Eight Semester

Course Title: Pipeline Transportation of Oil and Gas

Course Code: PTE 801

Course Duration: One semester

Marks (University Exam): 100marks (total)

Progressive Assessment: 50marks

Practical: No

Time of examination: 2 hours and 30 mins.

Note for Examiner: The course schedule includes 2 lectures, 1 tutorial.

Objective: To understand the process of fluid transportation with special reference to crude oil/gas/refined products, pipeline construction and maintenance, economics of Pipeline transportation.

SN	Topic	No. of Lectures
PTE 801	Oil Transport: Flow Properties of Crude Oil and Products, Rheology, Wax, Pump Characteristics: Reciprocating and Centrifugal. Congealing, Pressure Loss Relationship Compressors: Types, Characteristics, Multi Stage Compressors. Gas Transport: Compression Cycles and Efficiency, Multi Stage Compression, Pressure Loss Relationship. Looping & Branching Heat Flow: Ground Surface Temperature Gradient and Seasonal Variation, Flow Temperature Gradient In Pipe Fluid, Insulation Types and Thickness. Flow Under Low Temperature: Wax Crystal Modifiers. Pipe Laying: Pipe Specifications, Route Survey, Trenching, Welding, Wrapping, Laying: Equipment and Techniques, Expansion Loop, Pig	**42**

	Launchers and Receivers.Road and River Crossing.Wax, Scale and Condensate: Formation, Prevention and Removal. Pipe Line Automation, Lease and Custody Transfer, SCADA, Corrosion Protection and Control, Cathodic Protection.	

Outcomes:

- understand the piping fundamentals, codes and standards
- understand pipe fittings, selections, drawings and dimensioning
- understand Pipe Material specifications
- understand pressure design of pipe systems

Books:

- Andrew C. Palme, Roger A. King, "Subsea Pipeline Engineering", 2nd Edition, Pennwell corporation, 2008
- Macetta, John. "Piping Design Handbook", M.Dekker , 1992
- Mohinder Nayyar , "Piping Handbook" Seventh Edition , McGraw-Hill, New York, 2000 Ed
- Bausbacher and Roger Hunt, 'Process Plant Layout and Piping Design', First Edition, Prentice Hall, 1993
- Robert A. Rhea, Roy A Parisher, "Pipe Drafting and Design", Second Edition, Gulf Professional Publishing, 2003

Course Title: Enhanced Oil Recovery

Course Code: PTE 803

Course Duration: One semester

Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: No

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3lectures and 1 tutorial

Objective:

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

SN	Topic	No. of Lectures
PTE 802	**Enhanced Oil Recovery** Unit -I Introduction, Enhanced Oil Recovery from Reservoir, Implication, Pressure Maintenance as EOR method, Drive Index Modification. Unit - II Immiscible Displacement Process: Fractional Flow and Frontal Advance Rate Equation, Water Flooding: Mechanics and Performance, Displacement Front Monitoring, Polymer Loss In Reservoir. Unit- III Miscible Displacement Process: High Pressure Gas and Enriched Gas Displacement Process, LPG Flooding, Alcohol Flooding, CO2 Flooding, Surfactant Flooding. Unit- IV Thermal Recovery Process, Steam Stimulation and Flooding, in situ Combustion Process. Reservoir Selection and Process Design, Microbial Recovery Technique: Principles and Application Potential	48

Outcomes

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

Books:

- Von Pollen. H.K. and Associates. Inc., "Fundamentals of Enhanced oil Recovery" – Penn Well publishing co., Tulsa -8th edition, 1980.
- Latin. M. et al., "Enhanced oil recovery" – Gulf publishing co. Houston, 3rd edition, 1980.
- Donaldson-Earle, "Enhanced Oil Recovery-II", Processes and Operations, 7th edition, 2006.
- William C.Lyons & Gary J.Plisga, "Standard Hand Book of Petroleum & Natural Gas Engineering", Gulf professional publishing comp, 2nd Edition, 2005.
- Larry W. Lake, Russell Johns, Bill Rossen & Gary Pope, 2014, Fundamentals of Enhanced Oil Recovery, SPE, 496 pp
- Don W Green and Willhite G P, 1998, Enhanced Oil Recovery, SPE International, 553 pp.
- Sorbie K H, 1991, Polymer-Improved Oil Recovery, Springer, 371 pp.
- James Sheng, 2013, Enhanced Oil Recovery, Field Studies, Gulf Professional Publishing, USA, 683 pp.
- James J. Sheng, 2011, Modern Chemical Enhanced Oil Recovery Theory and Practice, Gulf Professional Publishing, USA, 632 pp.

Electives: 1

Course Title: Safety, Health & Environment in Petroleum Industry
Course Code: PTE 803
Course Duration: One semester

Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical:- No

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.

