

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – I Semester

ADVANCED NUMERICAL METHODS AND APPLIED STATISTICS

Unit-I: Numerical Integration and Differentiation

Newton-Cotes Integration Formulas: The Trapezoidal rule, Simpson's rules, Integration with unequal Segments, Open Integration Formulas, Multiple Integrals.

Integration of Equations: Newton-Cotes Algorithms for Equations, Romberg Integration, Adaptive Quadrature, Gauss Quadrature, Improper Integrals.

Numerical Differentiation: High-Accuracy Differentiation Formulas, Richardson Extrapolation, Derivatives of Unequally Spaced Data, Derivatives and Integrals for Data with Errors, Partial Derivatives, Numerical Integration/Differentiation with Software Packages.

Unit-II: Ordinary Differential Equations

Explicit and Implicit Forms of Difference Equations, Taylor's and Euler's Methods, Runge-Kutta Methods, Systems of Equations, Adaptive Runge-Kutta Methods, Stiffness of ODEs & Multi step methods, Gear's Algorithm, Finite Difference Technique for Boundary Value Problems (BVP), derivative boundary conditions, convergence and stability of finite difference schemes.

Unit-III: Partial Differential Equations

Finite Difference Approximations.

Finite difference methods – Elliptic equations: Laplace equation, Solution Technique, Boundary Conditions, The Control-Volume Approach.

Finite Difference methods- Parabolic Equations: The Heat-Conduction Equation, Explicit Methods, A Simple Implicit Method, The Crank-Nicolson Method, Parabolic Equations in Two Spatial Dimensions.

Unit-IV: Finite element method

Finite-Element Method: The General Approach, Finite-Element Application in One Dimension Two-Dimensional Problems, Solving PDEs with Software Packages.

Unit-V: Application of Statistical Methods

Joint probability distributions, marginal distributions, conditional distribution, statistical independence.

Reliability applications: Failure rate – Failure Laws of Exponential, Normal, Weibull models, Reliability of a component - System reliability connected with parallel and series components.

Text Books:

1. "Numerical methods for engineers"; Steven C. Chapra, Raymond P. Canale; McGraw Hill higher education, 6th edition, 2010.
2. "Probability and Statistics for Engineers and Scientists"; Ronald E. Walpole, Sharon L. Myers and Keying Ye; Pearson, Eighth edition.

Reference books:

1. “Mathematical Methods in Chemical Engineering”; Jenson V.G. and Jeffreys G.V; Academic press, 2nd edition.
2. “Advanced Engineering Mathematics”; Erwin Kreyszig, Wiley-India publication, 8th edition.
3. “Introductory Methods of Numerical Analysis”, Sastry S.S; 4th Edition, PHI Learning Pvt. Ltd., 2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – I Semester

(PE Stream) OFFSHORE DRILLING

Unit -I

Introduction to offshore oil and gas operations:

Introduction to offshore oil and gas operations-Sea states and weather: Meteorology, Oceanography, Ice, Sea bed oil-Buoyancy and stability.

Unit -II

Offshore fixed platforms and mobile units:

Offshore fixed platforms: Types, descriptions and operations- Offshore mobile units: Types description and installation. Station keeping methods like conventional mooring and dynamic positioning system.

Unit -III

Offshore drilling and well completions:

Difference in drilling from land, from fixed platform, Jackup, ships and semi submersibles. Use of conductors and risers. Deep sea drilling, Platforms and subsea completions, Deep water applications off subsea technology.

Unit IV

Advanced Drilling Techniques:

Direction drilling-Applications, Horizontal wells, MWD, LWD and ERD wells drilling techniques and tools.

Unit V

Deep water technology, Divers and Safety:

Introduction, Definition and prospects- Deep water regions, Deep water drilling rig- Selection and deployment, Deep water production system, Emerging deep water technologies- special equipment and system, Remote operation vessels (ROV), Principles of diving, Use of decompression chambers, life boats-Offshore environmental pollution and remedial measures.

Text books:

1. Offshore Drilling and completions Training Manual by DRIL-QUIP,INC.
2. Drilling Engineering Workbook, Baker Hughes Inteq,1995.

Reference books:

1. Applied Drilling Engineering, Adam T. Bourgoyne Jr., Keith K. Millheim, Martine E. Chenevert and F. S. Young Jr., Society of Petroleum Engineers, 1991
2. Well Engineering and Construction, HussainRabia, Entrac Consulting, 2002.
3. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – I Semester

(Non-PE Stream)

FUNDAMENTALS OF PETROLEUM GEOLOGY & RESERVOIR ENGINEERING

Petroleum Geology:

Unit-I:

Source Rocks: Definition of source rock. Organic rich sediments as source rocks. Nature and type of source rocks - Claystone / shale. The process of diagenesis, catagenesis and metagenesis in the formation of source rocks. Evaluation of petroleum source rock potential. Limestone as source rocks.

Reservoir Rocks: Characteristics of Reservoir rocks – classification and nomenclature: Clastic Reservoir Rocks, Carbonate Reservoir Rocks, Unconventional, fractured and miscellaneous reservoir rocks. Marine and non-marine reservoir rocks.

