeline design and optimization.
7. Analysis of well problem by inflow and outflow characteristics.
8. To study flow assurance related problems and remedial treatment to solve it.
9. Study of multiphase flow regimes with their characteristics.

Drawing of following sheets:

a) Piping and instrumentation symbols used in oil field drawings.
b) Piping and instrumentation diagram of group gathering station.
c) Group gathering station, central processing facility and central tank farm layout.
d) Process flow sheet for various oilfield facilities.
e) Layout of onshore/offshore production facility.

Reference Books:

1. Arnold K. and Stewart M., "Surface Production Operations", Vol. I and II, Gulf Publishing Company, 1986.
2. Mian, M.A., "Petroleum Engineering Hand Book for Practicing Engineers" Vol. I and II, Pennwell Publications, 1992.
3. Galambhor and Guo, "Petroleum Production Engineering a Computer Assisted Approach",
4. Construction of Offshore and Marine Structures - Ben C. Gerwick, Jr.
5. An Introduction to Offshore Engineering - Angus Mather.
6. Wireline operations and procedures – Book 5 of vocational training series – American Petroleum Institute.
7. Production logging – Theoretical and interpretive Elements by A.D.Hill.

412388 IMPROVED / ENHANCED OIL RECOVERY

Teaching Scheme:	Examination Scheme
Lectures: 3 Hours/week	In Semester 30 Marks
Practical: 2 Hours/ Week	End Semester 70 Marks
Credits: 4	Oral: 50 Marks

Objectives:

To understand the nature of reservoirs and strategy for increasing reservoir efficiency.
To be able to design an enhanced oil recovery technique.
To be able to predict the future performance of a reservoir.
To develop a dynamic reservoir model.

Course Outcomes

After completing this course, the students will be able to,

1. Develop recovery expectations and choose appropriate methods for improving oil recovery
2. Determine reasons and causes for less than theoretically possible recovery
3. Understand mechanisms responsible for recovery improvement in various EOR methods
4. Identify important variables that control recovery improvement in various EOR methods
5. Select EOR methods using screening criteria
6. Plan and implement EOR processes employing the proper empirical, analytical, and simulation tools
7. Forecast rate-time and recovery-time behavior under various EOR methods and analyze reservoir performance

Unit I: Introduction and Screening (8)

Introduction to EOR; reservoir engineering aspects of EOR; comparative performance of various EOR methods, screening criteria for EOR; phase behaviour and fluid properties; basic EOR parameter definitions.

Unit II: Gas Injection: (8)

Miscible processes; gas injection and production, ternary diagrams; P-T diagrams; mechanisms of displacement of oil; water injection and fingering; CO2 displacement; minimum miscibility pressure; case studies.

Unit-III: Equations and Models (8)

Fractional flow equation; Buckley-Leverett equation; displacement models for homogeneous and layered reservoirs; immiscible displacement processes; basics of polymer flooding.

Unit-IV: Chemical Flooding (8)

Introduction to chemical flooding; alkali flooding, surfactant flooding, polymer flooding; properties of surfactants and impact on EOR; polymer adsorption phenomenon; performance evaluation; case studies.

Unit-V: Microbial (8)

Microbial EOR; factors impacting MEOR; types of microbes; growth of microbes; conducive conditions for MEOR; field visit; cost to benefit analysis of MEOR vs. other EOR techniques; case studies.

Unit-VI: Thermal (8)

Introduction to thermal EOR methods; cyclic steam injection; continuous steam injection; in-situ combustion; reaction kinetics; SAGD; steam properties; heat losses; efficiency of thermal methods; introduction to EOR in reservoir simulation, performance evaluation; case studies.

Term Work

Every student should carry out minimum 6 experiments from the following list and submit the journal, which will form the term work.

Experiments

1. Modelling and interpretation of a 5 spot reservoir model
2. Modelling and interpretation of a 7 spot reservoir model
3. Modelling and interpretation of water flood staggered line
4. Modelling and interpretation of water flood 5(7,9) spot
5. Modelling and interpretation of water flood inverted 5(7,9) spot
6. Modelling and interpretation of polymer flood
7. Modelling and interpretation of steam flood
8. Modelling and interpretation of CO_2 flood

Reference Books*:*

1) Larry W. Lake, Russell Johns, Bill Rossen & Gary Pope, 2014, Fundamentals of Enhanced Oil Recovery, SPE, 496 pp
2) Don W Green and Willhite G P, 1998, Enhanced Oil Recovery, SPE International, 553 pp.
3) Sorbie K H, 1991, Polymer-Improved Oil Recovery, Springer, 371 pp.
4) James Sheng, 2013, Enhanced Oil Recovery, Field Studies, Gulf Professional Publishing, USA, 683 pp.
5) James J. Sheng, 2011, Modern Chemical Enhanced Oil Recovery Theory and Practice, Gulf Professional Publishing, USA, 632 pp.

412389 BASICS OF SUBSEA ENGINEERING

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hours/week	In Semester 30 Marks
Practical: 2 hours/ Week	End Semester 70 Marks
Credits: 4	Term work: 50 Marks

Objectives:

1) To understand deepwater drilling environment, equipment & drilling Operations.
2) To learn deepwater production operations & transportation of produced Fluids.