Objective: The course will give an overview of the safety and environmental issues in the petroleum industry. It will provide detailed understanding of the methods and techniques to resolve these key issues for making petroleum production and processing, cleaner and safer.

SN	Topic	No. of Lectures
PTE 803	Unit I Physical Hazards Noise, Heat, Vibration, Illumination, Radiation, and extreme climatic conditions. Chemical Hazards Hydrogen sulfide gas, Hydrocarbons, Ammonia, Chlorine, Formaldehyde, Hydrochloric Acid, Methanol, Sulphur, Sulphuric acid, Sodium Hydroxide, etc. Biological Hazards, Psychological Hazards, Ergonomic Hazards, Injuries, Burns etc., Unit II Prevention & Remedial controls of Occupational Hazards In Oil & Gas Industry for each type of Hazards Engineering Control, Administrative Control, Medical Control, Use of Personal Protective Equipment (PPE) Understanding Fire: Fire triangle/tetrahedron, Stages of development of fire Flammability, Concept of flash / Fire point, volatility, Flammable Limits, Fire Detection; Fire signature, Smoke, Heat, Flame, Combustible Gas Detection Fire Prevention, and Fire suppression. Unit III Safe Work Practices: PTW, MOC, and SIMOPS etc., Electrical Safety; Classification of Hazardous locations, use of electricity I Hazardous area. Accident Investigations: Study of major accidents like Piper Alpha, Flixborough, Bhopal etc., Unit IV Environment Concepts: - Effect on eco-system; Environmental Impact of Hydrocarbon Exploration &Exploitation (Off shore & On	48

	Shore) - Environmental Impact Assessment Oil Spills Control and their management. State, Environmental Rules & Regulations.	

Outcomes:

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

Books

- Smith, K. Environmental Hazards: Assessing Risk and Reducing Disaster. Third Edition. 2001. Routledge Press.
- Burton, I, R.W. Kates, and G.F. White, the Environment as Hazard, Second Edition. Guilford Press. 1993.
- Boesch D.F and Rabalis Nancy, "Long term environmental effects of offshore oil and gas developments", 7th edition, 2003.
- "Environmental control in Petroleum Engineering" by Reis J.C, Gulf publications, 5th edition,1968
- Katz D.L.et al, "Natural Gas Engineering (Production & storage)", Tata McGraw-Hill, Singapore, 6th edition, 2007.
- Smith J.M, "Chemical Engineering Kinetics", McGraw Hill, 3rd edition, 1981.
- Blake, R.P., "Industrial Safety", Prentice Hall, 3 rd edition, 1953
- Myer Kutz and Ali Elkamel, 2010, Environmentally Conscious Fossil Energy Production, John Wiley & Sons, 363 pp.
- Orzu Orszulik, "Environmental Technology in oil Industry", Springer – Verlag, 1996.
- Reis, J.C.1998, "Environmental control in Petroleum Engineering", Gulf publications, 287 pp.
- Boyce, A. 1996, "Introduction to Environmental Technology", John Wiley and Sons, 2
- Frank R. Spellman, 2013, Environmental Impacts of Hydraulic Fracturing, CRC Press, 462 pp.

Elective: 2

Course Title: Polymers in Petroleum Industry

Course Code: PTE 810

Course Duration: One semester

Marks (University Exam): 100marks (total)

Progressive Assessment: 50marks

Practical: - No

Time of examination: 2 hours and 30 mins.

Note for Examiner: The course schedule includes 3 lectures, 1 tutorial.

Objective: The course will provide a basic knowledge of polymers, different types of polymers and their structure- property relationship.

SN	Topic	No. of Lectures
PTE 810	Polymers in Petroleum Industry Unit I Classification of polymers, , Linear branched and cross – linked polymers, Molecular weights of polymers, Polydispersity and Mol. Wt. distribution in polymers, Random, alternate, block and graft co – polymers, polymer characterization techniques, polymer degradation. Unit II Kinetics of chain& Step polymerization, techniques of molecular weight control, Initiators, Chain transfer agents, Inhibitors. Techniques of polymerization Bulk, Solution, Suspension & Emulsion polymerization. Unit III Introduction to polymer rheology, Newton's law of viscosity, viscometris plots, rheometers, rheological models, theory of viscoelasticity, Tg, Heat distortion temperature. Unit IV	**48**

	Basic concept of polymer processing: Compounding methods, Extrusion molding, Injection molding, Blow molding, Rotational molding. Introduction to fiber reinforced plastics.	

Outcome: Provide application based knowledge for usages of polymer, on the basis of their rheology, in oil and gas industry for enhancement of production of hydrocarbon under EOR.

