JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF PETROLEUM ENGINEERING

COURSE STRUCTURE AND SYLLABUS

For

B. TECH PETROLEUM ENGINEERING

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA - 533 003, Andhra Pradesh, India

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III YEAR I SEMESTER

S. No.	Course Code	Course Title	L*	T	P	Credits
1	HSSMS	Managerial Economics & Financial Accounting	3	0	0	3
2	PCC	Process Dynamics & Control	3	0	0	3
3	PCC	Well Logging & Formation Evaluation	3	0	0	3
4	PCC	Drilling & Well Completions	3	0	0	3
5	PEC	**PROFESSIONAL ELECTIVE – I** i. Fundamentals of Liquefied Natural Gas. ii. CBM Reservoir Engineering	3	0	0	3
6	OEC	**OPEN ELECTIVE–I**(To be selected from open elective subjects offered by other branches)	3	0	0	3
7	PCC	Instrumentation, Process Dynamics & Control Laboratory	0	0	3	1.5
8	PCC	Drilling Fluids Laboratory	0	0	3	1.5
9		Industrial Visits (Local & Outside)				-
10	*MC	Mini Project(**Phase 1**)				-
11	*MC	Physical Fitness Activities	0	0	2	0
					Total Credits	**21**

OPEN ELECTIVE–I(offered for other Branches (except Petroleum Engineering))

i. Safety in Petroleum Operations
ii. Corrosion Control in Petroleum Industry
iii. Unconventional Hydrocarbon Resources

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III Year - I Semester		L	T	P	C
		3	0	0	3
MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS					

Course Objectives:

- The Learning objectives of this paper are to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting.
- To familiarize about the Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis.
- To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles.
- To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation.
- Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Unit-I
Introduction to Managerial Economics and demand Analysis:
Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

Unit – II:
Theories of Production and Cost Analyses:
Theories of Production function- Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.

Unit – III:
Introduction to Markets, Theories of the Firm & Pricing Policies:
Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles : Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

Unit – IV:
Introduction to Accounting & Financing Analysis:
Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

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Unit – V:

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

Course Outcomes:

- The Learner is equipped with the knowledge of estimating the Demand and demand elasticities for a product.
- The knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.
- The pupil is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.
- The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis.
- The Learner can able to evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

TEXT BOOKS:

A R Aryasri, Managerial Economics and Financial Analysis, The McGraw – Hill companies.

REFERENCES:

1. Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand & Company Ltd,
2. JL Pappas and EF Brigham, Managerial Economics, Holt, R & W; New edition edition
3. N.P Srinivasn and M. SakthivelMurugan, Accounting for Management, S. Chand & Company Ltd,
4. MaheswariS.N,AnIntroduction to Accountancy, Vikas Publishing House Pvt Ltd
5. I.M Pandey, Financial Management , Vikas Publishing House Pvt Ltd
6. V. Maheswari, Managerial Economics, S. Chand & Company Ltd,

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IIIYear - I Semester		L	T	P	C
		3	0	0	3
PROCESS DYNAMICS & CONTROL					

Learning objectives:

- Visualize and understand the behaviour and logic of different types of advanced controllers and their strategies.
- To understand how Laplace transforms can be used to get solutions of transfer function equations for different types of systems.
- To understand the basic procedure to derive transfer functions for first order, pseudo second order and second order systems.
- To understand the importance of underdamped second order systems in relation to the real life situations.
- To calculate the overall transfer function and thus offset calculation from the control system block diagram.
- To understand the concept of stability, stability criterion and frequency response analysis for sinusoidal forcing functions.
- To understand the behaviour and tuning of a controller and the calculation of controller parameters.
- To understand the inherent and effective characteristics of different types of control valves and the usage of valve positioners to induce linear characteristic into a non-linear control valve.

UNIT-I

Introduction to process dynamics and control, Response of First Order Systems - Physical examples of first order systems.

Response of first order systems in series, higher order systems: Second order and transportation lag.

UNIT-II

Control systems Controllers and final control elements; Closed loop transfer functions, Transient response of simple control systems.

UNIT-III

Stability Criterion, Routh Test, Root locus, Application of root locus to control systems Introduction to frequency response,Control systems design by frequency response.