Reservoir Properties and Cap Rocks: Reservoir pore space - porosity – primary and secondary porosity, Effective porosity, fracture porosity - permeability – effective and relative permeability relationship between porosity, permeability and texture. Cap rocks: Definition and characteristics.

Unit-II:

Hydrocarbon migration: Geological framework of migration and accumulation. The concept of hydrocarbon migration from source beds to the carrier beds - Carrier beds to the reservoir - Free-path ways for migration - Short distance and long distance migration.

Entrapment of hydrocarbons

Entrapment and accumulation of hydrocarbons - Classification and types of traps: Structural, stratigraphic and combination type of traps.

Sedimentary Basins: Sedimentary basins -origin and classification. Types of basins and their relationship to hydrocarbon prospects. Hydrocarbon accumulations of the following basins: Krishna-Godavari basin, Cambay basin and Mumbai off-shore.

Petroleum Reservoir Engineering:

Unit-III

Some basic concepts in reservoir engineering: Calculation of hydrocarbon volumes- Fluid pressure regimes- Oil recovery and recovery factor-Volumetric gas reservoir engineering – Application of the real gas equation of state - Gas material balance and recovery factor- Hydrocarbon phase behavior.

Material balance applied to oil reservoirs: General form -The material balance expressed as a linear equation- Reservoir drive mechanism- Solution gas drive- Gas cap drive- Natural water drive- compaction drive under related pore compressibility phenomena.

Unit-IV

Darcy's law and applications: Darcy's law and field potential- Sign convention- Units and units conversion- Real gas potential – Datum pressures- Radial steady state flow and well stimulation- Two phase flow- Effective and relative permeabilities.

Unit-V

The basic differential equation for radial flow in a porous medium- Derivation of the basic radial differential equation – Conditions of solution – The linearization of the equation for fluids of small and constant compressibility.

Text Books:

1. Geology of Petroleum, Levorsen, A.I., 2nd Edition, CBS Publishers, 2006.
2. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17th Impression 1998).

Reference Books:

1. Richard, C. Selley, Elements of Petroleum Geology, Elsevier, 1997.
2. Sedimentary basins of India- ONGC bulleting
3. CainengZou et al., Unconventional Petroleum Geology, Elsevier, 2013.
4. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing, 2006.
5. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman Inc. 1986.
6. Basic Reservoir Engineering, Rene Cosse, Editions Technip, 1993.
7. Petroleum Reservoir Engineering, James W Amyx, Daniel M. Bass Jr., Robert L. Whiting, McGraw Hill, 1960.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – I Semester

(PE Stream) WELL STIMULATION

Unit-I

Properties of Formation Materials and Treatment fluids:

Properties of Formation Materials and Treatment fluids-Chemical Properties of Oil-bearing formations and reservoir fluids-Physical properties of Formation Materials, Chemical and Mechanical Properties of Injected fluids.

Unit-II

Formation Damage:

Formation Damage-The origins of Formation Damage-Pretreatment Well Tests-Perforating Methods: Perforations.

Unit-III

Hydraulic Fracturing:

Hydraulic Fracturing -Dynamic Fracture Geometry-Fracture fluid temperature-Final fracture conductivity-Well productivity of fractured systems.

Unit -IV

Matrix acidizing and acidizing methods:

Acid Reaction Rates and matrix acidizing: Acidizing Methods-Rates of Acid Reactions with reservoir minerals-Sandstone Matrix Acidizing Theory-Design Considerations in Matrix Acidizing of Sand Stones.

Unit-V

Fundamentals and design of Matrix Acidizing of Carbonates Acid Additives:

Fundamentals and design of Matrix Acidizing of Carbonates Acid Additives-Sand control Methods: Gravel packing and consolidation Techniques: Sand control.

Text books:

1. Oil well stimulation, Robert S. Schechter, Prentice Hall, 1992.
2. Reservoir Stimulation, Michael J. Economides, Kenneth G. Nolte, 2nd Edition, Prentice Hall, 1989.

Reference Book:

1. Modern Fracturing Enhancing Natural Gas Production, Michael J. Economides, Tony Martin, ET Publishing, 2007

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – I Semester

(Non-PE Stream)

PETROLEUM WELL DRILLING & PRODUCTION ENGINEERING

Drilling:

Unit-I

Overview of drilling: Drilling Planning Approaches- Drilling team- Types of drilling. Rotary bit technology- Drilling string basics.

Drilling fluids and hydraulics: Drilling fluid economics- Drilling fluid properties- Drilling fluid report hydraulics calculations- Bit Hydraulics- Lost circulation.

Unit-II

Casing & cementation: Casing standards- Casing coupling- Cementing: Introduction cement slurries-Typical field calculations- Cementing nomenclature- Cement additives- Casing & cementing analysis report.

Stuck pipe, well control: Kicks- Kick control- Pressure control theory- BOP-Special kick problems and procedures to free the pipes and Fishing operations.

Driller's logs: Sample logs- Miscellaneous logging devices.

Production Engineering

Unit-III

Reservoir considerations - the flow of fluids into the wellbore. The concept of Productivity Index (PI) and the Inflow Performance Relationships (IPR) for oil and gas wells. Use of radial flow equation to define PI, and the factors affecting the shape of IPR curves. Use of generalized pressure functions. Transient IPR curves.

