

M. Sc. (Petroleum Exploration) (Duration 2 Years, 4 Semester)

Course contents:

Semester (I)

Paper I (Unit I & II)

[Total Marks: 125 (Final Examination: 100, Internal Examination: 25)]

Unit (I) (Marks: 50)

General Introduction of Petroleum & Natural gas- 1

1.0 Introduction of petroleum industries-its growth and their recent development, Estimation of oil & gas reserves, oil and product evaluation methods, characteristics and specifications of different petroleum products, petroleum product tests and their significance, well completion methods.

1.1 A brief introduction to petroleum-its source, availability, physical and chemical properties, natural gas-its chemical composition and physical properties

1.2 Natural gas-its availability and importance in this generation. A brief introduction to LNG, CNG, and LPG, PNG (with their physical and chemical properties), gas cracker and gas based power plants.

Unit (II) (Marks: 50)

Geology and Geophysics (G&G)- 1

2.0 Geology of Petroleum: Concept of source rocks, reservoir rocks, cap rock, traps and sedimentary basin. Tectonics in sedimentation, plate tectonics and its importance, Origin, migration and accumulation of petroleum, Formation of oil and gas pools, Textures and structures of sedimentary rocks, Principles of stratigraphy.

2.1 Well log techniques and Interpretation : Bore hole suevey and various logging data to solve various exploration and production problems. The logs such as Resistivity, sonic porosity, lithology and their advancement for thin bed analysis corrosion analysis, stacking of tools and various advancement in acquisition and interpretation log data.

2.3 Exploration of petroleum- different methods

2.4 Measurement while drilling (MWD), logging while drilling, seismic while drilling VSP, will include in the course.

Paper II (Unit IIIA & IIIB)

[Total Marks: 125 (Final Examination: 100, Internal: 25)]

(UNIT- III)(A) (Marks 50)

Reservoir Study

3.0 Classification of petroleum reservoirs.

3.1 Reservoir water- composition, solubility of gas, compressibility, formation volume factor, specific gravity, Viscosity- viscosity of reservoir fluids (oil, gas & water), effect of temperature & pressure.

3.2 Gas reservoir, the perfect gas law, non ideal or real gases, specific gravity o gases, reservoir gas volume factor, densities and gradients, gas solubility.

3.3 Reservoir fluid characteristics; Solubility & expansion-hydrocarbon formation volume factor, solubility, two-phase formation volume factor, specific gravity.

3.4 Advances in reservoir Management with case studies from Indian onshore/ offshore fields

Unit (III) (B) (Marks 50)

Drilling, Production Operation-1

3.6 Recovery of Petroleum: Enhanced oil recovery, hydrostatic pressure of liquid columns, types of fluid flow. Improved Oil Recovery (IOR) techniques and their selection criteria.

3.7 Production systems: Solution for deepwater Development- Field Development options and selection criteria, floating production system.

(Floating production storage and offloading system, Tension Leg Platforms, Floating, Storage and offloading Vessels). Emerging deepwater technologies, Solution for marginal field development- Status of Deep water and ultra Deep water fields, Offshore field development options and screening analysis, Mobile Offshore Production Unit (MOPU) and Floating Production and Offloading systems (FPSO).

Paper III (Unit IV & V)

[Total Marks: 125 (Final Examination: 100, Internal Examination: 25)]

(Unit-IV) (Marks 50)

Exploration & Development of Oil & Gas Fields

4.0 Methods of petroleum exploration- geological, geophysical, seismic survey (2-Dimensional & 3-Dimensional) Geochemical and remote sensing, drilling of exploratory well.

4.1 Sequence of operations to be carried out during petroleum exploration under different conditions. Well spacing and drilling priority and Development of multi horizon fields.

(Unit-V) (Marks 50)

Chemistry in Petroleum

5.0 Theory of solvent extraction, Catalysis in petroleum refining, Combustion of petroleum products, petroleum product tests and their significance, alkylation, reforming, hydro cracking, dehydrogenation, solvent reeving, etc., and their mechanisms. Physical and chemical properties of crude oil and its fractions and the methods of their determination.

5.1 Different types of laboratory distillations- ASTM, EFV, TBP, and their inter conversion.

5.2 Petrochemicals- Crude oil and natural gas as raw materials, Petrochemical feed stocks from biomass resources, Separation processes for manufacture of petrochemical feedstock.

Sulphonation- Basic reactions in the sulphonation of hydrocarbons, sulphonating agents, Some properties of the surface-active agents and their use.

5.3 Halogenations of hydrocarbons- Main homogenated hydrocarbons used in chemical industry, Thermodynamics and kinetics of hydrocarbon halogenation, chlorination processes of low molecular weight paraffin's, olefins and aromatics, Production of flu carbon derivatives, their properties and uses.