BOOKS:

- Gowariker, V.R., Viswanathan, N.V. and Sreedhar, J., "Polymer Science", New Age International (P) Ltd, New Delhi, 1986.
- Odian, G., "Principles of Polymerization", John Wiley & Sons Inc., New York, 1991.
- Tager, A., "Physical Chemistry of Polymers", Mir Publishers, Moscow, 1978.
- PerPEchko, I.I., "An Introduction to Polymer Physics", Mir Publishers, Moscow, 1981.
- Billmeyer, F. W. "Textbook of Polymer Science", John Wiley & Sons, New York, 1948.
- Kumar, A., "Fundamentals of Polymer Engineering", 2/e, Marcel Dekker, New York, 2003.

Elective: 3

Course Title: Offshore Drilling and Productions

Course Code: PTE811

Course Duration: One semester

Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: Yes

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.

Objective: The course will provide information on the various aspects of Offshore Drilling and Productions. Learn the concepts of petroleum site exploration, analysis of offshore structure and understand the offshore environment and soil mechanics.

SN	Topic	No. of Lectures
PTE811	Offshore Drilling and Productions Sea States and Weather: Oceanography, Seabed Condition, Wave Characterization, Meteorology, Buoyancy and Stability	48

	Fixed Platforms: Types, Descriptions and Operations Mobile Units: Types, Description, Installation, Station Keeping, Mooring, Dynamic Positioning. Drilling: From Fixed Platform, Jack up, Semi Submersibles, Drill Ship Conductor and Riser. Deep Sea Drilling Well Completion: Platform, Subsea Completion Production: Processing Platform, Water Injection, Storage, SPM and SBM, Transportation and Utilities.	

Outcomes:

- Develop awareness offshore structures and their installations.
- Understand the subsea control system.
- Understand development and production operations related to offshore.
- Acquaintance of offshore storage facilities and transport of oil and gas

Books:

- Standard Hand Book of Petroleum & Natural Gas Engineering" – 2nd Edition 2005-William C.Lyons & Gary Gulf-Gulf professional publishing comp (Elsevier).
- Well site Geological Techniques for petroleum Exploration by Sahay.B et al.
- Chakraborty S.K.: Handbook of offshore engineering volume I & II 3 IADC Deepwater control guidelines.
- James G. Speight, 2014, Handbook of Offshore Oil and Gas Operations, Gulf Professional Publishing, 428 pp

Elective: 4

Course Title: Refinery Plant Design
Course Code: PTE 816
Course Duration: One semester
Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: Yes

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.

Objective: The course will provide information on the various aspects on designing of refinery. To understand the importance of crude oil as source of fuel and the size of refining industry

SN	Topic	No. of Lectures
PTE 816	Unit- I Determining of properties like Average sulphur content, MEABP, VABP, average specific gravity, Characterization factor, Molecular weight, Vapour pressure, etc. for crude assay. Unit- II Estimation of Enthalpy; product True Boiling Point, Product ASTM and Product Equilibrium Flash Vaporization form crude assay. Unit- III Estimation of Flash point, Flash point index, Pour point and pour point index, Blending Index. Unit- IV Mass balance for Crude oil Distillation and Vacuum Distillation Unit.	48

Outcomes:

- Understanding of plant design
- Analyze crude oil different properties.
- Fundamental and methodologies in the petroleum refining processes
- Concepts of petrochemicals, polymerization and the unit operations involved in it.

Books:

- Technical Data Book- Petroleum Refining, American Petroleum Institute, 6th edition, 1997.
- D.S.J. Jones& P.R. Pujado, Handbook of Petroleum Processing, Springer,The Netherlands, 2006.

Elective: 5

Course Title: INTEGRATED RESERVOIR MANAGEMENT
Course Code: PTE 817
Course Duration: One semester
Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: Yes

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.

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

SN	Topic	No. of Lectures
PTE 817	Unit I: Reservoir Management Concepts and Processes Fundamentals, Data acquisition, interpretation and integration. Unit II: Reservoir Characterization Seismic analysis, well log analysis, recognition of flow units, stochastic modelling, autocorrelation, generation of different maps Unit III: Static and Dynamic Reservoir Modelling Integration of exploration and development technology, upscaling of properties, development of models, data management. Unit IV: Reservoir Performance Analysis and Prediction Calculation of reserves by different methods, Identifying and acquiring critical data, data acquisition, and analysis, recovery prediction Field development and field operating plans to optimize profitability, Efficient monitoring of reservoir performance Unit V: Improved Recovery Processes Primary recovery, pressure maintenance, and secondary and tertiary recovery Suitability of improved recovery processes, new drilling, completion and production technology. Use of artificial intelligence. Case studies from SPE monographs. Unit VI: Reservoir Economics Economic parameters, Risk and uncertainty, scenarios based economic evaluation, optimization.	48

Outcomes:

- Analyze and interpret data collected from different sources
- Develop reservoir model using up scaling of available data
- Run basic simulation model using iterations
- Predict the future performance of production of hydrocarbons.
- Apply suitable methods for increase in reservoir efficiency.
- Apply economic parameter to decide profitability of project.