Course Outcomes

After completing the course, the students will be able to

1. Understand components of physical ocean environment
2. Realise well problems and apply knowledge of rock mechanics
3. Develop awareness offshore structures and their installations
4. Understand the subsea control system
5. Understand development and production operations related to subsea
6. Acquaintance of offshore storage facilities and transport of oil and gas

Unit-I: Overview of Subsea Engineering (8)

Overview of physical ocean environment, geotechnical aspect –sea floor marine soils, composition & properties of sea water, seawater corrosion, offshore rigs, floating drilling vessels, comparison, fixed offshore structures, wind, wave, current and other forces acting on offshore structures, principle motions, metacenter, stability calculations, ballast control, Rov's.

Unit-II: Deepwater Drilling (8)

Deepwater well construction problems & solutions, deepwater cementation, high temp. High pressure wells, construction, casing & mud policy. Drilling logs, gas hydrates.

Wellbore stability & rock mechanics, Mohr's coulomb criteria 2D-3D system, insitu stress, Poisson ratio, mud window for vertical, horizontal deep water drilling.
Case studies.

Unit-III: Offshore Structures, Installations and Vessels (8)

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.

Unit IV: Subsea Control (8)

Types of Control Systems, Topside Equipment, Subsea Control Module Mounting Base, Subsea Control Module, Subsea Transducers/Sensors, Subsea Production Control System.

Unit-V Development and Production (8)

Risers for Production operations, deepwater completion, Subsea completion, planning, tree selection, design considerations of offshore platform, production & processing of oil & gas, separators, design & planning to stage separation, selection, specification & operations, production monitoring & control system. Multilayer producing fields, EOR, offshore field development considerations in deepwater.

Unit-VI Transport and other facilities (8)

Offshore storage, handling and transportation by oil and gas tankers, vessels and buoys.

Structural considerations functions & operations. Loading conditions, selection specification & operational aspect. Advantages & disadvantages, limitations of various systems.

Subsea oil and gas lines – Design, construction, installation (laying methods), J-tube installation, and pressure drop calculations for two phase flow including riser behavior. Economics & logistic considerations in exploring, drilling, production, transport & reservoir management. Offshore support vessels, their roles, types, capabilities including firefighting, pollution control, stimulation, disaster management rescue operations. Different types of barges and their operations. Offshore vessel mounted cranes. API, OSD grading (safety).

Termwork & Oral

Every student should carry out minimum eight exercises from the following list of practicals and submit a report of each experiment in the form of journal. This will form the basis for term work assessment

List of Practicals

1) Design of production facility at an offshore platform. Typical layout, process flow diagram.
2) Mohr's coulomb criteria, insitu stress.
3) Design atypical workover job (squeeze cementation)
4) Use Nitrogen gas to reduce lost circulation problem during cementation.
5) Study of any standard software to petroleum Engg.
6) DST operation & data analysis.
7) Volumetric kill fluid lubrication method.
8) Preparation of cement slurry & determination of free water content of cement slurry.
9) Soundness fineness of cement.
10) Initial & final setting time of cement.

11) Case studies.

Reference Books

1) Bai Young and Qiang Bai, 2010, Subsea Engineering Handbook, Elsevier, 910 pp.
2) Chakraborty S.K.: Handbook of offshore engineering volume I & II 3 IADC deepwater control guidelines.
3) Design of Concrete Gravity Structures - Edited by Ivar Holand, Ove T.Gudmestad and Erik Jersin
4) James G. Speight, 2014, Handbook of Offshore Oil and Gas Operations, Gulf Professional Publishing, 428 pp

412389 B PRODUCTION OPTIMIZATION AND ENHANCEMENT

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hours/ Week	In Semester 30 Marks
Practical: 2 Hors/Week	End Semester 70 Marks
Credits: 4	Term work: 50 Marks

Objectives:

1. Learn basic concepts of production enhancement methods
2. Select methods to optimize a production system and maximize the recoverable reserves from a field,
3. To understand use of any production enhancement software
4. To understand optimization of field management

Course Outcomes

After completing the course, the students will be able to

1. Understand the need and apply principles of production enhancement
2. Apply suitable methods of production enhancement to different formations.
3. Understand fracturing processes related to field operations
4. Understand principles of flow optimization applicable in field operations
5. Apply the production optimization techniques
6. Understand the field optimization

Unit I: Introduction to production enhancement process (8)

History of well stimulation, introduction to well stimulation, need for stimulation, types of stimulation methods used in the industry, data sources and data needed for a successful stimulation job, data analysis for designing a stimulation job

Unit II: Production Enhancement Methods (8)

Hydraulic fracturing, formation fracturing process, fracture geometry, productivity of fractured wells

Matrix acidizing, Acid rock interaction, sandstone and carbonate acidizing design

Unit III: Data FRAC and Post-Fracturing Processes (8)

Need for a Data FRAC, basics of Data FRAC process, use of results from DataFRAC process, basic of fracturing equipment and operations, fracturing fluids, fracturing proppants, models used for hydraulic fracturing, fracturing treatment design, post-job analysis, basics of fractured well-test analysis

Unit IV: Flow Optimization (8)

Optimization of flow components. Choke optimization, Tubing size selection. Pipeline optimization by simulation.

Choke valves: the function of production choke valves; empirical vs. Mechanistic models; critical and subcritical flow; the use of choke valves to handle back- pressure effects along the production system.

Unit V Production optimization techniques (8)

Production optimization techniques: solutions to boost oil production; liquid unloading techniques in gas wells; downhole and seabed water separation.

Optimization and control of produced of water wellbore conditions and surface facilities.

Diagnosis of systems performance: real-time multiphase flow metering; downhole monitoring; production logging;

Unit VI Planning and Field Operations (8)

Planning short-, medium and long-term optimization of field management: water and gas shut- offs; reperforation; stimulation; re-completion; debottlenecking of topsides facilities; handling transient flow situations in the system; case studies

Practical:

Solve any six exercises from given set.