5.4 Polymerization: The type and structure of the macromolecular products, physical and mechanical properties of high molecular mass compounds. Chain polymerization, its

mechanism and kinetics, methods of polymerization and polycondensation, some more important commercial polymer products, their properties, manufacture and use.

6.5 Role of Chemicals used in exploiting hydrocarbon refinery- Drilling, Operational areas, Oil well stimulation, Enhanced oil recovery, water injection, polymer flooding Water-shut off etc., corrosion mitigation, value addition products.

Paper IV (Unit VI)

[Total Marks: 125 (Project Report: 75; Presentation and Viva Voce: 50)]

Seminar and Field training-1

6.0 Petroleum Fundamentals: This topic covers concepts that are important for a novice to understand how oil and gas is found and how it is extracted from the ground, the various processes used to move it to storage and on to the final product. Terminology is important to be able to understand the language used in the oilfield environment. Students will receive a dictionary of terms commonly used in the petroleum industry.

6.1 Engine and Compressors: This subject covers the basic operation of reciprocation compressors and their prime movers to operate them. The theory and operation of two and four stroke cycle gas and diesel engines and high-speed engine drivers will be discussed and operated under supervision. The primary components used to operate the engines and compressors in an efficient manner will be demonstrated.

6.2 Health and Safety measures for field personnel. Preliminary hands-on training at drilling and production operations for direct one-to-one equipment handling.

Semester (II)

Paper V (Unit I & II)

[Total Marks: 125 (Final Examination: 100, Internal Examination: 25)]

(Unit-I) (Marks 50)

General Introduction of Petroleum & Natural gas-2

- 1.1 Drilling of oil and gas wells- different methods, different types of drilling rigs (onshore/ offshore) and drilling equipments, drilling fluid composition, properties and types, subsurface conditions, rock failure mechanisms.
- 1.2 Separation of gas fractions and manufacturers of LNG, CNG, LPG and PNG.
- 1.3 Petroleum production- different production installations and equipments, different production operations in onshore and offshore, primary and enhanced oil recovery methods, artificial lift, surface processing of oil, gas and water. Well testing operations.

Unit (II) (Marks 50)

Geology & Geophysics (G & G)-2

2.1 Exploration of petroleum- different methods

2.2 Crude oil and product evaluation methods, characteristics and specifications of different petroleum products, petroleum product tests and their significance.

2.3 Coal Bed Methane (CBM) Exploration: Geology of Coal, evaluation of basin and prospect identification, prospect generation, drilling and completion of CBM wells, stimulation technology, and testing and production operation.

Paper VI (Unit IIIA & Unit IIIB)

[Total Marks: 125 (Final Examination: 100, Internal Examination: 25)]

Unit (IIIA) (Marks 50)

Drilling, Production Operation -2

3.1 Improved oil recovery by gas Injection and thermal methods..

3.2 Well head equipment & flow control devices, Casing hangers, heads, tubing hangers, Christmass tree, chokes/beans, well head heaters, etc.

3.3 Subsurface production equipment, Tubing, production packers, Bridge plugs, tubing anchors, standing valves, screen & slotted liners, bottom hole chokes, etc. Safety valves: types and operation.

3.4 Artificial lift system- Introduction to artificial lift, various modes of lift Gas lift- continuous lift, intermittent lift, Gas lift valve mechanics, properties of natural gas, complications of gas lift well operation and complication control , increasing gas lift efficiency ,optimization of gas lift performances . plunger lift and chamber lift . mechanical pumping – sucker rod pumping – surface and subsurface equipment ,operation of sucker rod pumping , analysis of pumping unit operation from dynamometer cards , electrical submersible pumping , hydraulic pumping ,etc .

3.5 Pipeline Maintenance- Construction, maintenance and repairing of pipelines, corrosion of pipeline and its control, transportation problems in pipelines, Recent technological development of pipeline.

Unit (III B) (Marks 50)

Drilling, Production Operation-3

3.6 Management of oil field installations- Operational management (Offshore)), Safety management, Contract management and documentation management

3.7 Quality, Safety, health and environment. Different type of well kick, threatened blowout, preventive action, equipment testing, documentation, blowout control.

3.8 Recent drilling, drain-hole drilling, horizontal drilling, extended reach, deviation drilling, multilateral drilling.

3.9 Work over and well servicing operation, through tubing work over, coil tubing operation, down hole tools, bottom hole recording, wire line operation, fishing operation, cost consciousness, preventing, formation damage, conclusion testing, emerging technology induction.

Paper VII (Unit IV & Unit V)

[Total Marks: 125 (Final Examination: 100, Internal Examination: 25)]

Unit (IV) (Marks 50)

Exploration & Development of Oil & Gas Field

4.1 Formulation of rational development programme under different reservoir conditions, development of oil and gas fields, Stages of development, integration of data for field development.