UNIT-IV

Advanced control strategies: Cascade control, Feed forward control, Ratio control, Smith predictor, Internal model control.

UNIT-V

Controller tuning and Process identification; Control valves.

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Outcomes:
At the completion of the course students should be able to:

- Usage of partial fractions and Laplace transforms for converting ordinary differential equations into simple algebraic equations which are easier to solve.
- Write different types of unsteady and steady state balances
- Describe a process, how it works and what the control objectives are.
- Describe processes with appropriate block diagrams.
- Numerically model a process.
- Identify the stability limits of a system.
- Apply the advance control strategies.
- Tune process controllers.
- Experimentally determine the dynamic behaviour of a process.
- Design and operate the control valves.

Text Books:

1. Process Systems Analysis and Control, D.R. Coughanowr, 3rd Ed. McGraw Hill, 2008.

Reference Books:

1. Chemical Process Control, G. Stephanopoulos, Prentice Hall, 1984.
2. Coulson and Richardson's Chemical Engineering, Volume-3, 3rd Edition: Chemical and Biochemical Reactors and Process Control, Richardson J. F. et.al, Elsevier India, 2006.
3. Automatic Process Control, Donald P. Eckman, John wiley, Reprint 2011.
4. Instrumentation and Control Systems, K. Padmaraju, Y.J. Reddy, Mc Graw Hill Education, 2016.
5. Process Dynamics and Control, Dale Seaborg, Thomas F. Edgar, Duncan Mellichamp, 2nd Edition, Wiley India Pvt. Ltd., 2006.
6. Principles of Process Control. Patranabis, 3rd Edition McGraw-Hill Education Pvt. Ltd., 2012.

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		3	0	0	3
WELL LOGGING & FORMATION EVALUATION					

Learning objectives:

- To know the logging terminology.
- To delineate hydrocarbons through direct and indirect means/methods.
- To determine formation lithology through logs like S.P, G.R etc. and also depositional environment with the help of Gamma rays spectroscopy and Dip-meter tools.
- To determine physical properties of the subsurface, strata like resistivity, porosity, thickness etc. through tools like latero, induction, density, neutron, etc.
- To estimate hydrocarbon saturation using the data acquired by the logging tools.
- To estimate hydrocarbons reserves in a particular block.
- To refine the log interpretation data with the help of advanced technology tools namely, Scanner, NMR, Modular formation tester etc.

UNIT-I

Direct Methods: Mud logging- coring – conventional and sidewall coring - Core analysis.
Concepts of well logging: What is well logging? - Logging terminology - Borehole environment - Borehole temperature and pressure - Log header and depth scale-Major components of well logging unit and logging setup- Classification of well logging methods-Log presentation- Log quality control.

UNIT-II

Open hole logging: SP Logging- Origin of SP, uses of SP log-Calculation of salinity of formation water- Shaliness - Factors influence SP log.
Resistivity log: Single point resistance log (SPR)- Conventional resistivity logs- Response of potential and gradient logs over thin and thick conductive and resistive formations - Limitations of conventional resistivity tools. Focused resistivity log- Advantages of focused resistivity tools over conventional resistivity tools.
Micro resistivity log: Conventional and focused micro resistivity logs and their application.
Induction log: Principle of induction tool and the advantages, Criteria for selection of induction and lateral logging tool, Determination of true resistivity (Rt) of the formation - Resistivity index - Archie's equation.

UNIT-III

Gamma ray log: principle of radioactivity - Uses of gamma ray log- Determination of Shaliness of formation-API counts- Calibration of Gamma ray tool - Statistical fluctuation- Time constant.
Natural Spectral Gamma ray log: Principle and application.
Caliper log: Principle and application of caliper tool.
Density log: Principle of density tool- Environmental corrections - Porosity determination - Tool calibration, Litho density log.
Neutron log: Principle and application of neutron tool, Porosity determination.

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Sonic log: Principle and application of sonic log - Bore hole compensation - Determination of primary and secondary porosity, determination of mechanical properties of rock, elastic constants, fractures etc.,

UNIT-IV

Cased hole logging: Gamma ray spectral log - Neutron decay time log - Determination of fluid saturation behind casing - Cement bond log - Casing collar log - Depth control - Free point locater - Casing inspection logs.

