# UNIVERSITY OF PUNE

# STRUCTURE AND SYLLABUS

# OF

# B.E. (PETROLEUM ENGINEERING)

# (COURSE – 2008)

# UNIVERSITY OF PUNE

## STRUCTURE AND SYLLABUS OF B.E. (PETROLEUM ENGINEERING)

## (COURSE – 2008)

| Sub. No. | Subject | Teaching Scheme Hrs/Week | | | Examination Scheme (Marks) | | | |
|---|---|---|---|---|---|---|---|---|
| | | L | Pr | T/ D | Paper | TW | Pr | Or |
| **Term – I** | | | | | | | | |
| 412381 | Reservoir Engineering II | 4 | 2 | - | 100 | 50 | - | - |
| 412382 | Petroleum Formation Evaluation | 4 | 2 | - | 100 | 25 | | 50 |
| 412383 | Well Engineering and Design | 4 | 2 | - | 100 | 25 | - | 50 |
| 412384 | Elective I | 4 | 2 | - | 100 | - | 50 | |
| 412385 | Elective II | 4 | - | - | 100 | | - | - |
| 412386 | Project | - | 2 | - | - | - | - | - |
| | **Total** | **20** | **10** | **-** | **500** | **100** | **50** | **100** |
| | **Total Term – I** | **30** | | | **750** | | | |
| **Term – II** | | | | | | | | |
| 412387 | Improved Oil Recovery and Reservoir Simulation | 4 | 2 | - | 100 | 25 | 50 | |
| 412388 | Petroleum Production Engineering II | 4 | 2 | - | 100 | 25 | | 50 |
| 412389 | Elective III | 4 | 2 | - | 100 | 25 | - | |
| 412390 | Elective IV | 4 | | - | 100 | | - | - |
| 412391 | Petroleum Engineering Laboratory | - | 2 | - | - | 25 | - | - |
| 412386 | Project | - | 6 | | | 100 | - | 50 |
| | **Total** | **16** | **14** | | **400** | **200** | **50** | **100** |
| | **Total Term – II** | **30** | | | **750** | | | |
| | **Total for the year** | **60** | | | **900** | **300** | **100** | **200** |
| | **Grand Total** | | | | **1500** | | | |

L: Lectures / week, Pr: Practical / week, T: Tutorial, D: Drawing
TW: Term work, OR: Oral

Semester One,
Elective I, 412384

| | |
|---|---|
| 412384 A | Petroleum Exploration |
| 412384 B | Advanced Instrumentation and Process Control in Petroleum Industry |
| 412384 C | Programming, Database Management and Information Systems in Petroleum Industry |
| 412384 D | Mathematical Methods and Modeling in Petroleum Exploration and Production |

Elective II, 412385

| | |
|---|---|
| 412385 A | Petroleum Refining Technology |
| 412385 B | Petroleum Product Analysis |
| 412385 C | Non Conventional Hydrocarbon Resources |
| 412385 D | Carbon Management in Petroleum Industry |

Semester Two,
Elective III, 412389

| | |
|---|---|
| 412389 A | Advanced Drilling Engineering |
| 412389 B | Deepwater Technology |
| 412389 C | Transport of Oil and Gas |
| 412389 D | Environment Technology and Safety in Petroleum Industry |

Elective IV, 412390

| | |
|---|---|
| 412390 A | Petroleum Economics |
| 412390 B | Petroleum Production Enhancement and Optimization |
| 412390 C | Well Control Methods |
| 412390 D | Open Elective |

The students can opt for any IV elective subject of the IV elective which is not offered or taken before. The elective subject may be related to the program or may be offered by IV elective under faculty of engineering, university of Pune. An elective proposed by an industry may also be offered to students with the permission of Board of Studies and Faculty of Engineering. The procedure related to same has to be completed by November 30 for smooth functioning of elective.

# Term – I

**412381 RESERVOIR ENGINEERING - II**
**(B. E. Petroleum Engineering 2008 Course)**

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practical: 2 hrs/week | TW: 50 marks |

**Objectives:**

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

## SECTION – I

**Unit I: Well Testing-I:** (08)

Flow in porous media, diffusivity equation derivation, boundary equation, Ei solution to diffusivity equation, and other solutions to the diffusivity equation.

**Unit II: Well Testing-II:** (08)

Pressure buildup test, Pressure drawdown test, Variable rate buildup and flow tests: Their analysis and interpretation.

**Unit III: Well Testing-III:** (08)

Drill stem test, Operation, Their analysis and interpretation.

## SECTION II

**Unit IV: Well Testing-IV** (08)

Gas well testing: Pseudo Pressure, Pseudo time, AOF, isochronal, modified isochronal, interpretation and analysis.

**Unit V: Well Testing-V** (08)

Interference tests, pulse tests, horizontal well test, their interpretation and analysis

**Unit-VI: Decline Curves:** (08)

Decline curves; Arps equation, Harmonic, Hyperbolic, and Exponential Decline curves, Fetkovitch, Blasingame type curves.

**Term Work**

Every student will perform minimum of 6 experiments using standard software packages from the following list and submit the journal.

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

***Reference Books:***


1) Bourdarot, G. Well Testing, Interpretation Methods. Edition Technip. 1996
2) Chaudhry Amanat U, Oil Well Testing Handbook, Gulf Professional Publishing, 2004, 699 pp.
3) Earlougher, R.C., “Advances in Well Test Analysis”, Monograph Series, SPE, 1977.
4) Holstein, E.D. (Editor), Reservoir Engineering and Petrophysics. V 5, In Lake L W (Editor) Petroleum Engineering Handbook, SPE International, 2007, 1689 pp.
5) Horn R A, Modern Well Test Analysis, A Computer Aided Approach, Petroway, Second edition, 1995, 257 pp.
6) Lee W. J., “Well Testing”, Textbook Series, SPE, Richardson, TX, USA, 1982

**412382 PETROLEUM FORMATION EVALUATION**

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practical: 2 Hours/week | Term Work: 25 Marks |
| | Oral: 50 Marks |

**Objectives:**

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

## SECTION – I

**Unit I: Open Hole Logging-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: Open Hole Logging-II:** (8)

Nuclear Radioactive and Sonic Logging: Principles: Brief descriptions and applications.

Application of drilling time data. Sidewall coring and wireline fluid sampling.

Dipmeter, image logs

**Unit III: Cased Hole Logging:** (8)

Cement bond evaluation logs such as Temperature, CBL- VDL.

Other miscellaneous logging techniques such as Caliper, Temperature, Perforation, Depth, rate etc.

## SECTION – II

**Unit IV: 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 V: 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 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

***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) Resistivity measurement for a rock sample.
2) Determination of contact angle on different surfaces with various fluids.
3) Determination of capillary pressure.
4) Study of fluorescence.
5) Determination of radioactivity in rocks.
6) Evaluation of porosity, saturation, shaliness etc. from logs. (3 practicals).
7) Experiments based on log interpretation, preparation and evaluation of log cross-section (3 practicals).
8) Interpretation of DST data.
9) Use of any standard log interpretation software.
10) Core flooding studies.