4.2 Principles of development- aims, methods, and stages of development. Geological and engineering considerations required for development of hydrocarbon fields.

Petroleum Industry Vs Environment Management in Petroleum and Gas Industries

4.4 Environmental issues considered during exploration, production, transportation, reefing and marketing of petroleum. Treatment of produced oil field water, ground water and refinery waste water. Pollution by hydrocarbon processing industries and their control. Hazardous waste laws and regulations for the petroleum refining industry.

4.5 Air, Water and Soil Pollution. Sources methods and principles of treatment processes.

Unit (V) (Marks 50)

Financing and Budgeting in Oil Industries :

5.1 Basic economic analysis, engineering concepts of costing and budgeting, net present value concept, amortization, discount rate, depreciation, Engineering Cost-benefit analysis, Economic ratios, Project feasibility approaches, SWOT analysis, Spreadsheets, scheduling, manpower loading, PERT/ CPM analysis, critical path analysis, production functions, supply-demand concepts, risk analysis concepts

Paper VIII (Unit VI)

[Total Marks: 125 (Project Report: 75, Presentation and Viva Voce: 50)]

Unit (VI)

Laboratory, project work and field training-2

6.0 Basic Petroleum and Natural Gas Measurements: Hydraulics of pipeline operations, theory of hydraulic flows, flow operations used to determined efficient operations, and fluid properties and a total system design of a pipeline. These covers the basic procedures used to measure oil flow and refined products. Measuring techniques, equipment and devices at oil field, processing plants and pipeline will be discussed. Natural gas measurement topics include the theory of natural gas, the gas laws and how to calculate volumes, and the equipment used to measure natural gas. Gas Sampling, odorizing and quality determination of the gas will be covered during field visits.

6.1 Applications of Electronics and Electrical Engineering in Oil and Gas Industry: This subject area covers the basic theory of AC/ DC circuits and the test equipment used to measure and performs simple troubleshooting techniques. The topic also covers the theory and operations of electrical components commonly used in an Oil & gas production lease environment and how to properly size and determine motor operations, circuits, cables, SCR's and protection devices. Programmable Logic Controller (PLC) basics of ladder logic operation and how to use the various circuit designs in actual applications. The class is comprised of 30 percent laboratory activities in field and workshop environment

SEMESTER (III)

Name of papers/ duration	Number of Papers	Marks Contain		
		Final Examination	Internal Assessment	Total
Complete overview of E&P Industry Common Paper to all 2 Months	Paper (I)	100		100
	Project (II)	0	75+25 Ext	100
And				
Reservoir Study (Special Paper) Group A 4 Months	Paper (III)	100	50	150
	Paper (IV)	100	50	150
Or				
Petroleum Geology & Geophysics (Special Paper) Group B 4 Months	Paper (III)	100	50	150
	Paper (IV)	100	50	150
Or				
Petroleum Chemistry (Special Paper) Group C 4 Months	Paper (III)	100	50	150
	Paper (IV)	100	50	150
Or				
Drilling & Production Operation (Special Paper) Group D 4 Months	Paper (III)	100	50	150
	Paper (IV)	100	50	150

Program of Studies

Paper: Complete overview of E&P Industry (Common Paper to all)

Paper	Final Examination	Internal Examination	Total Marks
Paper I	100		100
Project Paper II		75+25 (Ext)	100
Total Marks			200

Paper I

[Total Marks 100]

Unit I (Marks 25)

PETROLEUM RESERVOIR STUDY :

- **Fluid flow in Reservoirs:** Darcy's Law, viscosities of water, oil and natural gas, types of fluid and compressibility flows of reservoirs fluids, productivity index, permeability variation in radial flow, productivity ratio, electric models and other well problems, zonal damage and well spacing, recovery and deliverability.
- **Sweep/ Displacement of oil and Gas:** Relative permeability, Buckley- Leverett displacement mechanism, displacement of oil and gas, oil recovery by internal gas drive, relative permeability ratios from field data, productivity index decline in depletion reservoirs, displacements of oil by water in stratified reservoirs, sweep efficiency.
- **Water Influx:** Hydraulic analogs of water influx, water influx from solutions to the diffusivity equation, Determination of water influx independent of material balance calculations, expressing water influx analytically, simultaneous calculation of initial oil in place and water influx.

PRINCIPLE OF PETRLEUM PRODUCTION:

- General composition and properties of oil and gas.
- Physical properties of oil and gas bearing rocks.
- Basic principles and characteristics of petroleum reservoirs.
- Fundamentals of oil and well drilling.
- Principles of oil field development.
- Fundamentals of production methods and equipment.
- Fundamentals of transportation and gathering of oil and gas.