Production logging: Solving production problems with the help of Fluid Density log - Temperature log and Flow meter logs.

UNIT-V

Advances in Well logging: Dip meter log - Formation tester - Cased hole resistivity logs -Nuclear magnetic resonance log & Scanner logs (Sonic scanner, MR scanner Rt scanner).Calculating the dip of the formations, collection of fluid samples from wells for confirmation of log interpretation, and also recording resistivity in cased holes.

Interpretation: Quick look interpretation - Cross plots. Neutron - Density, Sonic - Density, Sonic - Neutron cross plots - Hingle plot - Mid plot – Correlation - Hydrocarbon reserve estimate.

Outcomes:

From the well logs the students:

- Will be able to identify the lithology, depositional environment of subsurface strata.
- Will be able to calculate the porosity, permeability, thickness of different interesting layers in a well.
- Calculate finally, the hydrocarbon saturation in different reservoir rocks at the well site itself.

Text Books:

1. Formation Evaluation, Edward J. Lynch, Harper & Row, 1962.
2. Well Logging and Formation Evaluation, Toby Darling, Elsevier, New York, 2005.
3. Well Logging & Reservoir Evaluation, Oberto Serra, Editions Technip, 2007.

Reference Books:

1. Basic Well Logging and Formation Evaluation, Prof.Dr.JurgenSchon, First Edition, Bookboon publishers, 2015.

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		3	0	0	3
DRILLING AND WELL COMPLETIONS					

Learning Objectives:

- To understand the planning of drilling a well, the process of drilling and various equipment used for drilling and design of the drill string. To know the drilling fluid importance and its properties and hydraulics.
- To understand different types of casings lowered in a well, the requirement of cementation in a well and cement slurry design.To understand different tools used for directional drilling and various techniques, fishing, stuck pipe and well control concepts.
- To learn fundamentals of well testing. Knowledge of surface and subsurface equipment.Planning and designing of wellcompletion after testing of the hydrocarbon zones available.Knowledge of subsurface circulating equipment and packers. Testing of multi zones in a well with DST/RFT with logging tools as well as surface testing equipment.

UNIT-I

Overview of drilling: Drilling plan - GTO -Types of drilling, Hydrostatic pressure, Pore pressure, causes of abnormal pore pressure, abnormal pore pressure evaluation - Measurement while drilling & logging while drilling data -Direct measurements of pore pressure – Drilling fluid properties - Drilling fluid hydraulics calculations - Bit Hydraulics Formation integrity tests – Fracture gradient determination – Theory of wellbore – FIT procedural Guidelines – Predicting fracture gradient.

UNIT-II

Wellbore stability – In-situ stress - Determination of rock properties, Failure criteria – Stress distribution around a wellbore - safe mud weights to prevent hole collapse, Kick tolerance Use of kick tolerance to calculate wellbore pressures.

Casing: Functions of casing – Types of casing – Casing properties and specifications – Casing connections – Factors influencing casing design – Combination strings – Tension criterion - Compression loads – Biaxial effects – Triaxial analysis.

Cementation: Introduction to cement slurries - Cementing nomenclature - Cement additives.

UNIT III

(a) Directional drilling: Well planning - Deflection tools and techniques - Face orientation - Direction control with rotary assemblies - Navigation drilling systems; Horizontal wells – Well profile design considerations – Torque and drag –Extended reach well design – Multilateral wells. Kicks – BOP - Special kick problems and procedures to free the pipes and Fishing operations

b)Wellcompletion: Types of wells- Types of completion.Perforation methods.

Packers: Function – Application.

UNIT IV

Completion equipment (SSD, SSSV, mandrels, locks etc.) –Subsea well completions, Permanent gauges - Memory gauges - Intelligent completion equipment. Tubing string design.

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UNIT-V

Drill Stem Testing: General Procedure and considerations - Test tool components and arrangement - Analysis of Test data. HPHT and horizontal well completions, work over operations, CTU & Slick line operations.

Outcomes:

At the end of this course the student should be able to understand:

- The different details mentioned in the GTO
- Drilling and design of the drill string, drilling hydraulics.
- Casings, cement slurry design, directional drilling and various techniques, fishing, stuck pipe and well control concepts.
- Different types of wells, well testing, surface and subsurface equipment.
- Planning and designing of well completion, different perforation techniques.
- Subsurface circulating equipment and different types of packers
- Testing of multi zones, DST/RFT with logging tools as well as surface testing equipment.