***Reference Books:***


1) Asquith George and Krygowski Daniel: Basic Well Log Analysis. USA. AAPG, 2004
2) Brock James, “Applied Open-Hole Log Analysis”, Gulf Publishing, 1986.
3) Log Interpretation, Vol. I to IV and Document VIII; Schlumberger, 1979
4) Lynch E. J., “Formation Evaluation”, EBD Edition, 1976..
5) Rider, M. H., “The Geological Interpretation of Well Logs” John Wiley Publishing Company
6) Whitaker A., “Formation Evaluation” IHRDC, 1985.

## 412383 WELL ENGINEERING AND DESIGN

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practical: 2 Hours/week | Term Work: 25 Marks |
| | Oral: 50 Marks |

**Objectives:**

1) To learn design aspects of drilling equipments, 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.

### SECTION – I

**Unit-I: Well Planning and Design (08)**

Objective, Input data, Drilling program 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 (08)**

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 (08)**

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.

### SECTION-II

**Unit-IV: Drill String Design (08)**

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

**Unit-V: Rig Hydraulics (08)**

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 (08)**

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.

**Term work**

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 a 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 and calculations
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, planning, design and calculations
8) Solving simple drilling engineering problems using spreadsheets.
9) Compressive strength test of cement by NDT

**Reference Books:**


1) Adams N.; Drilling Engineering: A Complete Well Planning Approach, Penwell Publishing Company. 1985
2) Bourgoyne A. T, Millheim K K, Chenevert M E and. Young F S; Applied Drilling Engineering, SPE Text Book Series.1991, 508 pp.
3) Mitchell Robert L (Editor), Drilling Engineering. V 2, In Lake L W (Editor) Petroleum Engineering Handbook, SPE International, 2007, 770 pp.
4) Rabia H.; Well Engineering and Construction.
5) Robert D Grace, Cudd, Garden Shurjen; Advance Blowout and Well Control, Gulf Publishing Company.

## Elective I 412384 a PETROLEUM EXPLORATION

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practical: 2 Hours/week | Practical: 50 Marks |

**Objectives:**

- To understand the philosophy of petroleum 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 basic principles used in developing a geological model for basin analysis.

### SECTION – I

**Unit I: Introduction to Geological and Geophysical Methods:** (08)

Philosophy of oil exploration. Surface and subsurface geological data in exploration.

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.

**Unit II: Seismic Methods – I** (08)

Theoretical background, data acquisition, data processing and migration. Interpretation procedure. Concept of 2D, 3D and 4D field surveys. Well bore seismic

**Unit III: Seismic Methods – II** (08)

Elementary geological interpretation and seismic stratigraphy, Seismic facies analysis, Preparation of Isochron maps – Isochronopach maps, Seismic impedance, AVO, DHIS, Time lapse reservoir monitoring

### SECTION – II

**Unit IV: Geochemical Methods and Data Analysis:** (08)

Organic geochemistry, micro seepages and their detection, variations in concentrations of elements as indicators of geochemical anomalies. Applications in correlations and exploration.

Integrating surface and subsurface geological, geophysical and geochemical data for synergistic exploration.

**Unit V: Basin Analysis:** (08)

Basin evaluation with respect to petroleum prospecting. Understanding of Petroleum system.

Exploration in structural and stratigraphic traps, delta structures, carbonates rocks.

Classification of drilling locations, Mapping anomalies, Petroliferous traps, Delineation of reservoirs.

Predicting petroleum resources, Prognostication, Risk analysis, Reserves estimation.

Unconventional hydrocarbon resources

**Unit VI: GIS in Petroleum Exploration** (08)

Spatial objects, data structures, design of attributes, Mapping and correlation**,** Use of GIS in data presentation, editing, and preparation of maps

***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. Aerial Photo and satellite imagery interpretation (2 experiments).
2. Study of simple seismic sections and interpretation (2 experiments).
3. Study of resistivity meter, gravimeter, and magnetometer.
4. Geological data analysis.
5. Exercises based on subsurface geological and geophysical data. (3 experiments, manual-graphic and GIS).
6. Calculation of reserves using volumetric method (2 experiments)
7. Determination of total porosity and interconnected porosity and permeability.
8. Determination of water saturation using Dean-Stark apparatus.
9. Calcium carbonate content in the rocks by Bernard apparatus.
10. At least one computer oriented exercise involving above.

***Books:***


1) Allen P A and J R Allen, Basin Analysis: Principles and Applications, Second edition, Wiley Blackwell, 2005
2) Beacon, M, simm,R abd Redshaw, T. 3 D Seismic Interpretation. Cambridge University Press, 2003.212 pp.
3) Coffeen J. A., “Interpreting Seismic Data Workbook”, Penn Well Books, 1984.
4) Dobrin M. P. and Savit C. H., “Principles of Geophysical Prospecting”, 4th Edition, McGraw Hill Publishing Company, 1988.
5) Rao Ramchandra M. B., “Outline of Geophysical Prospecting”, EBD Publishing, 1987.
6) Tedesco S. A., “Surface Geochemistry in Petroleum Exploration” Chapman and Hall Publishing, 1993.

**412384 B ADVANCED INSTRUMENTATION AND PROCESS CONTROL IN PETROLEUM INDUSTRY**

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practical: 2 Hours/week | Practical: 50 Marks |

**Objectives:**

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

## SECTION – I

**Unit I:Basic electrical & electronics (8)**

Introduction to analog control systems, digital electronics, digital communication, various types of gates and circuits. Operation & characteristics of three phase induction motors, method of starting & speed control ward Leonard method of speed control of dc motor, types of electric motors, types of fuses & selection. thyrister controlled variable speed ac dc motors, power cable – types & selection, types of motor enclosures & purging.

Hazardous Area classification, electrical installations in hazardous area . Prevailing industry standards.

**Unit II: Field Instrumentation** (8)

Measurement of Temperature , Pressure , Level, flow, viscosity, level, pH, density, weight, speed, distance, penetration, torque, RPM, magnetic flux, vibration, vacuum, radiation etc. and applicability of various types of transducers. LEL and $H_2S$ detection, Solenoid valves, Elements of an indicating and recording open loop.

**Unit III: Controllers, Valves and DCS systems (8)**

Dynamics of physical systems, automatic control loop block diagram, feed back & feed forward control. PID control , controller tuning Types, Applicability, Selection, characteristics and design of control valves .DCS systems and control room instrumentation. Introduction to PLC , SCADA, HMI Introduction to PLCs and logic design. Ladder logic diagrams

## SECTION II

**Unit IV : Process control applications (8)**

Cascade control , distillation column control, reactor control, heat exchanger control, Pumps and compressors, Surge control, control system of oil & gas separators , oil &gas storage & transportation, Limit switches, and alarm system ,Measurement of Crude oil and natural gas for custody transfer.
Process safety management . Integration of various safety systems and process control, SIL, Construction and design of Pressure relief valves.