1. Detailed design of well stimulation job (two exercises).
2. Production Optimization using Nodal Analysis
3. Study of any one of the standard software in petroleum engineering with respect to data input, data analysis and interpretation

Reference Books

1) Boyun Guo, William Lyons and Ali Ghalambhor, 2007, Petroleum Production Engineering: a Computer Assisted Approach, Elsevier Technology, 287 pp.
2) Dale Beggs, 2003, Production Optimization using Nodal Analysis. OGCI Publications. 418 pp.
3) Economides M J and Martin Tony, 2007, Modern Fracturing: Enhancing Natural Gas Production, ET Publishing, USA. 536 pp.
4) Economides M J and K G Nolte, 1989 Reservoir Stimulation. Second Edition, Prentice Hall, 408 pp.
5) Warner H R (Editor), 2007, Emerging and Peripheral Technologies, Vol. VI, Petroleum Engineering Handbook, SPE, 629 pp.

412389 ELECTIVE III C PETROLEUM REFINING

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hours/ Week	In Semester 30 Marks
Practical 2 Hrs/Week	End Semester 70 Marks
Credits: 4	Term work : 50 Marks

Course Objectives

1. To understand the importance of crude oil as source of fuel and the size of refining industry
2. Get acquainted with the various refinery processes and the products along with their specifications
3. Be aware of the challenges involved in refining from viewpoint of product specifications, economic considerations and environmental regulations

Course Outcomes:

At the end of this course, the student will be able to,

1. Establish the link between the upstream and downstream petroleum industry
2. Know the composition of crude oil, along with its properties and characterization methods
3. Understand the purification and fractionation process of crude oil
4. Get conversant the conversion processes of the various products from distillation.
5. Select a good grade of lubricating oil and bitumen
6. Address the issues related to pollution from refineries

Unit – I: Refinery Overview (6)

Origin and formation of crude oil, Reserves and deposits in the world, Overall refinery flow, Refinery products, Refinery feedstocks, Markets and production capacities: India and World, Nelson Complexity Factor for a refinery

Unit – II: Composition and evaluation of Petroleum Products (6)

Classification of crude oil, Composition of crude oil, Crude Assay, ASTM/TBP/EFV curves, Specifications and Test methods for: LPG, Naphtha, Gasoline, Kerosene, Diesel, Lube oil, Waxes, Bitumen and Coke.

Unit – III: Crude Oil Distillation and Cracking (6)

Desalting of Crude, Preheating Train, Atmospheric Distillation of Crude oil, Vacuum Distillation, Catalytic Cracking, Hydrocracking

Unit – IV: Conversion Processes (6)

Catalytic Reforming, Alkylation, Isomerization, Hydroprocessing, Hydrotreating, Coking

Unit – V: Manufacture of Lube Oil and Bitumen (6)

Lube oil processing, Propane de-asphalting, Solvent Extraction, Dewaxing, Finishing Processes, Lube oil additives, Properties of Bitumen, Methods of Manufacture of Bitumen

Unit – VI: Supporting Processes (6)

Product Blending, Hydrogen Production, Sulphur Recovery, Control of air and water pollution, solid waste management

Term-Work

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

List of Practicals:

1. To study ASTM Distillation of Petroleum Products
2. To characterize a given crude oil sample for water content
3. To characterize a given crude oil sample for Viscosity Gravity Constant
4. To determine the softening point of bituminous material
5. To determine the melting point of petroleum wax
6. To determine the smoke point of given fuel sample
7. To determine the flash point of a given fuel sample
8. To aniline point and diesel index of diesel
9. To determine the cloud point and pour point of a given fuel sample
10. To determine the Reid Vapour Pressure of a gasoline sample
11. To determine the calorific value of a petroleum product using bomb calorimeter
12. To determine the oxidation stability of gasoline
13. Oil characterization using commercial simulation software like ASPEN HYSYS

Text Books

1. Bhaskararao, B.K, 2007 'Modern Petroleum Refining Processes', Fifth Edition, Oxford and IBH Publishing Co. Pvt. Ltd.
2. Gary, J.H and Handework,G.E., 2001 *'Petroleum Refining Technology and Economics'*, Fourth Edition, Marcel Dekker, Inc.
3. Ram Prasad, 2013 'Petroleum Refining Technology', First Edition, Khanna Publishers
4. Fahim, M.A., Alsahhaf, T.A. and Elkilani, A.2010 'Fundamentals of Petroleum Refining', Elsevier
5. Nelson, N.L. 1985 *'Petroleum Refinery Engineering'*, McGraw Hill Book Co.
6. Speight, J.G.2002 'Handbook of Petroleum Product Analysis', Wiley Inderscience
7. Myers, R.A., Ed., 2004. 'Handbook of Petroleum Refining Processes', Third Edition, McGraw Hill Book Co.

412389 Elective III D INTEGRATED RESERVOIR MANAGEMENT

Teaching Scheme:	Examination Scheme
Lectures: 3Hours/ Week	In Semester 30 Marks
Practical 2 Hrs/Week	End Semester 70 Marks
Credits: 4	Termwork: 50 Marks

Course Objectives

Prime objective of this course is to integrate the information collected from different discipline for efficient management of the reservoir.

Course Outcomes

After completing this course, the students will be able to,

1. Analyse and interpret data collected from different sources
2. Develop reservoir model using upscaling of available data
3. Run basic simulation model using iterations
4. Predict the future performance of production of hydrocarbons.
5. Apply suitable methods for increase in reservoir efficiency.
6. Apply economic parameter to decide profitability of project.