Unit-IV

Well performance prediction with reservoir pressure depletion and changes in gas oil ratio. Basic concept of single and multi-phase fluid flow in pipes. Vertical and inclined flow in oil and gas wells- energy and pressure losses, flow regime, correlation's and computational methods. Gas condensate wells.

Unit-V

Nodal Analysis: Introduction to Nodal Analysis. Performance prediction and surface pressure optimization. Evaluation of Choke performance for gas and multiphase flow. Determination of well deliverability for oil and gas wells.

Text Books

1. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.
2. Working Guide to Drilling Equipment and Operations, William Lyons, Gulf Publishing, 2009.
3. Petroleum Production Engineering: A computer Assisted Approach, BoyunGuo, William C. Lyons, Ali Ghalambor, Elsevier Science & Technology Books, 2007.

4. Petroleum Production Systems, M. J. Economides, A. Daniel Hill & C. E. Economides, Prentice-Hall, N. J – 07488, 1994.

Reference Books:

1. Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc., 1960
2. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie Charrier Pennwell, 1985.
3. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.
4. Primer of Oil Well Service, Workover and Completion, Petroleum Extension Service, University of Texas at Austin, 1997.
5. Formulas and Calculation for Drilling, Production and workover, Norton J. Lapeyrouse, 2nd Edition, Gulf Publishing, 2002.
6. Applied Drilling Engineering, Adam T. Bourgoyne Jr., Keith K. Millheim, Martine E. Chenevert and F. S. Young Jr., Society of Petroleum Engineers, 1991.
7. Well Engineering and Construction, Hussain Rabia, Entrac Consulting, 2002.
8. Drilling Fluids Processing Handbook, ASME Shale Shaker Committee, Gulf Professional Publishing, 2005.
9. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011.
10. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – I Semester

TRANSPORTATION OF OIL AND GAS

Unit-I

Physical and Transport properties: Physical and transport properties of crude oil, Petroleum liquids and Natural gas.

Unit-II

Modes of crude oil, hydrocarbon liquids and gas transportation: Tank-Trucks and Rail Transportation, Oceanic Tanker Transportation, Inland Water, Coastal and Oceanic, Tanker Size, Power, Cargo Space, Marine Storage Terminals, Shore Installation.

Unit-III

Pipeline transportation of oil: Crude oil and product flow characteristics, heat flux estimation, temperature gradient in flowing fluid in exposed and buried pipeline, insulation types and thickness, rheology and non-newtonian behavior. Pressure waves, water hammer; Slug transportation; Leaks and ruptures in pipelines; Isothermal oil transport; Non-isothermal oil transport; Methods of improving flow characteristics. Computer simulations.

Wax and Asphaltenes: Wax; Wax Management; Wax Remediation; Asphaltenes; Asphaltene Control; Design Philosophies.

Unit-IV

Pipeline transportation of Natural gas: Temperature of flowing gases; Steady state flow & Transient flow in pipeline systems; Computer simulation of the flow in pipeline system.

Unit-V

Subsea system engineering; Flow assurance challenges; flow assurance concerns; typical flow assurance process; fluid characterization and property assessments; steady-state hydraulic and thermal performance analyses; transient flow hydraulic and thermal performances analyses; system design and operability.

Heat Transfer and Thermal Insulation: Heat Transfer Fundamentals; U-Value; Steady-State Heat Transfer; Transient Heat Transfer; optimum insulation thickness calculations. Thermal Management Strategy.

Hydrates: Physics and Phase Behavior; Hydrate Prevention; Hydrate Remediation; Hydrate Control Design Philosophies.

Text Books:

1. Production and transport of oil and gas (part B: gathering and transport); Szilas A.P; 2nd Edition, Elsevier publications, 1986.
2. Subsea Engineering Handbook; Yong Bai., Qiang Bai; Gulf Professional Publishing; Elsevier., 2012

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech (Petroleum Engineering) – I Semester

ADVANCED EOR TECHNIQUES FOR FIELD DEVELOPMENTS

Unit-I

Reserves Estimation and Recovery methods:

Introduction to Reserves estimation and Characterization, Brief description of IOR & EOR- Primary and Secondary Recovery Techniques, Advanced Classification of EOR techniques and their Screening Selection and evaluation of process, Methodology, Simulation sensitivity and decision analysis.

Unit-II

Thermal Recovery Methods:

Steam Injection: Method and its effect on reservoir field development using steam Injection method.

In-situ Combustion: Method and its effect on reservoir field development using In-situ combustion method.

Unit-III

Chemical Methods:

Polymer Flooding: Method and its effect on reservoir field development using Polymer Flooding method, Micellar Polymer Flooding.

Alkaline Flooding: Method and its effect on reservoir field development using Alkaline Flooding method, Miscible fluid displacement.

Solvent Flooding: Method and its effect on reservoir field development using Solvent Flooding method.

Unit-IV

Other Methods:

CO₂Flooding Method and its effect on reservoir field development using CO₂Flooding method, Microbial and Electro thermal EOR Process.