Text Books:

1. Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc., 1960.
2. Working Guide to Drilling Equipment and Operations, William Lyons, Gulf Publishing, 2009.
3 Well Completion and Servicing, D. Perrin, Micheal Caron, Georges Gaillot, Editions Technip, 1999.
4 Primer of Well Service, Workover and Completion, Petroleum Extension Service (PETEX), University of Texas at Austin, 1997.

Reference Books:

1. Drilling Engineering, J.J. Azar and G. Robello Samuel, Pennwell Books, 2007.
2. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.
3. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie Charrier Pennwell, 1985.
4. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.
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. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011.
9 Well Completion Design, Jonathan Bellarby, Elsevier, 2009.
10. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.
11. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.
12 Well Testing, John Lee, Society of Petroleum Engineers, 1982.

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III Year - I Semester		L	T	P	C
		3	0	0	3
FUNDAMENTALS OF LIQUEFIED NATURAL GAS					

Learning Objectives:

- To impart basic knowledge of LNG and it's prospective.
- To learn different liquefaction technologies of LNG.
- To have knowledge on different functional units on receiving terminals
- To analyze transportation of LNG and regasification.
- To understand HSE of LNG industry.

UNIT-I
Introduction: Overview of LNG industry: History of LNG industry – Base load LNG – Developing an LNG Project – World and Indian Scenario – Properties of LNG.

UNIT-II
Supporting Functional Units in LNG Plants: Gas pre-treatment: Slug catcher – NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit – Mercury and sulfur removal unit – NGL recovery – Nitrogen rejection – Helium recovery.

UNIT-III
Liquefaction Technologies: Propane precooled mixed refrigerant process – Description of Air-Products: C_3MR LNG process – Liquefaction – LNG flash and storage.
Cascade process: Description of Conoco Phillips Optimized Cascade (CPOC) process – Liquefaction – LNG flash and storage.
Other Liquefaction Processes: Description of Linde MFC LNG process - Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and Subcooling - Trends in LNG train capacity – Strategy for grassroots plant - Offshore LNG production.

UNIT-IV
Receiving Terminals: Receiving terminals in India – Main components and description of marine facilities – Storage capacity – Process descriptions.
Integration with adjacent facilities – Gas inter changeability – Nitrogen injection – Extraction of C_2^+ components.

Major equipment in LNG industry – Cryogenic heat exchangers: Spiral-Wound heat exchangers – Plate & fin heat exchangers – Cold boxes; Compressors types; LNG pumps and liquid expanders – Loading Arms and gas turbines.

LNG Shipping Industry: LNG Shipping Industry - LNG fleet– Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations.

UNIT-V

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Regasification of LNG: Design of terminals - FLNG
Vaporizers: Submerged combustion vaporizers- Open rack vaporizers – Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater. Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air, LNG tanks.

Safety, Security and Environmental Issues: Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues – Risk based analysis of an LNG plant.

Outcomes:
Upon successful completion of this course, the student will be able to:

- Have good knowledge on LNG process.
- Classify different liquefaction techniques.
- Understand different units in LNG processing and transportation.
- Have knowledge associated with safety aspects of LNG.

Text Book:

1. LNG: Basics of Liquefied Natural Gas, 1st Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007. (https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/HTML/index.html .)

Reference Books:

1. Marine Transportation of LNG (Liquefied) and Related Products, Richard G. Wooler, Gornell Marine Press, 1975.
2. Natural Gas by Sea: The Development of a New Technology, Roger Rooks, Wither by, 1993.
3. LNG: A Nontechnical Guide, Michael D'Tusiani, Gordon Shearer PennWell Books, 2007.
4. Natural Gas Transportation, Storage and Use, Mark Fennell Amazon Digital Services, Inc., 2011.
5. Liquefied Natural Gas, Walter Lowenstein Lom, Wiley 1974.
6. Liquefied Natural Gas, C. H. Gatton, Noyes, 1967.
7. Liquefied Gas Handling Principles on Ships and in Terminals, 3rd Edition, McGuire and White, Witherby Publishers, 2000.