**Unit V: Drilling rig instrumentation onland & offshore** (8)

Pressure, temperature, flow, density, level measuring method, automatic controls in oil well drilling operations ( Top drive system ) , SCADA system.PID control in Dynamic positioning of floating vessels in deep sea operations.

**Unit VI: Subsea control systems (8)**

Ancillary equipments- subsea valves, Rov actuators, hydraulic actuators, multi phase flow meters ( r – rays ), subsea sand monitoring system, Production control system , types of control system – direct hydraulic , piloted hydraulic , electro-piloted, elecro- hydraulic multiplex control system, umbilicals, ESD system (emergency shutdown system .

***Term work***

Every student should carry out exercises (any 6) from the following list of practicals and submit a report of each experiment in the form of journal. This will be the basis for term work assessment and oral.

***List of Experiments:***

1) Study of Electrical Laboratory Panel
2) Study of Electronics Laboratory Panel
3) Pressure control
4) Temperature control
5) Level control
6) Cascade control
7) Study of turbine & orifice meter
8) Study of automation on drilling rig.
9) Study of automation on oil & gas processing platform
10) Study of various types of motors

.

***Books:***


1. Arnold K (Editor), Facilities and Construction Engineering, Volume III, Petroleum Engineering Handbook, SPE, 2007, 613 pp.
2. Bela Liptak; Instrument Engineer's Handbook; Fourth edition, CRC Press, 2003, 1861 pp
3. Coughanowr D.R.; Koppel L.B.; Process System Analysis and Control; McGraw Hill.1991, 586 pp.
4. Eckman D. T.; Industrial Instruments; Wiley Eastern.
5. Harriot P.; Process Control; Tata McGraw Hill Ed.

## 412384 C. PROGRAMMING, DATABASE MANAGEMENT AND INFORMATION SYSTEMS FOR OIL AND GAS INDUSTRY

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practical: 2 Hours/week | Practical: 50 Marks |

**Objectives:**

1. To understand importance of Microsoft Excel and Microsoft Access
2. To understand the basics of RDBMS and importance of handling data related to various operations in petroleum industry
3. To understand effective information systems capable of handling large petroleum data
4. To understand effective use of workspace and related database in important projects in petroleum industry.

### SECTION I

**Unit I: Programming (08)**

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

**Unit II: Handling Excel and MS Access (08)**

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

**Unit III: RDBMS (08)**

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

### SECTION II

**Unit IV: Geospatial Information System (08)**

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

**Unit V: Spatial Data Transformation and Auto Correlation (08)**

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

**Unit VI: Project Design (08)**

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 minimum of 3 experiments from the following groups 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 3 exercises)
2. Exercises based on subsurface geological and geophysical data. (2 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 ( 2 experiments)

**Reference Books:**


1. Billo J E, Excel for Scientists and Engineers: Numerical Methods, Wiley Interscience. 2007. 477 pp.
2. David Hoppman, Effective Database Design, Pennwell Corporation, 2003, 263 pp.
3. Longley, P. A., Goodchild, M. F. MaGuire, D. J. Rhind, D. W. Geographical Information Systems and Science, John Wiley and Sons, 2001.
4. Niravesh M, Aminzadeh F and Zadeh L A ( Editors), Soft Computing and Intelligent Data Analysis for Oil Exploration, Development in Petroleum Science, 51, Elsevier, 2003, 768 pp.

**412384 D MATHEMATICAL METHODS AND MODELING IN PETROLEUM EXPLORATION AND PRODUCTION**

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practical: 2 Hours/week | Practical: 50 Marks |

**Objectives:**

- To understand the philosophy of petroleum exploration
- To learn the basic principles of seismic interpretations used in petroleum exploration.
- To understand the principles used in developing a geological model building.
- To understand the principles used in developing Reservoir Modeling

## SECTION – I

**Unit I Seismic Exploration I** (08)

Introduction to Seismic Texture, Atlas of 3D Seismic Attributes, the Use of Structure Tensors in the Analysis of Seismic Data

**Unit II Seismic Exploration II** (08)

Automated Structural Interpretation through classification of Seismic Horizons, Automatic Fault Extraction Using Artificial Ants, Seismic Stratigraphy, seismic facies analysis

**Unit III Geostatistics for reservoir characterization** (08)

Variogram, Kriging, autocorrelation, conditional simulation for heterogeneity modeling and uncertainty quantification, data integration

## SECTION IV

**Unit IV Geological Model Building** I (08)

Geological Modeling and Reservoir Simulation, Uncertainty and risk, flow through porous media, reservoir heterogeneity, auto correlation, stochastic modeling, Monte Carlo Simulation

**Unit V Geological Model Building** II (08)

Geological Model Building**:** a Hierarchical Segmentation Approach, Mapping 3D Geo-Bodies, Modern Techniques in Seismic Tomography

**Unit VI Reservoir Modeling** (08)

From 3D Seismic Facies to Reservoir Simulation, up scaling, data integration, Reservoir flow simulation through adaptive ADER method, Optimal Multivariate Interpolation, Seismic Modeling and Time-Lapse Data

**Term Work:**

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

**List of Practical:**

1) Study of simple seismic sections (2 experiments).
2) Geological data analysis.
3) Exercises based on subsurface geological and geophysical data. (3 experiments manual-graphic and GIS).
4) Determination of total porosity and interconnected porosity and permeability using digital image analysis
5) Plotting and interpretation of data using geostatistical methods (3 experiments).
6) Development of static reservoir model
7) Reserves calculation ( deterministic and Probabilistic approach)
8) Reservoir modeling using any software.

**Books**


1. Armin Iske and Trygve Randen, Mathematical Methods and Modeling in Petroleum Exploration and Production, Springer Verlag, 2005, 451 pp
2. Beacon, M, Simm, R and Redshaw, T. 3 D Seismic Interpretation. Cambridge University Press, 2003.212 pp.
3. Clayton Deutsch, Geostatistical Reservoir Modeling, Oxford University Press, 2002, 400 pp.
4. Fanchi J R, Shared Earth Modeling: Methodologies for Integrated Reservoir Simulations, Gulf Publishing, 2002
5. Veeken Paul, Seismic Stratigraphy, Basin Analysis, and reservoir characterization, Elsevier Publications, 2007, 523 pp

**Elective II 412385 A. PETROLEUM REFINING TECHNOLOGY**

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

**Objectives:**

- To understand principles of refining and natural gas processing
- To learn chemistry and manufacture of important petrochemicals
- To get acquainted with basic separation and conversion processes used in refining of crude oil.
- To get familiarized with challenges involved in refining from viewpoint of environment and energy conservation.