Unit-V

Regulations and economics of advanced EOR Techniques:

Reservoir Development planning using advanced EOR techniques Regulations, Public opinion, economics, Case studies of some advanced EOR techniques, Current status of various advanced EOR techniques-offshore vs. onshore.

Text Books:

1. Applied Enhanced oil Recovery, Aurel Carcoana, Prentice Hall, 1992.
2. Enhanced oil Recovery-field planning and development strategies, Vladimir Alvarado, Eduardo Manrique, Gulf Professional Publishing, 2010.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – I Semester

PROJECT MANAGEMENT

Unit-I

Project Management & Project Initiation Techniques:

Projects-Project Management-Organizing Project Management-Implementing a computer-Software selection-Project initiation Techniques-Breakdown structures-Project life cycles.

Unit-II

Scheduling: Scheduling-critical path scheduling-critical path chain and uncertainty-Estimating task duration schedules-Time compression-Practical scheduling.

Unit-III

Resources Management and Budgeting:

Different elements of resource management-Role based needs-Resource leveling-Practical Resource Scheduling-Concepts of budgeting and Cost Control Software for Cost Management.

Unit-IV

Risk Management and Maintaining the Plan, Performance Measurement:

Managing contingency-Risk management-Managing schedule cost and Technical Risk and Contingency, Computer bar approaches to schedule risk analysis-Maintaining the Plan, Change control and scope management, Real time status vs Period data, Automatic project management, Measuring the value of work accomplishment.

Unit-V

Project Portfolio Management, Project Management, Enterprise Project Management and Enterprise Resource Planning: Defining and implementing project portfolio management-Bridging the gap between operations management, project management: The important role of project portfolio management, Project selection and risk, The search for automated, integrated-Integrated PM and ERP-Defining PSA market, building PSA solutions-Making project management work.

Text book:

1. Practical Project Management, Harvey A. Levine, John Wiley & Sons Inc, 2002.

Reference Books:

1. A Guide to Project Management, Frank Heyworth, Council of European Publishing, 2002.
2. Modern Project Management, Norman R. Howes, American Management Association, 2001.
3. Effective Project Management, Robert K. Wysocki and Rudd McGary, Third Edition, Wiley Publishing, Inc., 2003.

4. Project Management Made Easy, Entrepreneur Press and Sid Kemp, Entrepreneur Press, 2006.
5. Project Management Professional: Study Guide, Kim Heldman, SYBEX, Inc., 2002.
6. Project Management, Harold Kerzner, 7th Edition, John Wiley & Sons, Inc., 2001.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

I year M. Tech. Pipeline Engineering – I Sem

**ADVANCED NUMERICAL METHODS AND APPLIED STATISTICS LAB
(MATLAB BASED)**

Using MATLAB, Solving:

1. Numerical integration and differentiation problems.
2. Problems concerned with Linear & Non-Linear Algebraic Equation.
3. Different types of differential equations.
4. Different types of partial differential equations and estimations
5. Parameters of algebraic equations.

I year M. Tech. Petroleum Engineering II Semester

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

ADVANCED NATURAL GAS ENGINEERING

Unit-I

Natural Gas Basics: Natural gas origins-Accumulations- Natural gas resources-Natural gas composition and phase behavior- Review of natural gas properties.

Unique issues in natural gas exploration, Drilling and Well completion: Exploration-Drilling-Well completion.

Liquid loading on gas wells: Turners methods – Guo’s methods – Comparison of methods.

Unit-II:

Natural Gas Production: Darcy and non-Darcy flow in porous media -Gas well inflow under Darcy flow and non-Darcy flow -Horizontal gas well inflow- Hydraulic fracturing- Well deliverability.

Natural gas processing: Natural gas and liquid separation- Dehydration-Sweetening.

Natural gas transportation- Pipelines and compressed natural gas: Pipelines- Marine CNG Transportation.

Unit-III:

Hydrate control: Hydrate forming conditions – Preventing hydrate formation.

Pipeline cleaning: Pigging system – Selection of pigs – Major applications – Pigging procedure.

Liquefied Natural gas: LNG liquefaction processes- Thermodynamic analyses- C₃ MR process- Single mixed refrigerant loop process- Mixed fluid cascade process- Liqulifin™ process DMR process- LNG carriers- LNG terminals.

Unit-IV:

Gas-To-Liquids (GTL): Why GTL?- GTL processes GTL based on direct conversion of natural gas- GTL based on indirect conversion of natural gas- GTL economics.

Underground Natural gas storage: Types of underground storage- Storage measures -Losses in gas storage-Injectivity in gas storage well.

Unit-V:

Natural gas supply, alternative energy sources and the environment: Advantages of fossil fuels - Energy interchange ability Vs inflexibility-Regional gas supply potential - Alternatives to natural gas fixed electricity- Economics of electricity generation from different energy sources- Environmental impact of fossil fuels and renewable energy sources.

Text Books:

1. Advanced Natural Gas Engineering, Xiuli Wang and Michael Economides, Gulf Publishing Company, 2009.
2. Natural Gas Engineering Handbook, BojunGuo and Ali Ghalambor, Gulf publishing company, 2005.