Books:

- Fanchi J R, 2010, Integrated Reservoir Asset Management: Principles and Best Practices, Gulf Professional Publishing, 361 pp.
- Satter, A. and Thakur, G. C.1994, Integrated Petroleum Reservoir Management, Pennwell Pubs, 336 pp.
- Satter A, Jim Baldwin and Rich Jespersen, 2000, Computer-Assisted Reservoir Management, Pennwell Pubs, 289 pp.

Elective: 6

Course Title: PETROLEUM ECONOMICS
Course Code: PTE 819
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: Yes
Time of examination: 2 hours and 30 mins
Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.
Objective: To emphasize the importance of time value of money in petroleum projects and understand the economic and decision analysis parameters in Petroleum E and P Business.

SN	Topic	No. of Lectures
PTE 819	Unit I: Production Forecast and Reserves Estimation: 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, Crude oil characteristics, Marketing and trading of crude oil, Crude oil pricing mechanism and oil price elasticity, Inflation and effects on oil pricing. Factors controlling oil and gas pricing. Oil differential and influence on price of oil. E and P Business in world and India, Historical development, Role of OPEC and non OPEC countries.	48

	Unit III: Cash Flow Analysis and Economic Parameters: Time value of money, types of costs, Economic Yardsticks: Return on Investment, Pay, Net Present Value, Discounted Cash How, DCFROR, Incremental Analysis, Replacement Analysis, Sensitivity analysis, Optimization. Ranking of projects based on economic parameters, Unit IV: Risk and Uncertainty: Definition, Exploration and Production Probabilistic Analysis, Risk Analysis, Management and Economic Assessment, Decision Analysis, Preference Theory, Real Option Theory, simple examples of decision tree. Unit V: Financial Analysis and Accounting: Analysis of ongoing costs, analysis of field development investments, purchase / sale of producing property, financial reporting. Mergers and Acquisitions, overview of E & P acquisition environment. Petroleum Industry Accounting and types, Petroleum Auditing, Tax Analysis, Cost, Expenditure and revenues under different heads and their proportion in Asset. Depreciation, Depletion, Amortization Methods	

Outcomes:

- prepare a performance forecast for the realization of recovery of the hydrocarbons
- Understand of different terms related to reserves as advocated by SPE/SEG/AAPG
- analyze oil price elasticity and international oil market
- apply principles of time value of money in the economic evaluation of projects
- apply decision analysis addressing risk and uncertainty of exploration projects
- understand production sharing contract of different geographic regions

Books:

- Fanchi J R, 2010, Integrated Reservoir Asset Management: Principles and Best Practices, Gulf Professional Publishing, 361 pp.
- Abdel A. A. Bakr A. B, and Al Sahlawi M. A., 1992, Petroleum Economics and Engineering, Decker Publications.
- Johnston, D, 2003, International Exploration Economics, Risk, and Contract Analysis, Pennwell Books.
- Nadine BRET-ROUZAUT and Jean-Pierre FAVENNEC, 2011, Oil and Gas Exploration and Production, Reserves, Costs and Contracts. Technip Publication, 336 pp.
- Mian M A, 2011, Project Economics and Decision Analysis, Volume I and II, Pennwell Books; 2nd Revised edition, 461 pp and 411 pp.

- Seba R.D., 1998, Economics of Worldwide Petroleum Production OGCL Publications, USA, 761 pp.
- Silvana Tordo and D Johnston, Petroleum Exploration and Production Rights, World Bank Working Paper 179, Washington, 2010 , 126 pp

Elective: 7

Course Title: Natural Gas Engineering
Course Code: PTE 820
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: Yes
Time of examination: 2 hours and 30 mins
Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.
Objective: Students will be able to understand the Natural gas processing, Gas Compression, Gas Gathering and Transport Installation, Operation and trouble shooting of natural gas pipelines.