## SECTION – I

### Unit I: Refinery Overview [8]

Overall refinery flow, Refinery products, Specifications, Refinery feedstocks, Crude oil properties, Composition of petroleum, ASTM/TBP/EFV distillations, Crude Assays, Markets and production capacities: India and World, Nelson Complexity Factor for a refinery

### Unit II: Separation Processes [8]

Desalting crude oils, Atmospheric Topping Unit, Vacuum Distillation Unit, Gas Processing and Fractionation.

### Unit III: Conversion Processes [8]

Catalytic Cracking, Hydrotreating, Hydrocracking, Resid Processing, Coking and Thermal Processes.

## SECTION – II

### Unit IV: Petrochemical Feedstocks [8]

Catalytic Reforming, Isomerization, Alkylation, Polymerization.

### Unit V: Lube Oil Base Stocks [8]

Lube oil processing, Propane de-asphalting, Solvent extraction, De-waxing, Hydrofinishing, Specifications of lube oil, Lube Additives.

**Unit VI: Supporting Processes [8]**

Hydrogen production, Sulfur recovery, Environmental regulations, Waste water treatment. Pollution control, Product blending.

**Reference Books:**


1) Nelson N.L., *'Petroleum Refinery Engineering'*, McGraw Hill Book Co. (1985)
2) James H. Gary and Glenn E. Handework, *'Petroleum Refining Technology and Economics'*, Fourth Edition, Marcel Dekker, Inc.(2001)
3) Waquier, J.P., *'Petroleum Refining'* Vol .I and II, Second Edition, Technip (1995)
4) Mcketta S.S., Ed., *'Petroleum Processing Handbook'*, Marcel Dekker, Inc. (1992)
5) B.K.Bhaskara Rao, 'Modern Petroleum Refining Processes', Fifth Edition, Oxford and IBH Publishing Co. Pvt. Ltd.(2007)

**Elective II 412385 B PETROLEUM PRODUCT ANALYSIS**

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 hours/week | Paper: 100 marks |

**Objectives:**

- To take an overview of downstream petroleum industry
- To understand the various specifications of the petroleum products
- To get acquainted with the various standards for the analysis of petroleum products

## SECTION I

### Unit I Overall refinery view [8]

Refinery flow sheets, Refinery products, Crude assay and crude evaluation

### Unit II Basic properties of petroleum products [8]

Molecular weight, Density, specific gravity, API gravity, Refractive index, Critical constants, Acentric factor, Vapor pressure, Water content, Viscosity, Freezing and melting points, Flash point, Flammability range, Auto-ignition temperature, Octane number, Aniline point, Watson and UOP Characterization factor, Viscosity Gravity Constant, Carbon to hydrogen weight ratio, Cloud point, Pour point, Diesel index, Cetane number, Carbon residue, Smoke point, Metallic constituents, sulphur content

### Unit III Specification of important petroleum products [8]

Specifications for Low boiling products, Gasoline, Middle Distillate fuels, Heating oils, Residual fuel oils, Lubricating oils, Wax, Asphalt, Coke

## SECTION II

### Unit IV Property predictions [8]

Generalized correlations for hydrocarbon properties, Prediction of molecular weight, boiling point, specific gravity, critical properties, density, refractive index, CH weight ratio, freezing point, viscosity

**Unit V Product composition analysis [8]**

Types of composition (PONA, PNA, PIONA, SARA, elemental analysis), Various analytical instruments and methods (Solvent separation, Chromatographic and Spectroscopic methods)

**Unit VI International Standards [8]**

API, ASTM standards for petroleum products, Modern perspectives for sampling, measurement, accuracy, precision and method validation.

**Books:**


1. Riazi.M.R, '*Characterization and Properties of Petroleum Fractions'*, I edition, ASTM International Standards Worldwide. (2005)
2. James G.Speight, '*Handbook of Petroleum Product Analysis'*, First Edition, John Wiley and Sons, Inc. (2002)
3. James H.Gary and Glenn E.Handwerk, '*Petroleum Refining Technology and Economics'*, Fourth Edition, Marcel Dekker Inc. (2001)
4. B.K.Bhaskara Rao, 'Modern Petroleum Refining Processes', Fifth Edition, Oxford and IBH Publishing Co. Pvt. Ltd. (2007)

Elective II 412385 C **NON CONVENTIONAL HYDROCARON RESOURCES**

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 hours/week | Paper: 100 marks |

**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

## SECTION I

**Unit 1: Non conventional oil:** (08)

Heavy oil, extra heavy oil and bituminous, oil shales.

Introduction, geology of non conventional oil, origin and occurrence worldwide. Reservoir rock and fluid properties. Exploration and evaluation

**Unit 2: Non conventional Gas:** (08)

Introduction to shale gas and basin centered gas, Present status of coal bed methane. Tight reservoirs.

Formation and properties of coal bed methane. Thermodynamics of coal bed methane.

Introduction, importance of shale gas, shale gas geology, important occurrences in India, Properties of shale gas, petrophysical properties.

Introduction and present status of gas hydrates. Formation and properties of gas hydrates

Unit 3: **Coal and Gas conversions to oil.** (08)

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

Technological development of direct conversion and indirect processes and sustainability of conversions. Coal gasification and liquefaction. Fisher Tropsch synthesis

## SECTION II:

### Unit 4: Development and Production of Non conventional oil (08)

Non conventional oil production, thermal and non thermal methods of oil recovery.

### Unit 5: Development and Production of Non conventional gas (08)

Nature of CBM reservoirs, Hydro-fracturing of coal seam. Well operation and production equipment. Treating and disposing produced water. Testing of coal bed methane wells.

Development of shale gas, design of hydro fracturing job, horizontal wells, production profiles,

Drilling and completion of gas hydrate wells. Prevention and control of gas hydrates. , Gas hydrates accumulation in porous medium. Gas extraction from gas hydrates.

### Unit 6: Environment and Economic Considerations (08)

Environmental considerations of unconventional oil and gas. Economics of development.

Books recommended


1. Carrol John, Natural Gas Hydrates: A guide for engineers, Gulf Publications, 2003, 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. Marlan W. Downey, William Andrew Morgan, and Jack C. Threet, Petroleum Provinces of Twenty First Century. American Association of Petroleum Geologists, 2001, 573 pp.
5. United States Department of Energy, Modern Shale Gas: development in USA, A Primer, 2009, 116 pp.
6. Warner H R (Editor), Emerging and Peripheral Technologies, Vol. VI, Petroleum Engineering Handbook, SPE, 2007, 629 pp.