Unit I: Reservoir Management Concepts and Processes (6)

Fundamentals, Data acquisition, interpretation and integration.

Unit II: Reservoir Characterization (6)

Seismic analysis, well log analysis, recognition of flow units, stochastic modelling, autocorrelation, generation of different maps

Unit III: Static and Dynamic Reservoir Modelling (6)

Integration of exploration and development technology, upscaling of properties, development of models, data management.

Unit IV: Reservoir Performance Analysis and Prediction (6)

Calculation of reserves by different methods, Identifying and acquiring critical data, data acquisition, and analysis, recovery prediction

Field development and field operating plans to optimize profitability, Efficient monitoring of reservoir performance

Unit V: Improved Recovery Processes (6)

Primary recovery, pressure maintenance, and secondary and tertiary recovery

Suitability of improved recovery processes, new drilling, completion and production technology. Use of artificial intelligence.

Case studies from SPE monographs.

Unit VI: Reservoir Economics (6)

Economic parameters, Risk and uncertainty, scenarios based economic evaluation, optimization.

Reference Books:

1) Fanchi J R, 2010, Integrated Reservoir Asset Management: Principles and Best Practices, Gulf Professional Publishing, 361 pp.
2) Satter, A. and Thakur, G. C.1994, Integrated Petroleum Reservoir Management, Pennwell Pubs, 336 pp.
3) Satter A, Jim Baldwin and Rich Jespersen, 2000, Computer-Assisted Reservoir Management, Pennwell Pubs, 289 pp.
4) Tarek Ahmed and D. Nathan Meehan, 2012, Advanced Reservoir Management and Engineering, Second Edition, Gulf Professional Publishing, 701 pp.
5) Shah Kabir and Omer Izgec, 2012, Real-Time Reservoir Management, Society of Petroleum Engineers, 212 pp.
6) SPE Reprint Series, 1998, **48,** Reservoir Management**,** Dallas

412390 Elective IV A WELL CONTROL METHODS

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hrs / week	In Semester 30 Marks
Tutorial:1 Hrs/week	End Semester 70 Marks
Credits: 4	Term work 50 marks

Objectives:

1. To Understand Well control operation during drilling for blow out prevention.
2. To Understand Well control technology for horizontal, multilateral, ERD wells, and deep water drilling.

Course Outcomes

After completing this course, the students will be able to,

1. Understand basic terms related to drilling operations.
2. Realize the kick indications and apply shut in procedure.
3. Understand blow out preventer equipment and control system.
4. Apply methods for killing of wells.
5. Realize anomalous circumstances in controlling the well in different environment.

Unit I Basic terms, bottom hole pressure (8)

BHP, Normal , abnormal pressure, causes, U tube concept, shallow gas, top hole drilling with riser, gas cutting , effect of gas expansion in riser, swab , surge effect , scr , choke l ine friction, ECD.

Unit II Kick indication and shut in procedure (8)

Causes of kicks, kick signs, shut in procedure for land , jack up , floating rig, type of influx, influx behaviour , close circulation

Unit III Blow out preventer equipment surface / subsea (8)

Annular, ram preventer, packing element , accumulator system, sizing of accumulator surface and subsea unit , Kelly cock, safety valve , IBOP , check valve , bit float, subsea BOP stack and control system , choke manifold , kill manifold, diverters, function and pressure test, mud gas separator, vacuum degaser, rotating head, rotating BOP.

Unit IV Well killing method (8)

Driller' s method, wait weight method, comparison, pressure behaviour at different points during killing, volumetric method, subsea considerations, stripping and snubbing, well control considerations for horizontal wells , multilateral wells, associated problems.

Unit V Unusual situations in well control (8)

Plugged nozzles, pump failure, plugged and washed choke, string wash out , lost circulation, reversing out of influx through drill pipe , bull heading, hydrate formation, problems and their remedial actions

Unit VI Deep water well control (8)

Shallow flows on floating rigs, drilling with and without riser, kick prevention and detection, well killing techniques, choke and kill l ine consideration, hydrate formation and prevention, deep water equipment consideration, riser booster pump and remote operated valve, pressure testing of BOP.

Reference Books

1) Robert D Grace, 1994, Advanced Blowout and Well Control, Gulf Publishing Company, 414 pp.
2) David Watson, Terry Brittenham, and Preston L. Moore, 2003, Advanced Well Control, Society of Petroleum Engineers, 386 pp.
3) Neel Adams, 1980, Well Control Problems and Solutions, Petroleum Publishing company, 683 pp.
4) IWCF manual, 2007
5) IADC, Well Control Manual, 2009.

412390 Elective IV B: PETROLEUM FINANCE AND ECONOMICS

Teaching Scheme:	Examination Scheme
Lectures: 3 Hrs / week	In Semester 30 Marks
Tutorial:1 Hrs/week	End Semester 70 Marks
Credits: 4	Term work 50 marks

Objectives:

To emphasize the importance of time value of money in petroleum projects.
To understand the economic and decision analysis parameters in Petroleum E and P Business.
To understand the background of functioning of petroleum industry as an economic entity.
To understand petroleum fiscal system within the context of India

Course Outcomes

After completing the course, the students will be able to

1. Prepare a performance forecast for the realization of recovery of the hydrocarbons
2. Understand of different terms related to reserves as advocated by SPE/SEG/AAPG
3. Analyze oil price elasticity and international oil market
4. Apply principles of time value of money in the economic evaluation of projects
5. Apply decision analysis addressing risk and uncertainty of exploration projects
6. Understand production sharing contract of different geographic regions

Unit I: Production Forecast and Reserves Estimation: (8)

Decline Curve Analysis, Types and utility in production forecast, Reserves to Production Ratio, Statistical analysis, Hubert curves.