Reference Books:

1. Handbook of Natural Gas Engineering, D.L.Katz, McGraw-Hill, 1959.
2. Natural Gas Production Engineering, Chi U. Ikoju, Krieger Publishing Company, 1992.
3. Troubleshooting Natural Gas Processing: Well head to Transmission, Norman P. Lieberman, Pennwell Publishing Company, 1997.
4. Practical Natural Gas Engineering, R.V.Smith, 2nd Edition, PennWell, 1990.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

ARTIFICIAL LIFT TECHNIQUES

Unit-I

Introduction: Definition and Purpose of artificial lift selection-Reservoir pressure and well productivity-reservoir fluids-Types of artificial lift.

Unit-II

Sucker Rod lift: Sucker rod lift system-polished rod motion-load to the pumping unit-pump deliverability and power requirement-sucker rods-steel sucker rods-pony rods-FRP sucker rods-Non-API sucker rods-criteria for rod string design, advantages and limitations-Trouble shooting sucker rod lift installation.

Unit-III

Gas lift: Gas lift system-gas compression requirements sonic flow-subsonic flow- volumetric efficiency-stage compression-gas lift valve design-selection of gas lift valves-pilot valve-continuous and intermittent gas lift advantages and limitations.

Unit-IV

Electrical submersible pumps, Progressive cavity pumping: Electrical submersible pumps (ESP)-principle-hydraulic piston pumping-ESP design-ESP advantages and limitations. Progressive cavity pumping: Plunger lift-working principle-design-plunger lift models-progressive cavity pumping (PCP) advantages and limitations.

Unit -V

Hydraulic Jet pumping: Hydraulic Jet pumping-selection of jet pump-advantages and disadvantages.

Selection of artificial lift method: artificial lift method selection-gas lift vs pump assisted lift-installation and replacement of artificial lift-maintenance of artificial lift.

Textbooks:

1. Petroleum Production engineering: A computer assisted approach, Boyun GUO, William C. Lyons, Ali Ghalambor, Elsevier Science and Technology books 2007.
3. Petroleum Engineering Handbook-Production Operations Engineering, volume 4 by Joe Dunn Clegg and Larry W. Lake, SPE.

Reference Books:

1. Petroleum production systems, M.J. Economides, A. Daniel Hill & C. E. Economides, Prentice-Hall, N.J-07488, 1994.
2. The Technology of Artificial Lift Method, Brown, K.E, Volume 1-4, Penn Well Books, Tulsa, Oklahoma, 1977.
3. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

OPERATIONAL ASPECTS OF WELL TESTING

Unit-I

Well Test Objectives & Safety Procedures: Decision to Test, Mobilizing Test equipment, Well Test planning-input Data sheet.

Safety procedures: HSE Policies, H₂S services, HAZOP studies, Dangerous substances/Handling, Daylight operations, explosives and their storage, Oil spill Contingency, Safety meetings, site preparation & start of Testing Operations.

Unit-II

Job Responsibilities during Well Testing & Specific well Test Objectives:

Test Design: Test types, Single rate oil well testing, Gas well test, Transient pressure Analysis, Artificial Lift performance Testing, Aquifer Permeability and Mobility Testing, Bare Foot Testing Slug or closed chamber Testing, Open hole Testing, Reservoir Limits Tests & Extended well tests, HP/HT testing, Stimulation Techniques, Completion fluids.

Unit-III

Perforating: All types

Downhole Test equipment, DST & Various packers, pressure Gauges: Subsea equipment.

Unit-IV

Surface Test equipment:

Surface Test equipment, Oil & Gas Metering equipment Hook up Location, Well Test Operations, Production problems.

Unit-V

Reservoir fluid Behaviour & Sampling Operations:

Gas, Oil and water – Measurements & Analysis Reporting: Final well Test Report. CTU and Nitrogen Operations, Stimulation Operations- Safety.

Text Book:

1. Operational Aspects of Oil & Gas Well Testing, Stuart McAleese, Elsevier, 2000.

Reference Books:

1. Well completion and Servicing, D.Perrin, Michealcaron, Georges Gaillot, Editions Technip, 1999.
2. Well Completion Design, Jonathan Bellarby, Elsevier, 2009.
3. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

INTEGRATED RESERVOIR MANAGEMENT

Unit-I

Introduction & Reservoir management Concepts:

Introduction to Reservoir Management-Definition-Fundamentals of Reservoir Management-Synergy and Team-Integration of Geoscience and Engineering-Integrating Exploration and Development Technology.

Unit-II

Reservoir Management Process:

Setting Goals, Developing Plan & Economics-Implementation- Survey lines and Monitoring-Evaluation-Revision of Plans Strategies-Reasons for failure of Reservoir Management Programs-Reservoir Management Case studies.

Unit-III

Data Acquisition, Analysis and Management and Reservoir Model:

Data Types-Data Acquisition and Analysis-Data Validation-Data Storing and Retrieval-Data Application-Example Data-Role of Reservoir Model: Geoscience-Seismic Data-Geostatistics, Engineering, Integration and Case Studies.