FUNDAMENTALS OF NATURAL GAS:

- Chemical composition of Natural Gas.
- Phase behavior of Natural Gas Systems.
- Properties of Natural gas and Volatile Hydrocarbon Liquids.

- Gas flow measurements; orifice meters.
- Meter- run installation.
- Flow control and pressure regulating instruments.
- Critical; Flow Proverb Principles of gas transportation through pipeline.
- Safety measure in gas fields.
- Study of gas and gas –condensate reservoirs.
- Deliverability, reserves, recoveries, material balances.
- Gas well testing, determination of static and flowing bottom-hole pressures.
- Gas production from condensate and oil fields.
- Field separation from condensate and oil fields.
- Field separation and absorption processes.
- Dehydration an sweetening of natural gas.
- Hazard and safety measures in handling of natural gas.

GATHERING OF OIL AND GAS:

- Basic principles of oil and gas gathering system.
- Type of oil & gas gathering system.
- Oil & Gas separators.
- Equipment for oil & gas gathering system
- Pipe & Fittings, manifolds, flow rate measurements pressure controller system.
- Storage tank operations.
- Oil/ Gas flow measurements
- SCADA

Unit II (Marks 25)

Petroleum Geology, Geophysics, 2D & 3D Geophysical survey, Data Interpretation-2:

- Sedimentology- processes, stratigraphy, maturation, migration and distribution of hydrocarbons. Subsurface methods.
- Drilling, cores and sample logs, Electric logs.
- Geophysical methods in petroleum exploration including seismic interpretation.
- Physical conditions and properties of reservoirs.
- Investigation of reservoirs by wireline logs.
- Data acquisition and its use to reconstruct the geological and palaeogeographical history of a basin.
- Prospect and field- regional reconstruction of basin history and identification of low risks areas and study of prospects.

Geophysics:

- Basics of reflection seismology
- Signal theory and propagation of waves
- Reflection seismic acquisition
- Seismic processing fundamentals and digital filtering

- Seismic interpretation for structures
- Reservoir aspects of seismic interpretation
- Seismic stratigraphy
- Fundamentals of gravity and magnetic surveys
- VSP logging
- Generation of synthetic seismogram
- Generation of synthetic seismic section

Unit III (Marks 25)

Drilling and Production Operation:

- General method and equipment of rotary drilling
- Rotary bits, drill string
- Power and torque required at the bit and rotary table.
- Drilling hydraulics, pressure surges and anomalies
- Lost circulation , Casing and casing design
- Fishing operations and practices.
- Cements and cementing operations
- Coring operations
- Wire line usage and service in drilling
- Drilling of high tech wells
- Various types of drilling fluid, Hole problems
- Well completion and perforation.
- Completion and well workover fluids.
- Trouble shooting for vertical, horizontal and multilateral wells.
- Formation damage; causes, prevention and removal.
- Surfactants for well treatment, sand control.
- Well stimulation with hydraulic fracturing.
- Matrix and fracturing acidizing.
- Scale deposition, removal and prevention.
- Workover operations, types and selection of workover system.
- Corrosion; detection, control, and prevention.

FUNDAMENTALS OF ENHANCED OIL RECOVERY:

- A treatment of the primary, secondary and tertiary recovery mechanisms including water flooding.
- Thermal processes; steam stimulation, steam flooding, hot water injection, and in situ combustion..

Chemical Processes:

- Micellar solution flooding, polymer flooding, caustic flooding.
- Miscible hydrocarbon displacement: LPG miscible slug process, high-pressure lean gas miscible process, carbon dioxide miscible process.
- Microbial Enhanced oil Recovery (MEOR).

Unit IV (Marks 25)

TRANSPORTATION OF OIL AND GAS:

- Pipeline transportation of oil and gas
- Principles, flow calculations, sizing and specifying pipe, selection of route, protection against corrosion.
- Pipe laying maintenance of equipment.
- Pumps and compressors.
- Sampling and testing of oil and gas.
- Instrumentation and control.
- Safety and supervision.
- Economics and long distance pipeline.