Reserves auditing, standard practices for reporting of reserves. SEC/ SPE/ WPC norms.

Unit II: Oil and Gas Prices: International Market and Geopolitics (8)

Crude oil characteristics, Marketing and trading of crude oil, Crude oil pricing mechanism and oil price elasticity, Inflation and effects on oil pricing. Factors controlling oil and gas pricing. Oil differential and influence on price of oil.

E and P Business in world and India, Historical development, Role of OPEC and non OPEC countries.

Unit III: Cash Flow Analysis and Economic Parameters: (8)

Time value of money, types of costs, Economic Yardsticks: Return on Investment, Pay

out Period, Net Present Value, Discounted Cash How, DCFROR,

Incremental Analysis, Replacement Analysis, Sensitivity analysis, Optimization. Ranking of projects based on economic parameters,

Unit IV: Risk and Uncertainty: (8)

Definition, Exploration and Production Probabilistic Analysis, Risk Analysis, Management and Economic Assessment,

Decision Analysis, Preference Theory, Real Option Theory, simple examples of decision tree.

Unit V: Financial Analysis and Accounting: (8)

Analysis of ongoing costs, analysis of field development investments, purchase / sale of producing property, financial reporting.

Mergers and Acquisitions, overview of E & P acquisition environment.

Petroleum Industry Accounting and types, Petroleum Auditing, Tax Analysis, Cost, Expenditure and revenues under different heads and their proportion in Asset. Depreciation, Depletion, Amortization Methods and their use in tax calculations,

Unit VI: Petroleum Fiscal System: (8)

Reasons for development of a fiscal system for petroleum industry. Classification of Petroleum Fiscal Systems, Current distribution of exploration and production contract types, and their comparison with possible equivalence.

National Oil Companies and International Oil Companies: comparative assessment

Petroleum industry in India. Production fiscal system in India and abroad.

Reference Books:

1) Abdel A. A. Bakr A. B, and Al Sahlawi M. A., 1992, Petroleum Economics and Engineering, Decker Publications.
2) Johnston, D, 2003, International Exploration Economics, Risk, and Contract Analysis, Pennwell Books.
3) Nadine BRET-ROUZAUT and Jean-Pierre FAVENNEC, 2011, Oil and Gas Exploration and Production, Reserves, Costs and Contracts. Technip Publication, 336 pp.
4) Mian M A, 2011, Project Economics and Decision Analysis, Volume I and II, Pennwell Books; 2nd Revised edition, 461 pp and 411 pp.
5) Seba R.D., 1998, Economics of Worldwide Petroleum Production OGCL Publications, USA, 761 pp.
6) Silvana Tordo and D Johnston, Petroleum Exploration and Production Rights, World Bank Working Paper 179, Washington, 2010 , 126 pp.

412390 Elective IV C Project Finance and Management

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hrs / week	In Semester 30 Marks
Tutorial:1 Hrs/week	End Semester 70 Marks
Credits: 4	Term work 50 marks

Objectives

Prime objective of this course is to understand and apply project finance and management principles to complete the project in desire time.

Course Outcomes

After completing this course, the students will be able to,

1. Comprehend advanced methods and tools of project management
2. Apply realistic application of methods (strengths, limitations) and strategic issues
3. Apply principles of project management methods to optimize time for project completion.
4. Apply decision supporting tools.
5. Apply principles of engineering economics in the realization of project feasibility and profitability
6. Use risk analysis concepts and iteration for the effects of uncertainty parameters on project implementation

Unit I: Characteristics of Oil and Gas Projects, and communication (8)

Oil and gas projects: an overview, their characteristics, components,

Major pipeline network in the world, trade movement. Project planning,

Unit II: PERT- CPM (8)

Activity network, Critical Path Method, rules and examples, PERT formula and examples, work rate analysis, drag efficient, learning curve analysis.

Unit III: Decision Tools for Project Management in the Oil and Gas Industry (8)

Process mapping, learning principles, KAIZEN, different models, operational efficiency, decision analysis

Unit IV: Project Schedule Forecast, Execution and Control (8)

Objectives, Monitoring and Improving the Plan, time management, field development projects, different components of development, field installation and testing,

Unit V: Engineering Economics for Oil and Gas (8)

Time value of money, cost elements and management, project cost estimation, portfolio management, economic parameters, and scenario development for cost estimation

Unit VI: Project Risk Analysis (8)

Risk and uncertainty, elements, sources, government regulations, EMV and decision tree analysis, Monte Carlo simulation, risk management techniques for identifying, tracking and mitigating risks.

Reference Books

1. Adedeji B. Badiru and Samuel O. Osisanya, 2013, Project Management for the Oil and Gas Industry, A World System Approach, CRC Press, USA, 761 pp.
2. Abol Ardalan, 2000, Economic and Financial Analysis for Engineering & Project Management, Technomic Publishing Company, USA, 230 pp.
3. Trond Bendikesan and Geoff Young, 2005: Commissioning of Offshore Oil and Gas Projects The Manager's Handbook, Author House, USA, 230 pp.

412390 ELECTIVE IV D OPEN ELECTIVE

1. ADVANCED MATERIALS

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hrs / week	In Semester 30 Marks
Tutorial:1 Hrs/week	End Semester 70 Marks
Credits: 4	Term work 50 marks

Objectives

Prime objective of this course to understand various classes of advanced materials and their applications in different fields.