Unit-IV

Reservoir Performance Analysis and Forecast and Economics:

Natural Producing Mechanisms, Reservoirs-Volumetric, Decline Curve and Material Balance Method-Mathematical Simulation-Economics: Economic Criteria-Scenarios-Data-Economic Evaluation-Risk and Uncertainties-Economic Optimization Example.

Unit-V

Reservoir Management case studies, Plans, Importance and Current Challenges:

North ward Estes Field and Columbus Gray lease-McAllen Ranch Field-Brassey Oil Field-Means San Andres Unit-Teak Field and Esso Malaysia Fields-Reservoir Management Plans: Newly Discovered Field-Secondary and EOR Operated Field-Importance of Integrated Reservoir Management-Current Challenges and Areas of Further Work.

Textbook:

1. Integrated Petroleum Reservoir Management: A Team Approach, AbdusSatter and Ganesh Thakur, Penn Well Publishing Company, 1994.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

**Elective – I:
RESERVOIR MODELING & SIMULATION**

Unit-I

Introduction: Milestones for the engineering approach-Importance of the engineering and mathematical approaches.

Single-phase fluid equations in multidimensional domain: Properties of single-phase fluid- Properties of porous media- Reservoir discretization- Basic engineering concepts- Multidimensional flow in Cartesian coordinates- Multidimensional flow in radial-cylindrical coordinates.

Unit-II

Flow equation using CVFD terminology: Introduction- Flow equations using CVFD terminology- Flow equations in radial-cylindrical coordinates using CVFD terminology- Flow equation using CVFD terminology in any block ordering scheme.

Unit-III

Simulation with a block-centered grid: Introduction- Reservoir discretization- Flow equation for boundary grid blocks- Treatment of boundary conditions- Calculation of transmissibilities- Symmetry and its use in solving practical problems.

Simulation with a point distributed grid: Introduction- Reservoir discretization- Flow equation for boundary grid points-Treatment of boundary conditions-Calculation of transmissibilities - Symmetry and its use in solving practical problems.

Unit-IV

Well representation in simulators: Introduction- Single block wells- Multi block wells- Practical considerations dealing with modeling and well conditions.

Single-phase flow equations for various fluids: Pressure dependence of fluid and rock properties-General single-phase flow equation in multi dimensions.

Unit-V

Linearization of flow equation: Introduction- Nonlinear terms in flow equations- Nonlinearity of flow equations for various fluids- Linearization of nonlinear terms- Linearized flow equations in time.

Methods of solution of linear equations: Direct solution methods- Iterative solution methods.

Text Book:

1. Petroleum Reservoir Simulation: A Basic Approach, Jamal H. Abou – Kasem, S. M. Fariuq Ali, M. Rafiq Islam, Gulf Publishing Company, 2006.

Reference Books:

1. Principles of Applied Reservoir Simulation, John R. Fanchi, Elsevier, 2005.

2. Practical Reservoir Simulation, M.R. Carlson, PennWell, 2003.
3. Reservoir Simulation: Mathematical Techniques in Oil Recovery, Zhangxin Chen, Cambridge University Press, 2008.
4. Mathematics of Reservoir Simulation, Richard E. Ewing, Society for Industrial and Applied Mathematics (SIAM), 1983.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

**Elective – I:
OPTIMIZATION OF UPSTREAM PROCESSES**

Unit-I

Introduction to Production systems modelling and optimization-Overview:

Production System Modeling: Production systems-System Modeling-Nodal Analysis.

Optimization Objective and Constraints: Economic Objectives-Environmental Objectives-Technical Objectives-Constraints-Properties of Reservoir Fluids: Fluid Properties-Pressure Temperature Phase Diagram-Equation of State-Oil Models.

Unit-II

Single Phase Flow in Wells and Pipelines:

Governing Equations-Pressure Drop Analysis-Multi Phase Flow in Wells, Pipe lines and Chokes: Flow Regimes-Slip and Holdup-Gradient Curves-Intake Pressure Curves for Describing Performance-Multi Phase flow through Chokes.

Unit-III

Inflow Performance: The importance of Inflow Performance-Governing Equations-Inflow Performance Relationship-Formation Damage and Skin-Multi Layer Inflow Performance.

Unit-IV

Oil Well Productivity: Optimizing well Productivity-Oil Well Completions-Production Rate of a Vertical Well Operating at Given Tubing Head Pressure-Production Rate of a Vertical Well Operating Through a Surface Choice-Summary of Analysis Methods.

Unit-V

Field Development: Planning and Field Management-Short Term Optimization of Well Performance-Long Term Optimization of Well Performance-Productivity of Horizontal Wells.

Textbook:

1. Modelling and Optimization of Oil and Gas Production Systems, JD Jansen & P.K. Currie, TU DELFT, 2004.

Reference Book:

1. Production Optimization using Nodal Analysis, Beggs H.D., Oil and Gas Consultants International Publications, Tulsa 1991.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

**Elective – I:
FLOW ASSURANCE**

Unit-I

Introduction to flow assurance; Pipe friction; Friction in Non-circular pipes; Friction loss in components.