Specialization

Group A

(Reservoir Study)

(Marks 300)

Programme of Studies :

Duration- 4 Months

Total Marks- 300

Paper	Final Examination	Internal Examination	Total Marks
Paper III (Unit I & II)	100	50	150
Paper IV (Unit III & IV)	100	50	150
Total Marks			300

PAPER III (Unit I & II)

[Total Marks : 150 (Final Examination : 100 , Internal Examination :50)]

Unit I (Marks 50)

Reservoir Concept :

- Basic concept of an oil (or gas) field
- Basic understanding of major producing basin (eg Assam Arakans)
- Database of case study reservoir problems (from Assam Arakans and beyond)
- Basic operational geological concepts

- Various architectural relationships in reservoirs
- Reservoir flow units
- Flow units geometry in the subsurface
- How to draw maps of flow units
- Properties of flow units
- Determination of volumetric hydrocarbons in place
- Introduction to petroleum Exploration

Reservoir Sedimentology:

- Elements of plate tectonics
- Sedimentary processes and their impact on reservoir properties
- Basic petrographic data development of a fundamental understanding of facies environmental analysis
- Main clastic depositional environments
- Main carbonate environments
- Clastic and carbonate diagenesis and its impact on reservoir properties
- Problems particular to carbonate reservoirs
- Introduction to core description and field sedimentology / outcrop analysis
- Practical reservoir sedimentology and its links to other disciplines
- Concept of reservoir modeling (and its challenges)
- Information required to generate static and dynamic reservoir models

Reservoir structure :

- Vocabulary of structural geology and significance of the terms
- Techniques for depicting structural features
- Rock mechanics principles
- Kinematic methods
- Relation of fractures and their fluid flow consequences
- Relations of faults and their fluid flow consequences
- Practical uses of structural geology

Unit II (Marks : 50)

Geomechanics and Rocks Physics

- Introduction to the seismic method
- Rock physics (acoustic properties of rock and fluids)
- Measurements methods in the laboratory (yields & post –yields behaviour of rocks and determination of emergent properties)
- Practical applications of rock mechanics : well bore stability ,standing , hydraulic , fracturing ,reservoir compaction
- Case study : geomechanical evaluation of HPHT filed

- The significance of higher –order material descriptions (rheologies)
- Poroplastic behaviour in basin compaction
- Seal formation and failure pressured basins

Formation Evaluation :

- General concept of wireline and MSW logging
- Fundamentals of log interpretation
- Basic (passive) logging tools
- Lithology interpretations
- Various porosity tools and how to compute porosity
- Common resistivity tools and saturation determination
- Basis of shaley sand interpretation

Reservoirs Studies :

- Properties of reservoir oils
- Properties of reservoir gases
- Fundamental properties of rocks
- Reservoir drive mechanisms
- Material balance calculations
- Principles of water flooding

Financing and budgeting in Reservoir studies:

Paper IV (Unit III & Unit IV)

[Total Marks :150 (Final Examination : 100 , Internal examination :50)]

Unit III (Marks 50)

Well Testing and production Logging :

- Diffusivity equation and well test concept and radial flow theory and equations
- Theory and practice of pressure draw down and pressure build-up analysis
- Numerical well testing in heterogeneous reservoir systems
- Develop understanding of interpretation methods for testing data from complicated reservoirs and wells

- Use of static pressure measurements in reservoir description
- Use of pressure/ flow data in dynamic conditions
- How to integrate well testing with other disciplines for reservoir characterization and management.

Reservoir Simulation:

- Application and impact of reservoir simulation in reservoir engineering
- Fundamentals of single-phase compressible flow
- Principles of numerical flow simulation

- Concepts and techniques of up-scaling and pseudoisation
- Pitfalls of reservoir simulation

Geomodelling and Reservoir Management:

- Familiarization of geological modeling techniques
- Role of outcrop databases
- Use and limitations of geological geostatistical models
- Workflow in construction of geomodels
- Challenges of data integration in reservoir studies
- Awareness of current mature field management techniques
- Various techniques for uncertainty prediction and reduction

Unit IV (Marks 50)

Reservoir Geophysics:

- Influence of reservoir fluid on seismic properties
- Significance of seismic attributes
- Development of current seismic acquisition techniques
- Principles of seismic processing
- Quantitative seismic interpretation
- Benefits of 4D seismic
- The role of reservoir geophysics in geomodelling through imaging (structure, faults, etc) and lithofacies/ property interpolation between wells
- The role of 4D seismic in reservoir management

Laboratory Petrophysics :

- Core analysis report and core analysis techniques
- Strengths and limitations of poroperm data
- Derivation and meaning of parameters a , m , n
- Capillary Pressure/ Saturation relationships
- .Relative permeability measurements
- Basic rock typing concepts
- Relation of core and log measurements

Group B

Geoscience

(Petroleum Geology & Geophysics)

(Marks 300)

Programme of Studies :

Duration- 4 Months

Total Marks- 300

Paper	Final Examination	Internal Examination	Total Marks
Paper III (Unit I & II)	100	50	150
Paper IV (Unit III & IV)	100	50	150
Total Marks			300

Paper III (Unit I & Unit II)

[Total marks 150 (Final Examination: 100, Internal Examination:50)]

Unit I (Marks 50]