Course Outcomes

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

1. Distinguish various classes of advanced materials
2. Interpret new terms and information on Ultra-light materials, Biomaterials, coatings and thin films, composites, and high temperature refractory materials
3. Identify various classes of composite materials, their properties and applications
4. Identify various classes of ultra-light materials, their processing, properties and applications.
5. Distinguish materials suitable for application at elevated temperatures and identify coatings suitable for protection applications

Basics in Advanced Processes

Overview of unit operations in chemical engineering involving physical and chemical background. Basics in computational material science and process simulation, basics in nanomaterials and technology.

Ultralight Materials, metallic foams and Composites

Material definition and processing, Characterization of cellular metals and properties,

Composite materials, definition and classification, properties and applications.

Polymer Materials

Structure and characterization of polymers, Mechanical and thermal properties of polymers, Processing of Polymers, applications.

Nanomaterials and Nanotechnology

Nanotechnology of dispersed systems, processing and functionality of organic electronic devices, advanced high temperature alloys, polymeric nanomaterials.

Carbon nanotubes: synthesis, properties and applications

Mechanical Properties and Structure of Advanced Materials

Measures of mechanical properties on different scales, deformation and structure of complex materials, microstructures and evolutions.

Factors controlling environmental degradation of materials.

Computational Materials Science and Process Simulation

Overview of simulation methods, importance of Multiscale operations, equations and models in fluid mechanics, steady and unsteady problems and boundary condition.

Reference Books

1. Dmitri A. Molodov, 2013, Microstructural Design of Advanced Engineering Materials, Wiley-VCH, 517 pp.
2. Lloyd H. Hihara, Ralph P.I. Adler and Ronald M. Latanision (Editors), 2014, Environmental Degradation of Advanced and Traditional Engineering Materials, CRC press, 706 pp
3. Mohd Rafie, Johan Noorsaiyyidah and Darman Singho, (Editors) 2014, Science and Engineering of Materials, 331 pp.
4. Taufiq Yap and Yun Hin, (Editors), 2014, Advanced Materials and Engineering, Trans Tech Publications, 463 pp.

412390 ELECTIVE IV D OPEN ELECTIVE

2. ENVIRONMENTAL IMPACT ASSESSMENT

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hrs / week	In Semester 30 Marks
Tutorial:1 Hrs/week	End Semester 70 Marks
Credits: 4	Term work 50 marks

Objectives

Prime objective of this course is to understand the impact of the proposed activities on natural environment and life cycle assessment.

Course Outcomes

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

1. Recognize broad components of impact assessment.
2. Recognize and apply different methods used in the assessment and develop models.
3. Understand EIA regulations in India.
4. Understand different codes in the environmental management system.
5. Assess impact on life cycle and quality of life.
6. Assess global issues related to climate change.

Broad components of EIA

Introduction, definitions and concepts, Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration. Parameters to understand existing quality, public participation techniques

Methodologies

Measurement of environmental impact, organization, scope and methodologies of EIA pertinent environmental factors.

Six generic steps, Public involvement techniques, comprehensive environmental impact study, various project types, EIA Models.

EIA regulations in India

Environmental audit and Management

Definitions and concepts, partial audit, compliance audit, methodologies and regulations

Principles, problems and strategies; Review of political, ecological and remedial actions. Future strategies; multidisciplinary environmental strategies, the human, planning, decision- making and management dimensions.

EMS and Standardization

Introduction to ISO and ISO 14000.

EMAS regulations, wider application of system based approach.

Local infrastructure development and environmental management: A system approach, Regional environmental management system, Conversion plan development and implementation strategies, Environmental management systems in local government.

Life Cycle Assessment:

Life cycle assessment; Triple bottom line approach; Industrial Ecology.

Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting.

Quality of Life Assessment

Carbon Trading

Energy foot printing, Food foot printing and Carbon foot printing.

GHG emissions, global warming, climate change and Carbon credits, CDM, Initiatives in India; Sustainable development; Future scenarios

Reference Books

1. Charles H. Eccleston, 2011, Environmental Impact Assessment, A Guide to Best Professional Practices, CRC Press, 284 pp.
2. Canter, L W, 1997, Environmental Impact Assessment, 2nd Ed., McGraw-Hill, 1997.
3. Peter Morris and Riki Therivel, 2009, Methods of Environmental Impact Assessment, Third Edition, Routledge Publishing,
4. Eccleston, C H, 2000, Environment Impact Statements: A Comprehensive Guide to Project and Strategic Planning, John Wiley & Sons.

412390 ELECTIVE IV D OPEN ELECTIVE

3. SAFETY ENGINEERING

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hrs / week	In Semester 30 Marks
Tutorial:1 Hrs/week	End Semester 70 Marks
Credits: 4	Term work 50 marks

Objectives

Prime objective of this course is to inculcate the safety culture in personal and professional life.

Course Outcomes

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

1. Comprehend different industry hazards and plane safety.
2. Recognize modes of transportation of oil and gas, and safety measures in transportation.
3. Realise procedure of safety auditing and prepare safety reports.
4. Understand elements of SEMS.
5. Apply concepts of risk analysis to develop probabilistic assessment.
6. Understand consequences of accidents.

Unit I: Plant Safety and hazards

Importance & objectives of safety. Safety in chemical industry. Criteria for setting & layout of chemical plant.