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		3	0	0	3
CBMRESERVOIR ENGINEERING					

Learning Objectives:

This course introduces the student the basics of coal bed methane by giving an overview of reservoir, drilling, production.

This course makes the students to:

- Have overview of scenario of CBM.
- Have knowledge on the geology of coal.
- Deal with basic principles of sorption and isotherms.
- Analyze reservoir characterizes of CBM.
- Have basic idea of completions and driving of CBM reservoirs.
- Understand the hydrofrac job for coal seams.
- Learn in dealing with water from production and disposal.

UNIT-I
Introduction: Overview of coal bed methane (CBM) in India – CBM vs Conventional Reservoirs.Geological influences on cleat formation of coals – Coal chemistry – Significance of rank – Cleat system and natural fracturing.

UNIT-II
Sorption: Principles of Adsorption-The Isotherm construction-CH_4 retention by coal seams-CH_4 content determination in coal seams-The isotherm for recovery - prediction - Model of the micro-pores-coal sorption of other molecular species.Reservoir Analysis: Coal as a reservoir - Permeability-Porosity-Gas flow-Reserve analysis-Well spacing and drainage area-Enhanced recovery.

UNIT-III
Well Construction: Drilling-Cementing.Formation Evaluations, Logging: Borehole environment - Tool measurement response in coal-wire line log evaluation of CBM wells -Gas-In-Place calculations -Recovery factor -Drainage area calculations - Coal permeability/Cleating-Natural fracturing and stress orientation -Mechanical rock properties in CBM evaluation.

UNIT – IV
Completions: Open hole completions -Open hole cavitation process, Cased hole completions- Multi zone entry in cased hole.

UNIT-V
Hydraulic fracturing of coal seams: Need for fracturing coals - Unique problems in fracturing coals - Types of fracturing fluids for coal-In situ conditions - Visual observation of fractures.

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Water production and disposal: Water production rates from methane wells - Chemical content - Environmental regulations - Water disposal techniques - Economics of coal bed methane recovery - Application of CO_2 sequestration.

Outcomes:

By successful completion of this course, the students will be able to:

- Master the fundamentals of coal bed methane.
- Construct different isotherms.
- Evaluate different logs for CBM reservoirs.
- Have good knowledge on water disposal techniques and environmental laws.
- Understand reservoir drilling, completions, and production of CBM.
- Design a CBM well.

Text Books:

1. Fundamentals of Coal Bed Methane Reservoir Engineering, John Seidle, Pennwell Corp., 2011.
2. Coal Bed Methane: Principles and Practice, R. E. Rogers, 3rd Edition, Prentice Hall, 1994.
3. Coal Bed Methane, Robert A. Lamarre, American Association of Petroleum Geologists, 2008.

Reference Books:

1. Coal Bed Methane, Society of Petroleum, 1992.
2. A Guide to Coal Bed Methane Operations, B. A. Hollub, Society of Petroleum, 1992.

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III Year - I Semester		L	T	P	C
		3	0	0	3

SAFETY IN PETROLEUM OPERATIONS

(offeredfor other Branches (except Petroleum Engineering))

Learning Objectives:

- Knowledge of environment issues and all related Acts.
- Knowledge of drilling fluids and its toxic effects with environment.
- Proper disposal of drilling cutting after appropriate treatment.
- Treatment of produced water and makeup water and its disposal as per state pollution control board norms.
- Knowledge of oil mines regulations and proper implementation in drilling & production mines as per Act.
- Knowledge of HAZOP in drilling rigs & production installations.
- Knowledge of disaster management to fight any fire accident at drilling rig/ production installation/production platform.

UNIT-I

Introduction to environmental control in the petroleum industry: Overview of environmental issues- A new attitude- Air emissions

UNIT-II

The impact of drilling and production operations: Measuring toxicity- Hydrocarbons- Salt- Heavy metals- Production chemicals- Drilling fluids- Produced water- Nuclear radiation- Air pollution- Acoustic impacts- Effects of offshore platforms- Risk assessment.

UNIT-III

Oil mines regulations: Introduction-Returns, Notices and plans- Inspector, management and duties- Drilling and workover- Production- Transport by pipelines- Protection against gases and fires.