Unit-II

Non-Newtonian Fluid & Friction; Transient flow; Transient flow; Simplified liquid flow solution; Heat Transfer Fundamentals; U-Value; Steady State / Transient Heat Transfer; Thermal management strategy and Insulation; Simulation Results & Program Testing.

Unit-III

Composition & properties of Hydrocarbons; Emulsion, Phase Behavior, Hydrocarbon Flow; Single, two, three & four phase regimes; conservation equations; 2 & 3 fluid models; friction, deposition & entrainment, solving two-phase three fluid equations; gas & Liquid slug including boiling & condensation.

Unit-IV:Hydraulics

Two Phase Liquid-Liquid Flow; Two Phase Liquid-Gas Flow, Two Phase Liquid-Solid Flow; Three Phase Gas-Liquid-Liquid Flow; Three phase Gas-Liquid-Solid Flow

Unit-V:Hydrates, Wax & Asphaltenes

Physics & Phase Behavior; Hydrate Prevention; Hydrate Remediation; Hydrate Control Design Philosophies; Recovery of Thermodynamic Hydrate Inhibitors.

Wax; Wax Management; Wax remediation; Asphaltenes; Asphaltene control design philosophies

Text Books:

1. “Pipe Flow-1 Single Phase Flow Assurance” – Over Bratland (e-Book)
2. “Pipe Flow-2 Multi Phase Flow Assurance” – Over Bratland (e-Book)
3. “Subsea Engineering Handbook” – Yong Bai & Qiang Bai – Gulf Professional Publishing

Reference book:

1. “Natural Gas Hydrates in Flow Assurance” – Dendy Sloan et.al - GPP

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

Elective – II:

PROCESS SAFETY AND ENVIRONMENTAL ASPECTS IN PETROLEUM INDUSTRY

Unit-I

Introduction to Process safety; Case Histories; Toxicology – Toxicological studies, Dose & Response Curves, Threshold Limit Values (TLV)

Industrial Hygiene - Government Regulations, OSHA / EPA guidelines, MSDS, Evaluation & Control.

Unit-II

Source Models - Liquid & Vapor leaks (flows) through pipes & holes, Flashing liquids, Liquid Pool Evaporation or Boiling; Realistic & Worst-case Releases; Conservative Analysis.

Toxic Release & Dispersion Models – Parameters affecting dispersion; Neutrally Buoyant Dispersion models; Dense Gas Dispersion; Toxic Effect Criteria; Effect of Release Momentum & Buoyancy; Release Mitigation.

Unit-III

Fires & Explosions – Fire Triangle, Distinction between Fire & Explosion, Definitions, Flammability Characteristics of Liquids and vapors, Inertization, Flammability Diagram, Ignition Energy, Auto Ignition; Auto Oxidation; Adiabatic Compression, Ignition Sources, Sprays and Mists, Explosions.

Designs to Prevent Fires & Explosions – Inerting, Static Electricity, Controlling Static Electricity, Area & Material Classification; Ventilation; Sprinkler systems

Unit-IV

Introduction to Reliefs – Concepts, Definitions, Locations, Types, Scenarios, Data for sizing, Relief Systems.

Relief Sizing - Conventional Spring loaded valves for Gas & Liquid Service, Rupture Discs for Gas & Liquid Services, Two-Phase flow during runaway reaction relief, deflagration venting for explosions, Reliefs for Thermal Expansion.

Hazard Identification – Process Hazard Check lists, Hazard Surveys, Hazard & Operability studies, Safety Reviews.

Unit-V

Risk Assessment –Review of Probability study, Event trees, fault trees, QRA, LPOA

Accident Investigations – Learnings, Investigation Processes, Reporting, Diagnosis Tools, Aids for recommendations.

Introduction to Environmental Control in petroleum Industry, Environmental impacts in Drilling & production, Environmental regulations

Text Books:

1. “Chemical Process Safety – Fundamentals with Applications” - 2nd Edition by Daniel A. Crowl and Joseph F. Louvar – Prentice Hall International Series, 2002.

2. Process Safety, Perry's Chemical Engineering Handbook, 8th Edition (Section-23), 2007
3. Environmental Control in Petroleum Engineering, John C. Reis, Gulf Publishing Company, 1996.

Reference Books:

1. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, 1995.
2. Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety, Wiley-AIChE, 3rd Edition, 2008.
3. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.
4. Environmental Analysis and Technology for the Refining Industry, James G Speight, John Wiley & Sons, Inc., Publication, 2005.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

Elective – II: DEEP WATER TECHNOLOGY

Unit-I

Introduction: Definition, Global Deep water reserves & development activity. Technological advances. Dynamics of Offshore structure: Analysis of waves and fluid induced forces on offshore structures, Current and wind forces, Soil mechanics of seabed & structures.

Unit-II

Deep-water Exploration & Drilling: Siesmic /Seabed survey, constraints in Deepwater survey like geo-hazards, gas hydrate etc., Deep water Drilling with emphasis on the additional inputs to normal offshore Drilling operation.

Unit-III

Deep-water Production System: Fixed Platforms, Compliant Towers, Subsea systems, Extended Reach Wells, Floating production systems like FPSOs, FPSSs, TLPSs, Spar platform and FSOs.