Oil Industry hazards, Chemical hazards, Toxic hazards, Explosion hazards, Electrical hazards, Mechanical hazards, Radiation hazards, Noise hazards. Control, precautions & prevention, Safety measures in plant.

Unit II: Storage & Transportation of Hydrocarbons

Modes of transportation of hydrocarbons, Characteristics of chemical with special reference to safe storage & handling Layout of storage. Various modes of transport and Safety precautions in transportation.

Unit III: Safety Audit

Objective of safety audit. Procedure for safety auditing. Audit report, Safety report. Safety offshore,

Factories Act and Safety Regulations. Offshore Regulatory Agencies, Engineering standards, Safety

Unit IV: Safety and Environmental Management Systems, SEMS

Elements of SEMS, Safe Design and Operations of Plants, safe work practices, Safety of Process Plants by Process Control

Unit V: Risk Analysis

Hazard & Operability (HAZOP) studies. Hazard Analysis (HAZAN). Fault Tree Analysis. Consequence Analysis. Scenario and Probabilistic Assessment.

Onshore and Offshore Emergency Management Plans.

Unit VI: Consequences of Accidents

Known examples and analysis

Emission from Leaks, Free Jets, Pool Formation and Pool Vaporization, Atmospheric Dispersion, Fires and Explosions, boiling liquid expanding vapour explosion (BLEVE), Dust Explosion,

Reference Books

1. Ian Sutton, 2014, Offshore Safety Management Implementing a SEMS Program, Second Edition, Elsevier, 331 pp.
2. Ulrich Hauptmanns, 2013, Process and Plant Safety, Springer, 672 pp.
3. Genserik L.L. Reniers, 2010, Multi-Plant Safety and Security Management in the Chemical and Process Industries, 292 pp.
4. Nicholas P. Cheremisinoff and Madelyn L. Graffa, 1995, Environmental and Health & Safety Management A Guide to Compliance, Noyes Publication, 517 pp.

412390 ELECTIVE IV D OPEN ELECTIVE

4. CORING AND CORE ANALYSIS

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hrs / week	In Semester 30 Marks
Tutorial:1 Hrs/week	End Semester 70 Marks
Credits: 4	Term work 50 marks

Objectives

Prime objective of this course is to understand the coring mechanism and conventional methods of core analysis for investigation of rock and fluid properties.

Course Outcomes

After completing the course, the students will be able to,

1. Design coring programs and maximize recovery
2. Preserve core to minimize rock alteration
3. Use cores to estimate porosity, permeability, and fluid saturation (basic core analysis)
4. Understand special core analysis, e.g., wettability, relative permeability, capillary pressure, and reservoir fluid distribution for reservoir engineering and petrophysical evaluation
5. Prevent/spot errors in core analysis vendor reports (quality control)
6. Correlate core and log data

Design of coring and core analysis program

Coring and core analysis objectives, coring hardware and maximizing core recovery, Core handling, well site procedures, and preservation methods.

Methods and measurement

Sidewall coring and analysis, Organizing effective laboratory programs, Porosity, permeability and fluid saturation, Quality control in core analysis

Recognition of constituents in cores

Petrography and mineralogy, Special core analysis, sample selection and statistical data analysis,

Fractured Core Analysis, interpretation natural and induced cores

Integration of Data

Core-log correlation (includes NMR log calibration, acoustic, nuclear, and electrical properties), recognition of hydraulic flow unit.

Measurement of other properties and data integration

Wettability, relative permeability, capillary pressure, compressibility and reservoir fluid distribution, Data integration in reservoir simulation,

Reference Books

1. Anderson Gene, 1985, Coring and Core Analysis Handbook, Pennwell Corporation, 200 pp.
2. Graham A. Blackbourn, 2012, Cores and Core Logging for Geoscientists, 2nd Edition, Whittles Publishing, UK. 174 pp.
3. Jude Amaefule, Keelan D K, Kersey, D G and Marschall D M, 1990, Application of Core data in Integrated Reservoir Description and Exploitation, Core Laboratories, 434 pp.
4. Kulander B R, Dean S L and Ward B J, Fractured Core Analysis: Interpretation, Logging and Use of Natural and Induced Fractures in Cores, AAPG Methods in Exploration Series, 8, 84 pp.
5. ROTHWELL, R.G. 2006. New Techniques in Sediment Core Analysis. Geological Society, London, Special Publications, 267pp.

412390 ELECTIVE IV D OPEN ELECTIVE

5. PIPING ENGINEERING

Teaching Scheme:	**Examination Scheme**:
Lectures: 3 Hrs / week	In Semester 30 Marks
Tutorial:1 Hrs/week	End Semester 70 Marks
Credits: 4	Term work 50 marks

COURSE OBJECTIVES:

1. To introduce students to the crucial role of piping engineer in turn key projects
2. To make students understand the approval drawings and execute the work adhering to procedures and standards
3. To understand the layout and manage the work with adequate safety and reliability

COURSE OUTCOMES:

By the end of the course students should be able

1. understand the piping fundamentals, codes and standards
2. understand pipe fittings, selections, drawings and dimensioning
3. understand Pipe Material specifications
4. understand pressure design of pipe systems

Unit – I Introduction to Piping Engineering Fundamentals (06 hrs)

Scope of piping in projects, Plant piping systems and transportation, Difference between codes and standards, ASME / API Codes and Standards. Principles for piping design, Major piping standards, Pipe designators -NPS, IPS, NB, Pipe wall thickness and Schedule, Pipe weights, Lengths, grades, Ends, Joining methods, Methods of manufacture, Pipe ratings, Pipe symbols.