## Elective II 412385 D CARBON MANAGEMENT IN PETROLEUM INDUSTRY

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/Week | Paper: 100 Marks |

**Objectives:**

1. To understand key drivers for carbon management
2. To understand the key technologies in carbon management
3. To get introduced to the emerging technologies based on non-fossil feedstocks

### SECTION I

**Unit I: Drivers for carbon management (08)**

Global warming, Kyoto Protocol, Carbon credits, Economics

**Unit II: Industrial Carbon Management (08)**

Sector wise Review of Emissions and Capture

Electrical power, Automobile sector, Petroleum/Chemical/Petrochemical industries, Emission estimation, API recommendations.

**Unit III: Carbon Sequestration (08)**

Geological aspect of $CO_2$ sequestration, Chemical and Biological approaches in sequestration, $CO_2$ transport and storage technologies.

### SECTION II

**Unit IV: Non fossil resources for energy (08)**

Renewable energy, Sources, Technologies for Solar, Wind, Hydro, Geothermal and Tidal energy, Capacity, Economics and challenges for sustainable development.

**Unit V: Energy and Chemicals from Biomass (08)**

Concept of Biorefinery, Biofuels , Chemicals from wood, natural fibers, vegetable oils and other biomass sources, Biopolymers, Power generation from biomass. Bio-mass pyrolysis. Bio-mass gasification.

**Unit VI: Clean Development Mechanisms (CDM) (08)**

Carbon Credits Generation, Trading, Markets. Carbon credit calculations. Clean Development Mechanisms (CDM), approved CDM methodologies, CDP Project Design Document, Case studies

Petroleum Industry Energy savings

Books


1. American Petroleum Institute, Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry. 2004. 489 pp.
2. Lohmann Larry, Carbon Trading, Development Dialogue, 48, 2006, 362 pp.
3. Hester R E and Harrison R M ( editors), Carbon Capture: Sequestration and storage, Issue in Environmental Science and Technology, The Royal Society of Chemistry, 2010, 325 pp
4. Ibrahim Dincer · Adnan Midilli · Arif Hepbasli, T. and Hikmet Karakoc (editors), Global Warming: Engineering Solutions, A series in Green Energy and Technology, Springer, 2010, 632 pp.
5. Islam M R, Chhetri A B and Khan M M. The Greening of Petroleum Operations, the Science of Sustainable Energy Production, Scrivener Publishing, 2010, 867 pp.
6. Kutz M and Elkamel Ali, Environmentally Conscious Fossil Energy Production, John Wiley and Sons, 2010, 363 pp.

**412386 Project**

Practical: 2 hrs / Week

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

The students should work on some problem related to Petroleum Industry. The project, which is related to curriculum, is selected either by the student and approved by the faculty member, who will be the guide for the student, or on a topic assigned by the department. The project work may be carried out as in house project or industry sponsored project. In case of industry sponsored projects, students shall select an internal guide and shall regularly explain him/ her about progress report.

The project work shall consist of some investigation work, computer simulation design problem, and experimentation related to curriculum. No innovative idea is to be considered for the project.

The project activity has to be initiated in the first semester. Students should carry out extensive literature survey related to the topic in the initial stages and may be presented to the faculty assigned as Guide.

Every student shall be required to submit three bound copies of project report in a typed form in standard format. Title of the project should be embossed on the first page according to University Regulations.

Every student shall be orally examined based on report submitted

# Term II

## 412387 IMPROVED OIL RECOVERY AND RESERVOIR SIMULATION

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practical: 2 Hours/ Week | TW: 25 Marks |
| | Practical: 50 Marks |

**Objectives:**

- To understand the nature of reservoirs and strategy for increasing reservoir efficiency.
- To be able to design an oil recovery technique.
- To be able to predict the future performance of a reservoir.
- To understand working principle of reservoir simulation software

## SECTION – I IMPROVED OIL RECOVERY (IOR)

### Unit I: EOR I (08)

Waterflooding, Fractional flow equation, Buckley Leverette Equation, Stiles, CGM, Welge equation, Patterns, Arial Immiscible Displacement, Vertical Displacement models,

Waterflood Design. Pressure maintenance techniques.

### Unit II: EOR II (08)

Study of Miscible, Thermal methods of EOR with respect to fundamental principles and techniques, Analytic and Fractional flow theory, Screening criteria,

Design criteria, Project implementation, recovery efficiencies and case histories.

### Unit III: EOR III (08)

Study of Chemical, Microbial and other techniques of EOR with respect to fundamental principles and techniques, Analytic and Fractional flow theory, Screening criteria,

Design criteria, Project implementation, recovery efficiencies and case histories.

## SECTION – II RESERVOIR SIMULATION

**Unit IV: Simulation-I:** (08)

Introduction and Overview, Modeling Concepts, Designing the Reservoir Model, Selecting reservoir rock and fluid properties data, time steps and grids, solution techniques, history matching, forecasting future performance.

**Unit V: Simulation-II:** (08)

1-D, 2-D, types models, Implicit, Explicit and Crank Nicolson, Frankel Duforth methods, Matrix solution, Introduction to finite element practices, Material balance.

**Unit VI: Planning of a Real Reservoir Simulation Study: Case Studies:** (08)

Given the structure contour map, logs, production profile of a certain field, Decision on future production, Study of procedure to suggest and implement a Water flooding pattern and/or EOR techniques.

**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**

Modeling and interpretation of following patterns of

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

***Reference Books:***


1) Bradley H B, Petroleum Engineering Handbook, third edition, SPE, 1992.
2) Lake L., “Enhanced Oil Recovery”
3) Green D W and Willhite G P, “Enhanced Oil Recovery”, SPE, 2003, 556 pp
4) Holstein E (Editor), Reservoir Engineering and Petrophysics, Petroleum Engineering Handbook, Volume III, 2007,1659 pp.
5) Mattax, Dalton, “Reservoir Simulation”, SPE Series, USA, 1990.
6) Layil M, “Enhanced Oil Recovery”, Technip, 1980, 245 pp.

# 412388 PETROLEUM PRODUCTION ENGINEERING II

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/Week | Paper: 100 Marks |
| Practicals: 2 Hours/Week | Oral: 50 Marks |
| | Term Work: 25 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.
- To understand emerging technologies in production operations

## SECTION I : SEPARAION, EMULSION TREATMENT AND OILFIELD CORROSION

**Unit I: Two Phase- Three Phase Separators and storage:** (08)

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.

**Unit II: Treatment on Produced Emulsion Equipment and Process**: (08)

Theory of emulsion and demulsifiers, treating system, equipment, sizing and heat calculations. Electronic coalescesers. 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 and offshore.

**Unit III: Oil field corrosion and corrosion treatment: (08)**

Corrosion mechanism and influencing factors, corrosion preventive methods, chemical inhibitors, cathodic protection, protective coatings and plastics, removal of corrosion gases and selection of appropriate materials for preventing corrosion. Economics of corrosion.

## SECTION – II WELL INVESTIGATION AND REMEDIES

**Unit IV: Problem Well Analysis and remedies I** (08)

Inflow and outflow restrictions. Well Production problems: mechanical failure, critical wells with casing pressures, sand control, 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, removal and prevention: causes, prediction of scaling tendency, identification of scale, scale removal and prevention methods.