INTRODUCTION TO PETROLEUM GEOLOGY AND GEOPHYSICS

- Basic concepts of Geology, History of rock evaluation, Geological process of earth crust movement
- Elements of crystallography and mineralogy including atomic structures, physical properties and chemical properties.
- Study on common types of igneous, sedimentary and metamorphic rocks, including origin, description and classification, Kerogen- Types and origin
- .An introduction to structural geology including primary structures, folds, joints, faults, foliations, and plate tectonics, convergent, divergent and transform boundaries.
- Types of petroleum traps: anticline, fault and stratigraphic traps.
- Geologic Time Scale
- Characteristics of source rock, reservoir rock and cap rock.
- .Primary, secondary porosity and effective porosity.
- Permeability and its determination. Vertical and Horizontal permeability, Effective and absolute permeability.
- Well log techniques and Interpretation.
- Bore hole survey and various logging data to solve various exploration and production problems.
- The logs such as Resistivity, sonic porosity, lithology and their advancement for thin bed analysis corrosion analysis, stacking of tools and various advancement in acquisition and interpretation log data.
- Measurement while drilling (MWD), logging while drilling, seismic while drilling, VSP. Will include in the course.

- Methods of petroleum exploration- geophysical, seismic survey (2D & 3D) remote sensing, drilling of exploratory well.

Unit II (Marks 50)

SEDIMENTATION, STRATIGRAPHY AND SUBSURFACE GEOLOGY:

- Principles of sedimentation and environments of sedimentation Origin, description and classification of sedimentary rocks. Definition rock on the basis of particle size.
- Structural features of sedimentary origin.
- Principles of petroleum geology including origin, migration, and accumulation and methods of finding hydrocarbons. Petrochemical properties of reservoir rock
- Geology of oil fields and oil prospective regions of Myanmar.
- Principles of stratigraphy and subsurface geology.
- Stratigraphic correlation and other methods and techniques applied in stratigraphy and subsurface geology; logging and evaluating subsurface geologic data.
- The role of geology in petroleum production and development operations, especially dealing with the geology of sandstone and carbonate reservoirs.
- .Laboratory work will include field description and logging of cores and drill cuttings. Subsurface methods using micro fossils, construction of structural contour maps, isopach maps and geologic cross-sections.

Paper IV (Unit III & Unit IV)

[Total marks: 150 (Final Examination: 100, Internal Examination:50)]

Unit III (Marks 50)

BASIN ANALYSIS:

- Introduction- scope, purpose and developments.
 - Sedimentary Basins-Definition, geologic concept, tectonics in sedimentation, plate tectonics and its importance.
 - Classifications of sedimentary basins with respect plate tectonics and commercial production.
- Regional and global stratigraphic cycles.
- Depositional systems and facies analysis.
- Data acquisition- measuring and recording surface and subsurface data.
- Data manipulation. Burial history.
- Selected case histories of sedimentary basins.
- Basin modeling fundamentals.

Unit IV (Marks 50)

SUBSURFACE FACIES ANALYSIS:

- Recognition of ancient sedimentary environments using a combination of wireline log responses, sedimentary structures and mineralogy.
- The Construction of subsurface contour and facies maps, and isopach maps using borehole data.

Group C (Petroleum chemistry)

(Marks 300)

Programme of studies

Duration – 4 Months

Total Marks-300

Paper	Final examination	Internal examination	Total Marks
Paper III(Unit I & II)	100	50	150
Paper	100	50	150
Total Marks			300

Paper III (Unit I & II)

[Total Marks : 150(Final examination :100, Internal Examination :50)]

Unit I (Marks 50)

An Introduction to Petroleum Chemistry :

- Crude oil : its chemical and Physical Properties
- Chemical Composition of Natural Gas, CNG, LNG, and PNG.
- Fractional distillation, Different petroleum fractions (as per boiling point) obtained in petroleum refinery.
- Gas cracker and gas based power plants.
- Chemical reactions involved in complete as well as incomplete combustion of gasoline.
- Theory of solvent extraction
- Catalysis in petroleum refining
- petroleum products
- production tests and their significance
- Alkylation, reforming, hydro cracking, dehydrogenation, and solvent refining.

- Different types of laboratory distillations – ASTM, EFV, TBP, and their inter conversion.

Unit II (Marks 50)

Petrochemicals

- Petrochemicals- Crude oil and natural gas as raw materials,
- Petrochemical feed stocks from biomass resources
- Separation processes for manufacture of petrochemical feedstock
- Sulphonation – Basic reaction in the sulphonation of hydrocarbons sulphonating agents . Some properties of the surface-active agents and their use
- Halogenations of hydrocarbon – Main homogenate hydrocarbon used in chemical industry
- Thermodynamics and kinetics of hydrocarbon halogenation
- Chlorination processes of low molecular weight paraffin ,olefine and aromatics , production of fluorocarbon derivatives, their properties and uses.