Unit – II Pipe Fittings and Flanges – ASME Standards, Selection, Application, Drawing Symbols and Dimensioning (06 H)

Types of fittings, Pipe bends branch connections, Reducers , Offset calculation, Stub ends and types, Application of Stub Ends, Fabricated branch connections, Welding minimums for Stub In, Branch reinforcements, Types of flange and Couplings, Dimensioning, Minimum pipe requirements, Screwed and Socket weld fittings – Drawing representations, Dimensioning exercises.

Unit – III Piping Material Specification, Pipe Supports, Pipe Racks and Utility Stations (06 hrs)

Piping material Specifications (PMS), PMS creation requirements, Piping specifications, Material selection, P-T ratings, Valve data, PMS Application, Piping supports, Anchors, Pipe guides, Limit stops, Pipe shoe, Shoe guides / Hold down guides, support, Rigid hangers,

Manifold Supports, Pipe rack design, Pipe arrangements, Control station and Utility station on pipe racks.

Unit – IV Process Flow Diagrams and Piping Drawings (06 hrs)

Block and process flow diagrams, Utility flow diagram, Piping & Instrumentation diagram, Line Numbering, Line Designation table/ Line list creation, Print reading exercise, Flow Diagram versus Piping drawings, Symbols and abbreviations, Equipment vendor data, Instrument types and symbols – flow, temperature pressure and level, Instrument hook-up drawings, Plot plan and Equipment layout.

Unit – V Pressure Design of Process Piping Systems – ASME B 31. 3: (06 hrs)

Scope of ASME B 31.3, B31.4 & B 31.8, Code interpretation – ASME B 31.3 ASME B 31.3 Fluid service categories, Design pressure and temperature for piping systems, Pressure design of straight pipe under internal pressure. – wall thickness calculations, Maximum design pressure for piping systems, Maximum allowable operating pressure for pipelines, Piping material Selection per ASME Code, ASME piping materials for fluid service categories.

Unit – VI Miscellaneous Topics. (06 hrs)

Steam piping, Corrosion and protection, Thermal insulation, costing, Pipe color coding, Fabrication and installation, Valves, its types and selection, Introduction to Subsea piping.

Pipe Stress Analysis: objectives and definition of stress analysis. Critical line list, Information required for stress analysis, Piping loads, Introduction to Pipe stress analysis software CAESAR II

Flexibility Analysis: Concept of thermal expansion, minimum leg required to absorb thermal Expansion, Stress monographs for pump and Vessel piping, Types of expansion loops.

Text Books:

1. Macetta, John. "Piping Design Handbook", M.Dekker , 1992
2. Mohinder Nayyar , "Piping Handbook" Seventh Edition , McGraw-Hill, New York, 2000

Reference Books

1. Ed Bausbacher and Roger Hunt, 'Process Plant Layout and Piping Design', First Edition, Prentice Hall, 1993
2. Robert A. Rhea, Roy A Parisher, "Pipe Drafting and Design", Second Edition, Gulf Professional Publishing, 2003

412386 PROJECT

Teaching Scheme:	Examination Scheme
Tutorial: 6 Hrs/week	TW: 100marks
Credits: 6	Oral: 50 marks

Objectives:

The project work aims developing problem solving skills by integrating their knowledge using systematic methodology for an investigations related to broad areas of discipline specific curriculum.

Course Outcomes

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

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

The project work shall be carried out in a group up to maximum of four students or even at an individual level.

The students shall work on some problem related to Petroleum Industry. The project topic shall be selected either by the students and approved by the faculty member ready to work as project guide or assigned by the department. The project work may be carried out as in house project or industry sponsored project. Industry sponsored projects shall be monitored and controlled by the faculty member of the department jointly with the supervisor from the industry.

The project work shall be inclusive of updated literature survey, some investigation work, computer simulation, design work and experimental work. No innovative idea shall be considered for the project.

The project work shall be divided in to two parts spread over two terms of final year of engineering. Project stage I shall be inclusive of problem identification and relevant updated literature survey and methodology to evolve solution for the same.

The students shall submit printed copy of final project certified by the supervisor/ guide/mentor and present the same in effectively.

Assessment shall be based on quality and originality of work submitted and presented.

Format of report for the project work:

Approximate format of the report for the final project to be submitted at the end of final year (term II) is given below. The actual contents of the project report may be decided in consultation with the project guide.

Project report should be 60 to 70 pages. The report must be hard bound. Following shall be the format for the report.

1. Page size: Trimmed A4
2. Top Margin: 1.00 Inches
3. Bottom Margin: 1.00 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inches
6. Para Text: Times New Roman 12-point font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right aligned at footer. Font 12 point Times New Roman
9. Headings: New Times Roman, 14 Points, Boldface
10. Certificate All students should attach standard format of Certificate as described by the department. Certificate should have signatures of Guide, Head of Department and Principal.

Following shall be the contents of the project report

i. Title Sheet ii. Certificate
iii. Acknowledgement
iv. Abstract
v. List of Figures
vi. List of Photographs/ Plates vii. List of Tables
viii. Table of Contents

Chapter One: Introduction, problem identified, objectives, scope of work, methodology and brief summary of chapters
Chapter Two: Literature Survey/ Theory
Chapter Three: Design/ Experimentation/ Actual work carried out for the same.
Chapter Four: Result and Analysis of data
Chapter Five: Discussion
Chapter Six: Summary and Conclusions
References, should be written as per SPE format

The report shall be assessed jointly by an internal examiner (guide/supervisor) and an external examiner (industry professional/ expert from other institute) and oral examination based on same shall be conducted.