**Unit V: Problem Well Analysis and remedies II** (08)

Paraffin and Asphaltene: chemistry, deposition mechanism, organic scale removal, preventing deposition.

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

Flow assurance.

**UNIT VI: Emerging, Peripheral Technologies** (08)

Multilateral, Intelligent-Well Completions.
Subsea and Downhole Processing.
Cold Heavy-Oil Production with Sand. Oil shale and sands
Ultrdeep production methods.

Every student shall carry out minimum six exercises from the following list of practical 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. 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. Analysis of well problem by inflow and outflow characteristics.
7. To study scale deposition and suggest and test remedial treatments to it.
8. Study of multiphase flow regimes with their characteristics.

***Reference Books:***


1. Arnold K. and Stewart M., “Surface Production Operations”, Vol. I and II, Secomd Edition, Gulf Publishing Company, 1986.
2. Boyun Guo, William Lyons and Ali Ghalambhor, Petroleum Production Engineering: a Computer Assisted Approach, Elsevier Technology, 2007, 287 pp.
3. Joe Dunn Clegg, Production Operations Engineering, Vol.IV, Petroleum Engineering Handbook, SPE, 2007, 908 pp.
4. Warner H R (Editor), Emerging and Peripheral Technologies, Vol. VI, Petroleum Engineering Handbook, SPE, 2007, 629 pp.
5. Bradley H B, Petroleum Engineering Handbook, third edition, SPE, 1992.

## ELECTIVE III 412389 A ADVANCED DRILLING ENGINEERING

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practicals: 2 Hours/week | Term Work: 25 Marks |

### Objectives

1) To learn design aspect of well drilling equipments,
2) To understand horizontal, multilateral drilling techniques.
3) To know about wellbore stability and completions
4) To understand recent developments in drilling technologies

### SECTION-I

**Unit-I** (08)

Derrick and block tackle system types, design considerations ton-mile and cutoff practices off drilling line, derrick design considerations.

**Unit-II** (08)

Casing buckling – Neutral point, axial, radial and tangential stresses and calculations. Corrosion mechanism, casing wear, drill sting operations in $H_2S$ environment.

**Unit-III** (08)

Cement rheology, gas well cementation, drilling logs- temp, CBL, VDL, casing inspection logs, USIP (ultrasonic image tester), IBC (image behind casing), radio active tracer survey, stuck pipe, mud logs, LWD, DST, MWD

### SECTION-II

**Unit-IV** (08)

Well bore stability / rock mechanics – Mohrs coulomb criteria 2D- 3D system, insitu stress. Chemo-poro-thermo- plastic behaviour, pore pressure andBiot's constant, stress around vertical well bore, failure of inclind well bore,Mud window for vertical, horizontal wells, wellbore instability types and causes.,hydro fracturing.

**Unit-V** (08)

Introduction to horizontal and multilateral drilling, MPD, UBD, CTD, deepwater drilling operations. Construction, planning and design aspect. Case studies related to CTD and UBD

**Unit-VI** (08)

Horizontal well completion, completion sting design vertical and horizontal wells. Reservoir production prediction, tubing design, types of completion, surface and subsurface equipments, completion problems affecting the well planning, case studies.

**Termwork**

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

**Practicals**

1) Study and design block and tackle system. Derrick design considerations.
2) Mohr's coulomb criteria – in-situ stress calculations
3) Drill Stem Testing operation and data analysis
4) Design of a typical well completion job.
5) Design of a typical Workover job.
6) Design of a sand control system.
7) Soundness and fineness of cement.
8) Preparation of cement slurry and determination of free water content of cement slurry.
9) Initial and final setting time of cement.
10) Drilling log analysis.

**Reference Books:**


1) Bourgoyne A.T, Millheim K K, Chenevert M E and Young F S; Applied Drilling Engineering, SPE textbook series. 1991, 508 pp.
2) Carden, R S, Horizontal and Directional Drilling, Petroskills, OGCI, 2007, 409 pp.
3) Mitchell R F, ( Editor), Drilling Engineering, Petroleum Engineering handbook, Volume II, 2007, 770 pp.
4) Lyons w, Working Guide to Drilling Equipment and Operations, Gulf Professional Publishing, 2010, 617 pp
5) H. Rabia. Well Engineering and Construction. Gulf Publishing,

## ELECTIVE III 412389 B DEEPWATER TECHNOLOGY

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/week | Paper: 100 Marks |

**Objective:**

1) To understand physical environment and field operations in deepwater
2) To understand deepwater drilling environment, equipment and drilling Operations.
3) To understand deepwater production operations and transportation of produced Fluids.

### SECTION-I

**Unit-I: Physical Environment (08)**

**O**verview of physical ocean environment, geotechnical aspect –sea floor marine soils, composition and 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: Field Operations (08)**

Station keeping, conventional mooring system, spread mooring system, design considerations, operations, equipment and functions, Dynamic positioning system, components, working.

Deepwater drilling operations, riser system, components, riser tensioners, heave compensator, operations, emergency disconnect and hang off.

Floater well control, shut in procedures, well kill operations, subsea well head, BOP stack

**Unit-III: Deepwater Drilling (08)**

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

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

Case studies.

## SECTION-II

### Unit-IV : Offshore Structures (08)

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-V Development and Production (08)

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

### Unit-VI: Handling and Transportation (08)

Offshore storage, handling and transportation of oil and gas tankers**,** vessels and buoys. Structural considerations functions and operations. Loading conditions, selection specification and operational aspect. Advantages and 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 and logistic considerations in exploring, drilling, production, transport and reservoir management. Offshore support vessels, their roles, types, capabilities including fire fighting, pollution control, Different types of barges and their operations. Offshore vessel mounted cranes.

### Termwork

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, in-situ stress.
3) Design of a typical workover job ( squeeze cementation )
4) Use Nitrogen gas to reduce lost circulation problem during cementation.
5) Study of any standard software of petroleum Engg.
6) DST operation and data analysis.

7) Volumetric kill fluid lubrication method.
8) Preparation of cement slurry and determination of free water content of cement slurry.
9) Soundness fineness of cement.
10) Initial and final setting time of cement.
11) Case studies.