SN	Topic	No. of Lectures
PTE 820	UNIT I Natural gas technology and earth science: Branches of petroleum Industry. Sources of Information for natural gas engineering and its applications. Geology and earth sciences: Earth sciences-Historical geology, Sedimentation process, Petroleum reservoirs, Origin of petroleum. Earth temperatures & pressure, Earth temperatures, Earth pressure. Petroleum: Natural gas, LP gas, Condensate, & Crude oil. UNIT II Properties of Natural Gases: typical compositions. Equations of state: general cubic equations, specific high accuracy equations. Use of equation of state to find residual energy properties, gas measurement gas hydrates, condensate stabilization, acid gas treating, gas dehydrations, compressors, process control deliverability test, gathering and transmission, and natural gas liquefaction. UNIT III Gas Compression: Positive displacement and centrifugal compressors; fans. Calculation of poser requirements. Compressible	48

	Flow in Pipes: Fundamental equations of flow: continuity, momentum, elegy equations. UNIT IV Isothermal flow in pipes: the Weymouth equation. Static and flowing bottom-hole pressures in wells. Fundamentals of Gas flow in porous media: Steady state flow equations. Definition of pseudo-pressure function. Gas flow in cylindrical reservoirs: general equation for radial flow of gases in symmetrical homogeneous reservoirs. UNIT V Non-dimensional forms of the equation; derivation of coefficients relation dimensionless to real variables. Infinite reservoir solution: Pseudo-steady-state solution. Gas Well Deliverability Tests: Flow-after-flow tests: prediction of IPR curve and AOF for the well. Isochronal tests. Draw down tests: need for data at two flow rates.	

Outcomes

- Understand the properties of natural gas.
- Apply different measures in the recognition of reservoir performance.
- Understand and apply flow behavior of gas in production tubing
- Conversant with different methods of processing of gas
- Understand and apply gas compression fundamentals
- Conversant with the system of gathering stations, modes of transportation and problems associated.

Books:

- Katz D.L.et al., Natural Gas Engineering (Production & storage), McGraw-Hill, Singapore.
- Bahaduri Alireza, 2014, Natural Gas Processing: Theory and Engineering Design, Gulf Publishing Company, 872 pp.
- Boyun Guo and AIi Ghalambor, 2005, Natural Gas Engineering Handbook, Gulf Publishing Company, 456 pp.
- Lyons Williams, Working Guide to Petroleum and Natural Gas Engineering, Gulf Publishing Company, 316 pp.
- Ikoku, Chi, 1948, “Natural Gas Production Engineering”, John Wiley and Sons, 1948.
- Kumar Sanjay, 1987,“Gas Production Engineering”, Gulf Publishing Company, TX, USA,
- Lee, J, Wattenbarger, R. A., “Gas Reservoir Engineering”, Society of Petroleum Engineers, TX, USA, 1996.
- Wang Xialu and Economides Michael, 2009, Advanced Natural Gas Engineering, Gulf Publishing Company, 400 pp.

Elective: 8

Course Title: Project Finance and Management
Course Code: PTE 821
Course Duration: One semester
Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: Yes

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.

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

SN	Topic	No. of Lectures
PTE 821	Unit I: Characteristics of Oil and Gas Projects, and communication Oil and gas projects: an overview, their characteristics, components, Major pipeline network in the world, trade movement. Project planning, Unit II: PERT- CPM Activity network, Critical Path Method, rules and examples, PERT formula and examples, work rate analysis, drag efficient, learning curve analysis. Unit III: Decision Tools for Project Management in the Oil and Gas Industry Process mapping, learning principles, KAIZEN, different models, operational efficiency, decision analysis Unit IV: Project Schedule Forecast, Execution and Control ,Objectives, Monitoring and Improving the Plan, time management, field development projects, different components of development, field installation and testing, Unit V: Engineering Economics for Oil and Gas ,Time value of money, cost elements and management, project cost estimation, portfolio management, economic parameters, and scenario development for cost estimation Unit VI:	48

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

Outcomes:

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

Books:

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

Elective: 9

Course Title: TOTAL QUALITY MANAGEMENT
Course Code: PTE 822
Course Duration: One semester
Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: Yes

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.

Objective: The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

SN	Topic	No. of Lectures
PTE 822	UNIT I Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality. UNIT II TQM PRINCIPLES :Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating. UNIT III TQM TOOLS AND TECHNIQUES I :The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types. UNIT IV TQM TOOLS AND TECHNIQUES II: Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures. UNIT V QUALITY SYSTEMS: Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..	48

Outcomes:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

Books:

- Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).

Elective: 10

Course Title: Reservoir simulation
Course Code: PTE 823
Course Duration: One semester
Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: Yes

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.