UNIT-IV

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixtures - Sour gases with their threshold limits- Guidelines for occupational health monitoring in oil and gas industry. Additives during acidizing, sand control and fracturing.

UNIT-V

Hazard identification- Hazard evaluation- HAZOP and what if reviews- Developing a safe process and safety management- Personal protection systems and measures.

Classification of fires- The fire triangle- Distinction between fires and explosions- Flammability characteristics of liquids and vapors- Well blowout fires and their control- Fire fight equipment.

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Outcomes:
The students will be able to:

- Be conversant with the knowledge of various Acts related to safety, Health and environment in petroleum industry.
- Have the knowledge of various drilling fluids handling and safe disposal such toxic products.
- Gain Knowledge of disaster management to fight any crisis.
- Apply HAZOP to petroleum equipment operation and assess risk involved
- Mitigate occupational health hazards in the industry.

Text Books:

1. Environmental Control in Petroleum Engineering, John C. Reis, Gulf Publishing Company, 1996.
2. Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries, Dennis P. Nolan, Noyes Publications, 1994.
3. Oil Industry Safety Directorate (OISD) Guidelines, Ministry of Petroleum & Natural Gas, Government of India and Oil Mines Regulations-1984, Directorate General of Mines Safety, Ministry of Labor and Employment, Government of India.

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 Fire Protection in Chemical, Petrochemical and Hydrocarbon Processing Facilities, Centre for Chemical Process Safety, American Institute of Chemical Engineers, 2003.
3. Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety, Wiley- AIChE, 3rd Edition, 2008.
4. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.
5. Chemical Process Industry Safety, K S N Raju, Mc Graw Hill, 2014.

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III Year - I Semester		L	T	P	C
		3	0	0	3

CORROSIONCONTROL IN PETROLEUM INDUSTRY

(offeredfor other Branches (except Petroleum Engineering))

Learning Objectives:

- Provide fundamental understanding of aspects of electrochemistry and materials science relevant to corrosion phenomena.
- Understand the causes of and the mechanisms of various types of corrosion, including uniform corrosion, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, and various modes of environmentally assisted cracking.
- Provide methodologies for predicting, measuring, and analyzing corrosion performance of materials.
- Identify practices for the prevention and remediation of corrosion.
- Understand the corrosion resistance and application of major constructional metal alloys.

UNIT-I

Introduction to Oilfield Chemistry and Corrosion: Fundamentals of oilfield chemistry including corrosion chemistry.

Classification of corrosion: General corrosion, localized corrosion, MIC, FAC, SCC, CO_2 and H_2S corrosion.

Thermodynamics of electrochemical corrosion: Pourbaix and Evans diagrams, electrochemical reactions, polarization and corrosion rate calculation and measurement. Corrosion tests and standards.

UNIT-II

Advanced Oilfield Corrosion: Introduction to coating and corrosion protection, CO_2 and H_2S corrosion mechanisms in oilfield environments, Review and application of CO_2 corrosion models, Microbiological induced corrosion in oil field, Pipeline corrosion monitoring, inspection and control strategies - applications to Oil & Gas Industry, Mitigation of corrosion with inhibitor applications, corrosion inhibitor evaluation.

UNIT-III

Materials Selection: In service failure modes; Methodologies of materials and process selection in structural and functional design: qualitative and quantitative; Materials specification and sourcing: alloy designations and materials equivalences; Databases and materials information sources; Maintenance, monitoring and lifetime predictions.

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UNIT-IV

Failure Analysis: Approach to failure analysis; Tools of failure analysis; Fractography.

Metallurgical failure analysis: Mechanical failure, environmental effects; characteristics of fracture; Weld failure; Failure of polymers, ceramics and composites: special features of mechanical failure and environment;

Failure prevention: Design codes and inspection procedures; Failure in electronic components and devices; Case studies relevant to the individual programme of study.

UNIT-V

Metals and Alloys: Foundations of physical metallurgy: phase diagrams and phase equilibria; metallic crystal structures and microstructure; mechanical properties, deformation and strengthening mechanisms - applications to Oil & Gas Industry.