Paper III (Unit I & II)

[Total Marks : 150(Final Examination : Internal Examination :50)]

Unit III (Marks 25)

Polymerization

- Polymerization : The type and structure of the macromolecular products, physical and mechanical properties of high molecular mass compounds
- Chain polymerization , its mechanism and kinetics , methods of polymerization and polycondensation , some more important commercial polymer products , their properties , manufacture and use .

Unit IV (Marks 75)

Chemistry of drilling Mud

- Colloidal properties of liquid : vapour pressure ,viscosity and specific gravity of liquid .
Rault's Law
- Drilling mud or drilling fluid : types of drilling mud (WBM & OBM), composition and its role in oil well drilling.
- Functions of drilling mud (a brief explanation)
- Minerals used in oil industry: bentonite (sodium & calcium), barite, mica, tungsten, lead, diamond etc.
- Fluid additives used in drilling mud: Weighting agents, PH control agents, Emulsifiers, Filtrate control agents, loss circulation materials, lubricants, ROP enhancer, spotting fluids, sweeping agents, Thinners, defloculates, viscosifier, emulsifier, suspending agents, corrosion inhibitors, defoamers, foaming agents, Shale control inhibitors, surfactants.
- Viscosity and Specific gravity of drilling mud and their importance during drilling operation. Mud weight and mud balance.

- Determination of viscosity by Marsh Funnel Viscometer/ Fann VG meter
- Role of chemicals used in exploiting hydrocarbon- refinery, Drilling and related operations. Oil well stimulation, Enhanced oil recovery, water injection, polymer flooding, Water shut off etc., corrosion mitigation, value addition products.

Group D
(Drilling & Production Operation)
(Marks 300)

Duration- 4 Months

Total Marks- 300

Paper	Final Examination	Internal Examination	Total Marks
Paper III (Unit I & II)	100	50	150
Paper IV (Unit III & IV)	100	50	150
Total Marks			300

Paper III (Unit I & Unit II)
[Total marks: 150 (Final Examination: 100, Internal Examination:50)]

Unit I (Marks 50]

Drilling Operation and Equipments :

- Methods of well drilling and characteristic of drilling rig and Sub-Structure.
- Technology of drilling of vertical wells.
- Break-downs and drilling complications.
- Well testing and methods of BOP.
- Directional well drilling.
- Properties of rocks, methods of effective drilling and information through various methods like electric logs, radiometry, gravity, seismic and acoustic.
- Function and composition of drilling equipment.
- Rotary equipment, equipment of rig's hoisting system.
- Derrick, masts, and substructures.
- Circulating equipment and accessories.
- Equipment of mud system Power plants.
- Characteristics of different prime movers.
- Derrick floor equipment and drilling rig instrumentation.

- Drilling rig selection, maintenance and safety measures.

Drilling Holes Design:

- Principles of a drilling well design.
- Designing of a drilling well with the analytical method.
- Casing policy and casing design (Burst, tensile strength, collapse).
- Drilling mud.

Production Operation:

- Types and characteristics of well completions, perforating, wellbore damage and simulation, combined inflow and well performance analysis, multiphase flow through conduits, oil well pumping, gas lift, surface facilities and flow measurement, applied mass transfer.
- Well completion design/review and Workover/ trouble shooting for vertical, horizontal & multilateral wells.
- Feasibility study of hydraulic/ acid fracturing and matrix acidising job.
- Stimulation technique.
- Sand control design/ post job analysis.
- Design/ development/ evaluation of water shut off technologies
- Concept development of marginal fields.

Unit II (Marks 50]

Mechanics of Rock Mass drilling

- Basic properties of rocks, methods of their determination, measures of these properties.
- Mechanism of impact of individual drilling tools on the rock mass in the process of drilling, accounting for energy-consumption of the process.

Technology of Drilling FluidsL

- Special purpose materials and chemical agents.
- Surfactants, inhibitors of corrosion and agents neutralizing oxygen and hydrogen sulphide.
- Materials and agents used for fighting lost circulations.
- Influence of drilling fluids in directional drilling.
- Environment friendly drilling fluid.
- Rheology, various types of factors on mud's parameters (temperature, salts)
- Drilling muds in the process of drilling, types of drilling muds, Systems for making and cleaning of drilling muds.
- Tools and standards: PN, API, OCMA used for the measurement of mud parameters.

Financing and budgeting in drilling and production operation:

- Estimation and control Production Operating Cost.
- Materials / Inventory control and accounting.
- Preparation of well cost estimates and control the cost of drilling operations.
- Project and Development Cost- how to control capital expenditure and major maintenance project costs.