Objective:

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

SN	Topic	No. of Lectures
PTE 823	**Unit I: Simulation-I** Introduction and overview; need for reservoir simulation; selecting reservoir rock and fluid properties data; reservoir model components, discretization concepts – temporal and spatial discretization; time steps and grids. **Unit II: Simulation-II** Introduction; 1D, 2D and 3D type models, derivation of diffusivity equations; derivation of flow equations; Taylor series; forward, backward and central difference; finite difference techniques; error terms, time and space derivatives. **Unit-III: Simulation-III** Implicit and explicit formulation of difference equations; stability, convergence and consistency; Dirichlet and Neumann conditions; discretization of diffusivity equation, definition of transmissibility and flow coefficients; numerical approximations. **Unit-IV: Simulation-IV** Review of relative permeability and capillary pressure fundamentals; introduction to IMPES method, assumptions of IMPES method;	48

Outcomes:

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

Books:

- G.F. Froment, K.B. Bischoff, "Chemical Reactor Analysis and Design", 2nd ed., John Wiley, New York, 1990.
- O. Levenspiel, "Chemical Reaction Engineering", 3rd edition, Wiley Singapore, 2000. Abou-Kassem, J.H., Farouq Ai, S.M., Islam, M.R.2006, Petroleum Reservoir
- Simulation – A Basic Approach, Gulf Publishing Company,
- Holstein E (Editor), 2007, Reservoir Engineering and Petrophysics, Petroleum Engineering Handbook, Volume III, 1659 pp
- Khalid Aziz and Antonin Settari, 2006, Petroleum Reservoir Simulation, Applied Science Publisher, London, 476 pp.
- Mattax, Dalton, 1990“Reservoir Simulation”, SPE Series, USA, 148 pp.

Elective: 11

Course Title: Field development plan
Course Code: PTE 824
Course Duration: One semester
Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: Yes

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.

Objective: To impart knowledge on the stages in the development of an oil/gas field, exploration study, data analysis, identification and development of oil field, the methods to be followed for sustained and optimal production, risk and economic factors to be analyzed.

SN	Topic	No. of Lectures
PTE 824	UNIT I: Production field: Age of producing field - Stages of exploration delineation and development phases - Exploration stage – wild eat and exploratory wells. Resource and reserve estimation. Concepts and methods. UNIT II: Analysis of exploration: Analysis of exploratory results - Delineation of field - Exploratory step-out and step-in well test analysis - Reservoir performance - Review of maps and modifications. UNIT III: Data Analysis Development stage - Reservoir data analysis - Facies Changes of reservoirs data analysis. Facies changes of reservoirs and delineation of depositional environments - Seismic stratigraphy and reinterpretation. Well production and field performance. UNIT IV: Preparation of development plan - Reservoir characterization - Compartmentalization of reservoirs – faults. Identification - Identification of in-full wells - Recovery methods and identification. UNIT V: Production logging, interpretation of time lapse seismic data, fluid movement identification, cluster and multilateral drilling, Risk analysis, break even economics, Finalization of plan, Abandonment of plans.	48

Outcomes:

- Produce a field development plan/ design for an energy system
- Understand the application of remote sensing and satellite imaging/maps to petroleum Engineering in terms of design and analysis.

Books:

- Rene Cosse, "Basics of Reservoir Engineering - Oil & Gas Field Development Techniques", Editions Technip, 1993

Elective: 12

Course Title: Unconventional Resources of hydrocarbon
Course Code: PTE 826
Course Duration: One semester
Marks (University Exam): 100 marks (total)
Progressive Assessment: 50 marks
Practical: Yes
Time of examination: 2 hours and 30 mins
Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.
Objective: To give comprehensive view of unconventional oil and gas resources and their exploration. Also to understand the place of oil and gas in the domestic and international energy landscape and debate the future of oil and natural gas in the world economy.

SN	Topic	No. of Lectures
PTE 826	UNIT I: Definition of unconventional hydrocarbons – shale gas, coal bed methane, gas hydrates, heavy oil, oil shale's, CBM UNIT II: Heavy oil – origin, properties, occurrence, geology, exploration and evaluation, development and production of unconventional oil, thermal and non-thermal recovery methods. UNIT III: Shale gas, basin centered gas and coal bed methane-origin, occurrence and geology, evaluation and exploration UNIT IV: Production and development of non-conventional gas, Design for Hydro fracturing and fracking, well operation, production equipment's, water disposal, Horizontal wells. UNIT V: Gas hydrates – origin and occurrence. Drilling and completion of wells, gas extraction from gas hydrates. Environmental consideration	48

	of unconventional of oil and gas. Economics of development.	

Outcomes:

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

Books:

- Carrol John, "Natural gas hydrates: A guide for engineers", Gulf Publications, 4th edition, 2003.
- SmithJ.M, " Chemical Engineering Kinetics", McGraw-Hill, 5th edition, 2002
- Warner HR, "Emerging and Peripheral Technologies in Petroleum Engineering", vol VI, 6th edition, 2007.
- FoglerH.S., "Elements of Chemical Reaction Engineering", Prentice Hall of India, 3rd edition, 1998.
- Farooai Ali Jones S A, Ansmeldau RF, "Practical heavy oil recovery", 2nd edition, 1997.