Outcomes:

The student will be able to:

- Understand the concept of corrosion and various forms of corrosion.
- Understand the thermodynamics of electrochemical corrosion, corrosion tests.
- Understand the corrosion protection and kinetics of corrosion.
- Understand material selection & design, and the metallurgical failure analysis.
- Understand the foundations of physical metallurgy, ferrous and non-ferrous metallurgy.

Text Books:

1. Mars G. Fontana, “Corrosion engineering”, McGraw-Hill, 1967, ISBN: 007021460.
2. Denny A Jones, “Principles and prevention of corrosion (second edition)”, Prentice Hall, N. J. 1996.
3. H. H. Uhlig and R. W. Revie, “Corrosion and corrosion control” Wiley (NY), 1987.
4. L. L. Shreir, “Corrosion. Vol I and II, Butterworths, Kent 1976.

Reference Books:

1. M. Pourbaix, “Atlas of Electrochemical Equilibrium in aqueous solutions”, NACE, Houston 1974.
2. J. O. M. Bockris and A. K. N. Reddy, “Modern Electrochemistry”. Vol I and II, Plenum Press (NY).
3. J. D. A. Miller, “Microbial Aspects of Metallurgy, Medical and Tech. Pub. CO. Lancaster” 1971.

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3

UNCONVENTIONAL HYDROCARBON RESOURCES

(offeredfor other Branches (except Petroleum Engineering))

Learning Objectives:

The idea of this elective is that the candidate should know apart from conventional hydrocarbons like oil and gas they should have a broad understanding of other types of hydrocarbons like CBM,ShaleGas,Shale Oil and Gas hydrates

UNIT-I

Introduction: Basic Introduction to CBM,Shalegas,Shale oil, Gas Hydrates, Distinction between conventional and unconventional systems.

UNIT-II

Coal Bed Methane (CBM): Coal chemistry – Significance of rank – Cleat system and natural fracturing. Principles of Adsorption-The Isotherm construction-CH_4 retention by coal seams-CH_4 content determination in coal seams, Reserve Analysis-Well spacing and drainage Area-Enhanced recovery. Hydraulic fracturing of coal seams: Water production and disposal Economics of coal bed methane recovery.

UNIT-III

Shale Gas: Formation of shale gas, Extraction of shale gas, shale gas potential. Relevant Technology: Hydro-fracturing, relevant environmental issues.

Shale oil: Properties of shale oil, History,ProductionTechniques.WellheadsandGathering.AdvantagesandLimitationsofOilProductionTechnologyinShaleOil.TechnicalandEconomicAspectsofShale OilProduction.

UNIT-IV

Global Occurrence & Distribution of Natural Gas Hydrates,Properties, formation, and disassociation of gas hydrates, Bottom simulating reflectors (BSR), drilling for Gas Hydrates, Technology used for the exploration of Gas Hydrates, Methodologies for the extraction of Gas Hydrates.

UNIT V

Technology used for the exploration of Gas Hydrates, Methodologies for the extraction of Gas Hydrates status of Gas Hydrate production research and development in India

Outcomes:

At the end of this course student should have acquired a very broad understanding of:

- What are unconventional reservoirs?
- Extraction and production of shale and shale oil reservoirs.
- Basic knowledge of gas hydrates, identification of BSR.

- The technological developments of drilling for gas hydrates and their associated problems and latest research in gas hydrates

Text Books:

1. Natural Gas Hydrates, John Carrol, Gulf Publishers
2. Advanced Marine Seismic Methods, OBC and Vertical Cable Analysers, Carlos Rodriguez Surez.
3. Shale Oil and Gas Book, ShorabZedenbondi and AlirezaBahador.

Reference Books:

1. www.energytomorrow.org/Shale_Gas.asp
2. www.guardian.co.uk/business/2011/apr/08/shell-oil-gas-james-smith
3. http://www.naturalgas.org/naturalgas/exploration.aspp
4. Fundamentals of Coal Bed Methane Reservoir Engineering, John Seidle, Pennwell Corp.,
5. A Guide to Coal Bed Methane Operations, B. A. Hollub, Society of Petroleum, 1992.
6. Collet, A. Johnson, C. Knapp, and R. Boswell, eds., Natural gas hydrates—Energy resource potential and associated geologic hazards: AAPG Memoir 89, p. 146– 219.
7. Rappel, C., 2007, Tapping methane hydrates for unconventional natural gas, Elements, 3(3), 193-199.