**Reference Books**


1) Benc Gerwick Jr.: Construction of Marine and offshore structures, IDT ONGC Dehradun, Drilling operations manual.
2) Chakraborty S.K.: Handbook of offshore engineering volume I and II, Elsevier, 2006, 1213 pp.
3) IADC deepwater control guidelines.
4) Exxon Mobil, Floating Drilling School, Deepwater, 2002, 992 pp.
5) Total Fina Elf, Deepwater reference book, 2000, 782 pp

**ELECTIVE III 412389 C TRANSPORT OF OIL AND GAS**

| **Teaching Scheme:** | **Examination Scheme:** |
|---|---|
| **Lectures: 4 Hours/Week** | **Paper: 100 Marks** |

Objectives:

1. To familiarize the students with the various elements and stages involved in transportation of oil and gas.
2. To understand international standards and practices in piping design.
3. To know various equipment and their operation in pipeline transportation.
4. To understand modern trends in transportation of oil and gas

## SECTION I

### Unit I: Hydrocarbon Properties and General Background (08)

Introduction. Basic Principles. Steady State Liquid Flow. Gas Flow. Complex flow system, Flow Regimes in Vertical and Horizontal Multiphase Pipeline Flow. Gathering System. Storage tanks, Trunk line System. Role of Flow Improvers. Factors Affecting Flow Characteristics. Flow Correlations.

### Unit II: Pipeline Transportation I (08)

Pressure Drop in Piping

Basic Principles. Fluid Flow Equations. Heat Loss in Valves and Fittings. Friction Factor and Flow types. Pressure drop in liquid line. Pressure drop in gas line. Pressure drop in two phase line

Line Size and Wall Thickness

Line Size Criteria. Wall Thickness Criteria. Pressure Rating Classes. Industrial Standards, Liquid line, Gas line, Two-Phase line. Pipe lines in Series and parallel. Problems based on piping design.

### Unit III: Piping Operations (08)

Onshore and offshore Pipelines, mechanical operations, Supervisory control. Leaks and ruptures in pipelines Maintenance and repair.

Valve types. Working mechanism of different valves. Valve sizing. Process procedures. Changing operating conditions. Materials. Connections. Tees. Pigging Operation and equipment. Testing of pipeline. Metering.

## SECTION II

Unit IV: **Pumps and Compressor:** (08)

Pump Classification. Centrifugal Pumps. Reciprocating Pumps. Diaphragm Pumps. Rotary Pumps. Basic Principles. Working Mechanism. Types. Head. Horsepower. Net Positive Suction Head. Basic Selection Criteria and calculations.

Positive Displacement Compressors. Dynamic Compressors. Reciprocating Compressors. Working Mechanism. Stage Compression and Operations. Compressor Design and Operation. Multistaging calculations

**Unit V: Gas monetization** (08)

Stranded gas, deep offshore gas reserves, marginal gas fields, associated gas reserves, and remote gas reserves

Overview of gas transportation options, transportation as gas, solid, or liquid, and transmission as electric power. Gas to Gas, Gas to solids, Gas to liquids, various processes, gas to power, Pipelines, Compressed Natural Gas, processes, Liquefied Natural Gas, Gas to ammonia and urea, Gas to Liquids—Fischer-Tropsch Route, Gas to Methanol, Gas to Power, Evaluation of Gas Monetization Options

**Unit IV: Subsea challenges** (08)

Flow assurance, sub sea system engineering, challenges, flow assurance process, system design and operability, hydraulics, heat transfer and thermal insulation, hydrate, wax and Asphaltene formation, inhibition methods Safety and supervision. Economics of long distance pipelines. Rules and regulations.

***Term Work:***

Every student should carry out minimum five exercises two drawings from the following list of practical's 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 various production facilities and their plant design considerations.
2) Pressure drop calculations in piping for oil and gas transportation.
3) A detailed exercise based on pipeline design.
4) Study of multiphase flow regimes and their characteristics.
5) Study of pipeline corrosion, causes and measures
6) To study development of piping and instrumentation diagrams.
7) To study hydrate formation

***Drawing of following sheets:***

a) Piping and instrumentation symbols used oil fields.
b) Piping and instrumentation of group gathering station.
c) Group gathering station and central tank farm, process flow sheet and layout.

Books


1. A. H. Mouselli, “Offshore Pipeline Design, Analysis and Methods”, Pennwell Books, Tulsa, Oklahoma
2. Francis S. Manning and Richard E. Thompson, “Oil Field Processing of Petroleum”, Volume I, Pennwell Publishing Company, Tulsa. Oklahama.
3. Ken Arnold and Maurice Stewart, “Surface Production Operations”, Volume I and II, Gulf Publishing Company, London.
4. Lurie Mikhail, Modeling of Oil Product and Gas Pipeline Transport, Wiley, 2008, 232 pp.
5. Young Bai and Quang Bai, Subsea Pipelines and Risers, Elsevier Publishing, 2005, 841 pp.
6. Szilas A P, Production and Transport of Oil and Gas, Par B: Gathering and Transport, Development in Petroleum Series, 18 B, Elsevier, 1986, 353 pp.

**412389 D ENVIRNMENTAL TECHNOLOGY AND SAFETY IN PETROLEUM INDUSTRY**

| | |
|---|---|
| Teaching Scheme: | Examination Scheme: |
| Lectures: 4 Hours/week | Paper: 100 Marks |
| Practical: 2 Hours/Week | Term Work: 25 Marks |

**Objective:**

- 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.

## SECTION – I: IMPACT OF PETROLEUM INDUSTRY OPERATIONS ON ENVIRONMENT

**Unit I: Basic Environmental compartments:** ( 08)

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**

(08)

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:** (08)

Surface and subsurface disposal, treatment of water, solid material and air emissions.

Oilfield waste management, effluent water treatment methods. Sampling methods.

## SECTION – II SAFETY MEASURES AND OCCUPATIONAL HEALTH

**Unit IV: Decommissioning of oil and gas installations:** (08)

Legal framework of platform decommissioning, planning, abandonment phases.

Well abandonment procedure, well plugging guidelines.

**Unit V: Regulatory Approaches and Safety Measures:** (08)

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:** **(08)**

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.

**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 Practical**

1) To analyze a given hydrocarbon waste for BOD and COD.
2) To analyze a given hydrocarbon waste for Total solids, Dissolved solids, Sludge volume index and Suspended solids.
3) To analyze a given hydrocarbon waste for Dissolved oxygen. To analyse a given hydrocarbon waste for Total organic carbon.
4) To analyze a given hydrocarbon waste for Conductivity / Salt concentration / Heavy metals (at least two).
5) To separate dust from gas using electrostatic precipitator.

6) To separate solids from gas using cyclone separator.
7) To separate solids from gas using ventury scrubber.
8) To separate gas pollutants at trace level using adsorption..
9) To analyze a gaseous sample for volatile organics using Gas Chromatograph.
10) Study of safety measures in Petroleum Industry
11) Study of Oil Mines Regulation Act in India

***Reference Books:***


1. Boesch D F and Rabalis Nancy, Long-term Environmental Effects of Offshore Oil and Gas Development, Elsevier Applied Science, 2003, 719 pp.
2. Boyce, A., “Introduction to Environmental Technology”, John Wiley and Sons, 1996
3. Orzu Orszulik, “Environmental Technology in oil Industry”, Springer – Verlag, 1996.
4. Reis, J.C., “Environmental control in Petroleum Engineering”, Gulf publications.1998

**ELECTIVE IV 412390 A PETROLEUM ECONOMICS**

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/Week | Paper: 100 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

## SECTION – I

**Unit I: Production Forecast and Reserves Estimation:** (08)

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** (08)

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.