Module	Learning units	Total Hours
1	1.1 History of Fuels 1.1.1 History of solid fuel 1.1.2 History of liquid fuels and gaseous fuels 1.2 Production, present scenario and consumption pattern of fuels 1.3 Fundamental definitions, properties and various measurements 1.3.1 Definitions and properties of solid fuels 1.3.2 Definitions and properties of liquid and gaseous fuels 1.3.3 Various measurement techniques	2 1 3
2	2.1 Coal classification, composition and basis 2. 2 Coal mining 2.3 Coal preparation and washing 2.4 Combustion of coal and coke making	1 1 1 3

	2.4.1 Action of heat on different coal samples 2.4.2 Different types of coal combustion techniques 2.4.3 Coal tar distillation 2.5 Coal liquefaction 2.5.1 Direct liquefaction 2.5.2 Indirect liquefaction 2.6 Coal gasification	 2 1
3	3.1 Exploration of crude petroleum 3.2 Evaluation of crude 3.3 Distillation 3.3.1 Atmospheric distillation 3.3.2 Vacuum distillation 3.4 Secondary processing 3.4.1 Cracking 3.4.1.1 Thermal cracking, Visbreaking 3.4.1.2 Coking 3.4.1.3 Catalytic cracking 3.4.3 Reforming of naphtha 3.4.4 Hydrotreatment, dewaxing, deasphalting 3.5 Refinery equipments	 1 1 2 3 1 1 1
4	4.1 Natural gas and LPG 4.3 Producer gas 4.4 Water gas 4.4 Hydrogen 4.5 Acetylene 4.6 Other fuel gases	1 1 1 1 1 1
5	5.1 Fundamentals of thermochemistry 5.2 Combustion air calculation 5.3 Calculation of calorific value of fuels 5.4 Adiabatic flame temperature calculation 5.5 Mechanism and kinetics of combustion 5.6 Flame properties 5.7 Combustion burners 5.8 Combustion furnaces 5.9 Internal combustion engines	1 1 1 1 1 1 1 1 1

Elective: 13

Course Title: Transport phenomena
Course Code: PTE 827
Course Duration: One semester
Marks (University Exam): 100 marks (total)

Progressive Assessment: 50 marks

Practical: Yes

Time of examination: 2 hours and 30 mins

Note for Examiner: The course schedule includes 3 lectures, and 1 tutorial.

Objective: To develop understanding of basic principle involved in transporting of oil/gas and their applicability in the industry for designing a systems.

SN	Topic	No. of Lectures
PTE 827	UNIT - 1 Viscosity and Mechanism of Momentum Transport: Newton's Law of Viscosity; Non-Newtonian fluids; The Bingham model; The power law model; The Elli's model and the Reiner Philipp off model; Temperature and pressure dependents of viscosity. Velocity Distributions in Laminar Flow: Shell momentum balances; Boundary conditions; Flow of a falling film; flow through a circular tube; flow through annulus. UNIT - 2 Equation of change for Isothermal Systems: Equations of continuity and motion in Cartesian and curvilinear co-ordinates; Use of the equations of change to set-up steady flow problems. Tangential annular flow of Newtonian fluid; Shape of surface of a rotating liquid. Velocity Distributions with more than One independent variable: Unsteady viscous flow; Flow near a wall suddenly set in motion. UNIT - 3	48

	Interphase Transport in Isothermal Systems: Definition of fraction factors; Friction factors for flow in tubes; for around spheres. Thermal Conductivity and Mechanism of Energy Transport: Fourier's law of heat conduction; temperature and pressure dependence of thermal conductivity in gases and liquids. UNIT - 4 Equations of change for Non-Isothermal Systems: Use of equations of energy and equations of motion (for forced and free convection) in non- isothermal flow; Tangential flow in an annulus with viscous heat generation; steady flow of a non-isothermal film; Transpiration cooling. Temperature Distributions with more than One Independent Variable: Unsteady heat conduction in solids; Heating of a semi-infinite slab. UNIT - 5 Interphase transport in Non-Isothermal Systems: Definition of heat transfer coefficient; Heat transfer coefficients for forced convection in tubes; for forced convection around submerged objects. Diffusivity and the mechanism of mass transport: Definition of concentrations; Velocity and mass fluxes; Fick's law of diffusion; Temperature and pressure dependence of mass diffusivity.	

Outcome: Students will have understanding on transportation techniques and the auxiliary equipment's involved in the transportation process.

Books:

- Bird R.B., Stewart W.E. and Light Foot E.N. Transport Phenomena, John Wiley International – 2nd Edition New York, (2002).
- Christie J. Geankoplis, Transport Processes and Unit Operations, Pentice Hall of India Pvt. Ltd., New Delhi, 1997.

PETROLEUM TESTING LABORATORY

Objective:

On completion of the course, the students should be conversant with the theoretical principles and experimental procedures for quantitative estimation.