Unit-IV

Deep-water applications of Subsea Technology: Subsea completion, X-mas tree, Control systems, Manifolds, Templates, ROVs, Deepwater installation vessels with DP system and associated problems.

Unit-V

Deep-water pipelines, Umbilicals& Emerging Deep-water Technologies:

Issues in Deep-water pipeline design, Rigid and Flexible flowlines, pipe-in-pipe, Deep-water Risers and their configurations, Pipeline installation methods, Umbilicals-functions, configurations and installation, Flow assurance strategies. Innovative Floating production concepts, Subsea processing, Subsea separation and any new innovations.

Textbooks:

1. Subsea Engineering Handbook, Yong bai and Qiangbai, Gulf Professional Publishing, 2012.
2. Manual on Subsea Technology by IOGPT, ONGC.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

Elective – II: CHARACTERIZATION OF PETROLEUM OILS

Unit-I

Characterization and Properties of Pure Hydrocarbons:

Definition of Pure Components; Characterization of Hydrocarbons; Prediction of Molecular Wt. / Boiling Point / Specific Gravity; Prediction of Critical Properties and Acentric Factor; Prediction of Density/CH ratio/RI/Freezing Point; Prediction of KV @ 38 & 99 C; Analysis & comparison of various Characterization methods.

Unit-II

Characterization of Petroleum Fractions: Experimental data on basic properties of Petroleum fractions; Prediction and Conversion of Distillation data; Prediction of properties of Petroleum fractions; General procedures for properties of mixtures; Prediction of composition of Petroleum Fractions; Prediction of other properties; Quality of Petroleum products; Minimum Laboratory data; Analysis of Laboratory data and development of predictive methods.

Unit-III

Characterization of Reservoir fluids and Crude Oil:

Specifications of Reservoir fluids and Crude Oils; Generalized correlations for Pseudo-critical properties of Natural gases and Gas Condensate systems; Characterization and properties of single carbon number groups; Characterization approaches for C₇⁺ fractions; Pseudoization and Lumping approaches; Continuous Mixture Characterization Approach; Calculation of Properties of Crude Oils and Reservoir Fluids.

Unit-IV

PVT Relations and Equations of State:

Basic definitions and Phase Rule; PVT Relations; Intermolecular forces; Equations of State; Cubic Equations of State, Non-cubic Equations of state; Corresponding state correlations; Generalized correlation for PVT properties of Liquids – Rackett Equation; RI based Equations of State.

Unit-V

Thermodynamic Relations for Property Estimation:

Definitions and Fundamental Thermodynamic Relations; Generalized correlations for calculation of Thermodynamic properties; Properties of Ideal gases; Thermodynamic properties of mixtures; Phase equilibria of Pure Components; Phase equilibria of mixtures; general methods for calculation of properties of Real mixtures; Use of velocity of sound for prediction of fluid properties.

Text Book:

1. “Characterization and Properties of Petroleum Fractions”; M R Riazi; ASTM International

Reference book:

1. “API Technical Data Book – Petroleum Refining; API – Sixth Edition.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

RESORVOIR SIMULATION LABORATORY

The students will be trained to be conversant with the software ECLIPSE Black-oil Reservoir Simulation, to model and solve reservoir engineering problems.

ECLIPSE features

- File organization and structure
- Selection of suitable by grid sensitivity studies.
- Fluid properties
- Rock properties
- Wells
- Aquifer modelling
- History matching consisting of adjusting the parameters of the model such as permeability, porosity etc. until the computed results for the historical period are close to historical data
- Prediction of properties permeability, relative permeability, saturation etc.

Software:

ECLIPSE Black-oil Reservoir Simulation.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

1st Year – M. Tech. Petroleum Engineering – II Semester

SUMMER INTERNSHIP

Each student should do summer internship in any pipeline industry (GAIL, Pipeline Divisions of HPCL, IOCL, BPCL, RIL, GSPL, Petronet etc and City Gas Distribution companies for 6-8 weeks and submit a report.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

2nd Year – M. Tech. Petroleum Engineering – I Semester

PRESENTATION OF SUMMER INTERNSHIP REPORT

Each student should make a presentation on SIP before a Committee appointed by the University. The Committee evaluates the report and presentation for 50 marks.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

2nd Year – M. Tech. Petroleum Engineering – I Semester

SEMINAR ON ADVANCED TOPICS IN PETROLEUM ENGINEERING

Each student should give a Seminar on an advanced topic before a Panel consisting of Head of the Department, a Senior Faculty and One expert from Industry . The panel adjudges the seminar presentation for 50 marks. (All the Faculty, UG and PG students of petroleum engineering should be present in the seminar. The topic of the seminar should be given to the students before the end 1st year for giving them adequate time to collect the information & data and preparing presentation for the seminar)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

2nd Year – M. Tech. Petroleum Engineering – I & II Semesters

PROJECT WORK

The Project work should be carried out in a Petroleum Industry / R & D Laboratories for I and II Semesters (minimum of 6 months) after completing presentation of SIP report and Seminar in the first week of I Semester of 2nd year. After completion of the project each student has to make a presentation, before a committee appointed by the University, in order to earn 36 credits.