**Unit III: Cash Flow Analysis and Economic Parameters:** (08)

Time value of money, types of costs, Economic Yardsticks: Return on Investment, Payout Period, Net Present Value, Discounted Cash How, DCFROR,

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

## SECTION-II

**Unit IV: Risk and Uncertainty:** (08)

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

Decision Analysis, Preference Theory, Real Option Theory, Stochastic Modeling.

**Unit V: Asset Management and Accounting:** (08)

Asset definition, performance evaluation, Analysis of ongoing costs, analysis of field development investments, purchase / sale of producing property, sources of funds.

Project management techniques.

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:** (08)

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

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. NELP and bidding process in India.

***Reference Books:***


1) Abdel A. A., Bakr A. B, and Al Sahlawi M. A., “Petroleum Economics and Engineering”, Decker Publications, 1992.
2) Johnston, D, “International Exploration Economics, Risk, and Contract Analysis”, Penwell Books, 2003.
3) IFP, Oil and Gas Exploration and Production, Reserves, Costs and Contracts. Technip Publication 2007.336 pp.
4) Mian M A, Project Economics and Decision Analysis, Penwell publications, Volume I and II, 2002.
5) Seba R. D., “Economics of Worldwide Petroleum Production”, OGCL Publications, USA, 1998.
6) Silvana Tordo and D Johnston, Petroleum Exploration and Production Rights, World Bank Working Paper 179, Washington, 2010, 126 pp.

**ELECTIVE IV 412390 B** **PETROLEUM PRODUCTION ENHANCEMENT and OPTIMIZATION**

| Teaching Scheme: | Examination Scheme: |
|---|---|
| Lectures: 4 Hours/Week | Paper: 100 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

## SECTTION I : PETROLEUM PRODUCTION ENHANCEMENT

### Unit I: Introduction to production enhancement process (08)

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 (08)

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 (08)

Need for a DataFRAC, basics of DataFRAC 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

## SECTION II PRODUCTION OPTIMIZATION

### Unit IV: Flow Optimization (08)

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 (08)

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 and gas for reservoir conditions, wellbore conditions and surface facilities.

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

### Unit VI Planning and Field Operations (08)

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

Books


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

**ELECTIVE IV 412389 C** **WELL CONTROL METHODS**

Teaching Scheme:
Lectures: 4 Hrs / week

Examination Scheme:
Paper: 100 Marks

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**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.

## SECTION1

### UNIT I Basic terms, bottom hole pressure (08)

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 line friction, ECD.

### UNIT II Kick indication and shut in procedure (08)

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

### UNIT III Blow out preventer equipment surface / subsea (08)

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.

## SECTION II

### UNIT IV Well killing method (08)

Driller’s method, wait weight method, comparison, pressure behavior 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 (08)**

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 (08)**

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

**REFERANCE BOOK**


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

**412390 D Open Elective**

| **Teaching Scheme:** | **Examination Scheme:** |
| --- | --- |
| **Lectures: 4 Hours/Week** | **Paper: 100 Marks** |

The students can opt for any elective subject of the same semester which is not offered or taken before. The elective subject may be related to the program or may be offered by any program under faculty of engineering, university of Pune.

## 412391: PETROLEUM ENGINEERING LABORATORY

Practical: 2 hrs/ W TW: 25 marks

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**Objectives:**

- To understand various products derived from crude oil
- To be able to analyze and solve practical problems in drilling, completion, workover and production field practices and provide solution by designing appropriate systems.
- To understand petroleum fiscal system and calculations related to economic evaluation of performance predictions

***Term Work:***

Every student should carry out minimum mentioned exercises from each set given below and submit a report of each experiment in the form of a hand written journal. This will form the basis for term work assessment.

***List of exercises:***

**Set I**: Solve any two 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

**Set II**: Practical's related to refining and product analysis (any five)

1. To characterize a given crude for (i) Water content (ii) $^{0}$API
2. To characterize a given crude for Viscosity Gravity Constant (VGC)
3. To characterize a given crude of Conradson carbon residue.
4. To study ASTM distillation of petroleum products
5. To develop TBP and EFV curves for a given petroleum product from laboratory ASTM distillation
6. To determine following properties of a given petroleum product: smoke point, flash point, cloud point, pour point, aniline point and diesel index, and Reid vapor point
7. To verify relation between Smoke Point, Aromatic content and Aniline point for an artificially prepared hydrocarbon mixture
8. To analyze and compare the given hydrocarbon and related samples with standards using GC.
9. To verify relation between Smoke Point, Aromatic content and Aniline point for an artificially prepared hydrocarbon mixture

10. To verify blending charts reported in literature by carrying out product mix to meet desired specifications

**Set III** perform any three exercises from given set

1. prepare kill sheet for surface BOP, Vertical well
2. Prepare kill sheet for surface BOP, Deviated well.
3. prepare kill sheet for subsea BOP vertical well
4. Prepare kill sheet for subsea BOP, Deviated well.
5. Drawing sheet of BOP control unit
6. Drawing sheet for parts of Cameron “U” type ram BOP.

**Set IV**: Spreadsheets related to performance prediction and economic evaluation within the framework of Petroleum fiscal system of India (two exercises).

***Reference Books:***


1) Bradley H B, Petroleum Engineering Handbook, third edition, SPE, 1992.
2) Lake L W, Petroleum Engineering Handbook, Volume I to VI, SPE International, 2007.
3) Mian M. A., “Petroleum Engineering Hand Book”, Vol. I and II, Pennwell Books.
4) Nelson N.L., *‘Petroleum Refinery Engineering’*, McGraw Hill Book Co. (1985)
5) Speight J G, Handbook of Petroleum Product Analysis, Wiley Interscience, 2002, 389 pp

**412386** **Project**

Practical: 6 Hrs/week

TW: 100 marks
Oral: 50 marks

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

The students should work on some problem related to Petroleum Industry. The project, which is related to curriculum, is selected either by the student and approved by the faculty member, who will be the guide for the student, or on a topic assigned by the department. The project work may be carried out as in house project or industry sponsored project. In case of industry sponsored projects, students shall select an internal guide and shall regularly explain him/ her about progress report.

The project work shall consist of some investigation work, computer simulation design problem, and experimentation related to curriculum. No innovative idea is to be considered for the project.

The project activity has to be initiated in the first semester. Students should carry out extensive literature survey related to the topic in the initial stages and may be presented to the faculty assigned as Guide.

Every student shall be required to submit three bound copies of project report in a typed form in standard format. Title of the project should be embossed on the first page according to University Regulations.

Every student shall be orally examined based on report submitted