List of Experiments:

- Aromatics content Determination

- Carbon residue determination
- Karl-Fisher Conductometer Apparatus for water estimation
- Foaming characteristics of tube oil
- Mercaptan as sulphur estimation
- Corrosion testing of petroleum oils and copper
- Freezing point of Aqueous Engine coolant solution
- Automatic Vacuumed Distillation
- Characteristics of Hydrocarbon types in Petroleum products
- Coking tendency of oil
- Saybolt color of petroleum products
- Water separately of Petroleum products.

Outcomes:
Students would be able to understand basic principles involved in testing of Petroleum products by different techniques.

List of Equipment's:
- Conradson Apparatus 2
- Karl –Fisher 2
- Dr. Test Apparatus 2
- Bomb Calorimeter 2
- API Distillation Apparatus 2
- Junkers Gas Calorimeter 2
- Abbey Refractometer 2
- Mercaptain as sulphur Estimation Apparatus
- Kinematic viscosity test apparatus (Viscometer bath, Cannon Fenske Viscometer glass U tubes)
- Conradson Carbon residue apparatus
- Smoke point apparatus
- Cloud and pour point apparatus. ASTM distillation of apparatus

HEAT TRANSFER LABORATORY

Objective:
To train the students on different types of heat transfer equipment's.

Lis of Experiments:
- Thermal conductivity of Insulating Powder
- Double Pipe Heat Exchanger

- Thermal conductivity of Insulating Liquid
- Stephen Boltzmann
- Heat Transfer through Composite Wall
- Shell and Tube Heat Exchanger apparatus
- Pool boiling apparatus
- Drop wise and film wise condensation

Outcomes:

Student should be able to calculate heat transfer by conduction, different types of convection using classical models for these phenomena.

List of Equipment's:

- Thermal conductivity of Insulating Powder apparatus
- Double Pipe Heat Exchanger
- Thermal conductivity of Insulating Liquid apparatus.
- Stephen Boltzmann Apparatus
- Heat Transfer through Composite Wall apparatus
- Shell and Tube Heat Exchanger apparatus
- Pool boiling apparatus
- Drop wise and film wise condensation apparatus

GEOLOGY LABORATORY

Objective:

To demonstrate various methods involved in the preparation of structural maps and interpretation and calculation the thickness of the beds, studying depositional environment using grain size analysis and find out sediment types using Sand – Silt – Clay ratio.

List of Experiments:

- Calculation of True and Apparent Dip.
- Estimation of Thickness, Distance and Depth of the ore body.
- Estimation of Throw and Nature of the fault.
- Interpretation of surface Geology using contour maps.
- Sand – Silt – Clay ratio estimation.
- Grain – Size analysis.
- Identification of important sedimentary rocks in hand specimen.
- Identification of important sedimentary rocks in microscopic level

Outcome:

Students will be able to understand the preparation of Geological maps and identify the rock specimens by Megascopic and Microscopic, Identify the Depositional environment and Sediment types.

List of Equipment's:

- Sieve Shakers
- Sieves set.
- Petrological Microscopes
- 1000 ml and 50 ml beakers

DRILLING FLUIDS LABORATORY

Objectives:

To demonstrate the processes involved in drilling operations, introduce laboratory techniques which are used to select and optimize drilling fluids and to develop interest in experimentation.

List of experiments:

- To prepare the mud sample with given bentonite and fresh water.
- To determine the Marsh Funnel Viscosity of given mud sample.
- To determine the pH of a given mud sample
- To determine the gel strength of a mud sample.
- To determine the sand content of drilling fluid.
- To determine the Filtration Loss & Cake Thickness of given mud sample.
- To determine the Mud Density of given mud.
- To determine the Apparent Viscosity, Plastic Viscosity, Yield Point & True Yield Point of given mud

Outcome:

Students able to understand the drilling fluid equipment, Principles and operation and oil well properties.

List of Equipment's:

- Mud Mixer
- Marsh funnel
- Filter press, low pressure – Low temperature and high temperature filters
- PH meter
- Sand content kit
- Hydrometer
- Mud resistivity meter

- 1000 ml and 50 ml beakers
- Weight Machine.

GEOPHYSICS LABORATORY

Objectives:

To demonstrate the processes involved in geophysical operations, introduce laboratory techniques which are used to select and optimize geological interpretation and to develop interest in experimentation.

List of experiments:

- Study of simple seismic section
- Study of resistivity meter, gravimeter, and magnetometer.
- Preparation of different subsurface maps
- Geological data analysis.
- Exercises based on subsurface geological and geophysical data.
- Determination of total porosity and interconnected porosity and permeability.

Outcome:

- Students able to understand the geophysical equipment, Principles and operation and rock properties by analyzing geological data's.

List of Equipment's:

- Different Seismic section
- Geological data (gravity, magnetic data etc.)