Paper IV (Unit III & Unit IV)

[Total marks: 150 (Final Examination: 100, Internal Examination:50)]

Unit III (Marks 50)

Drilling and Testing:

- Techniques and technology of drilling up of liquid deposits.
- Causes of changed permeability of reservoir rock mass in the near-well-zone.

Drilling Break-downs and complications:

- Sticking and destruction of the string.
- Formation fluid blowouts.
- Lost circulations.
- Break-downs accompanying piping and cementing operations.
- Complications at directional well drilling.

ADVANCED DRILLING OPERATION:

Rotary Drilling Hydraulics:

- Jet nozzle selection, pump pressure schedules, surge pressure, slip velocity and carrying capacity.
- Performance of rotary bit: Rock failure mechanisms bit selection factor affecting tooth and bit wear, terminating a bit run.
- Casing design: Combined stresses on casing , design criteria. Prediction of pore pressure and fracture gradient: Methods of pore pressure prediction. Formation, fracture gradient, pressure testing.

Directional Drilling and Control :

- Planning of directional trajectory calculations of trajectory, kick off and trajectory.

Horizontal Drilling:

- Uses of horizontal well and equipment.
- Hydraulic for horizontal holes, torque and drag.
- Subsurface pressure control.

- Wellbore pressure, equivalent circulating density, well kick and interpreting pressure, control methods.

Offshore Drilling :

- Floating drilling subsea guides, guide structure, casing and wellhead equipment, subsea BOP stack and control, marine riser and its tensioning system, guide line system.

Unit IV (Marks 50]

Mechanization and automation in Drilling:

- Principles of control and automation
- Automation of drilling processes, process of pipe tripping and removal.
- Mechanization of the circulation and mud cleaning system.

Optimization in drilling :

- Process control.
- Building of a drilling model.
- Optimization methods.
- Optimization of the drilling process.

Well Drilling Technology :

- Designing of mechanical and hydraulic parameters of drilling with normal drilling bit. PDC cutter, diamond bits.
- Methods of stabilization of lower part of the string.
- Complex optimization.

Production Operation :

- **Well Completion-** Practical aspects of well completion planning, tools and equipment, overview of costing, Oil Field development: Prolong and optimum recovery of petroleum- primary, secondary and tertiary.
- **Oil Collecting and Gas Gathering Station:** Oil collection in fields, various aspects of oil collecting stations, Gas-oil-water separation, Gas gathering stations, compressors.
- **Land units in world:** Types and characteristics of well completions and workover operation, perforating, wellbore damage and simulation, combined inflow and well performance analysis, multiphase flow through conduits, oil well pumping.
- **Artificial Lift:** Introduction, reasons for using artificial lift, different types, selection criteria.
- **Rod Pump:** types, Sucker rod pump- components and principle, pump designation.
- **Electrical submersible pump (ESP):** Components of ESP, Gas separator.

- **Gas lift**{ its principles and classification, advantage of gas lift, gas lift design, gas lift valve, injection pressure operated gas lift valve, gas lift mandrels and kick over tools,
- **Hydraulic lift system:** its principles and applications, surface unit of hydraulic system, Hydraulic jet & piston pumping-principles and advantage, surface facilities and flow measurement, applied gas transfer.
- **Enhanced Oil Recovery (EOR):** its importance, EOR Methods- Thermal, miscible and Chemical, Microbial Enhanced Oil Recovery (MEOR)- its principles.
- **Well completion:** design/ review and Workover/ troubleshooting for vertical, horizontal & multilateral wells.
- **Fracturing:** Feasibility study of hydraulic/ acid fracturing and matrix acidizing job.
- **Stimulation Technique.**
- **Sand control:** Design/ post job analysis.
- **Water shutoff-** Design/ development/ evaluation of water shut off technologies.
- **Flow assurance-** Reservoir to well to surface, surface flow lines and restrictions, hydrate formation.
- **Marginal field-** Category of such fields and concept development of marginal fields.
- **Offshore production management-** Shallow to deep water offshore production, Fixed platforms, Sub- sea production system and Floating production platforms.
- **Quality, Safety , Health, Environment and other statutory issues including Mines Act, Oil Mines Regulations, Record keeping, Reporting to various authorities.**

Semester (IV)

Duration: 6 months

Paper

Contents	Marks
Project and business management overview and on job field training (Specialization in specific petroleum project and business management)	100+ 50 (Internal)
Dissertation on 2 specific projects job on 2 field problems with case history and probable solutions under the guidance of industry experts.	Project Report 1: 100 Internal : 50 External : 25
Presentation & Viva-Voce	Project Report 2: 100 Internal : 50 External : 25
Total Marks	500