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - I Semester		L	T	P	C
		0	0	3	1.5
INSTRUMENTATION, PROCESS DYNAMICS & CONTROL LABORATORY					

Learning Objectives:

- To calibrate and determine the time lag of various first and second order instruments.
- To determine the response in single and two capacity systems with and with-out interaction.
- To understand the advanced control methods used for complex processes in the industries. Different experiments like Temperature, level and pressure control can be configured and studied.
- To study the open loop (Manual control) and the on/off controller, Proportional controller, PI controller, PD controller, PID controller, Tuning of controller (Open loop and close loop methods).
- To understand the control valve operation and its flow characteristics.
- To determine the damping coefficient and response of U-tube manometer.

Experiments:

1. Study of hysteresis of bourdon tube pressure gauge tester
2. Temperature Measurement apparatus:
    a. Study the characteristics of different types of temperature sensors: RTD, Thermistor, Temperature transmitter and thermocouple
    b. Determine the time constant and study the characteristics of bi-metallic thermometer
    c. Study the see back effect
3. Flow measurement apparatus:
    Study of different types of flow measurement devices: Venturi meter, orifice meter, water meter, rotameter and Pitot tube.
4. Determination of time constant & transportation lag for mercury in glass thermometer with and without thermal well.
5. Sinusoidal response of mercury in glass thermometer with and without thermal well.
6. Study of dynamic response of single tank liquid level system, two tank non-interacting and interacting liquid level systems.
7. Study of dynamic response of two tank Determination of damping coefficient for U-tube:
    a. Water manometer
    b. Mercury manometer
8. Study of control valve characteristics and determine valve flow coefficient for the following valves:
    a. Equal percentage valve
    b. Quick opening valve
    c. Linear valve

9. Determination of hysteresis for the following valves:
    a. Equal percentage valve
    b. Quick opening valve
    c. Linear valve
10. Temperature control trainer:
    a. Open loop response
    b. On-off control
    c. P-control
    d. PID-control
    e. Auto tuning
11. Level control trainer:
    a. Open loop response
    b. On-off control
    c. P-control
    d. PID-control
    e. Auto tuning
12. Pressure control trainer:
    a. Open loop response
    b. On-off control
    c. P-control
    d. PID-control
    e. Auto tuning

Outcomes:

The student will be able to:

- Understand the hysteresis of pressure gauge tester and control valves.
- Characteristics of different types of temperature sensors.
- Determine the discharge coefficient for different types of flow measurement apparatus.
- Estimate the dynamic characteristics of first and second order systems.
- Apply the advanced control methods used for complex processes in the industries.
- Screen and suggest controllers like On/Off, P, PI, PD and PID for process systems.
- Identify the stability of the system.

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III Year - I Semester		L	T	P	C
		0	0	3	1.5
DRILLING FLUIDS LABORATORY					

Learning Objective:

- The students will be given hands on training in the determination of the properties of different drilling fluids.

List of Experiments:

1. Measurement of drilling fluid weight.
   Equipment: The Baroid mud balance
2. Measurement of mud viscosity.
   Equipment: Marsh funnel
3. Measurement of pH of mud.
   Equipment: pH meter and hydrion pH dispensers
4. Determination of mud rheology (Viscosity, Gel strength, and Yield point).
   Equipment: The Baroidrheometer
5. Determination of the loss of liquid from a mud.
   Equipment: Standard API filter press
6. Measurement of a drilling mud cake and evaluate resistivity.
   Equipment: Baroid digital resistivity meter
7. Measurement of the effect of adding bentonite on mud properties.
8. Drilling fluid contamination test (Salt, Gypsum & Cement contamination) and their effect on the drilling fluid properties.
9. Measurement of solid and liquid content and emulsification characteristics of drilling fluid.
   Equipment: Sand content set, fann emulsion and electrical stability testers
10. Measurement of Oil, water, solid and clay content.
    Equipment: Oil/ water retort kit
11. Measurement of water ratios for Portland cement slurry.
    (Effect of water ratio on free water separation normal and minimum water content and thickening time)
    Equipment: The atmospheric consistometer
12. Measurement of specific gravity of cement slurry
    Equipment: specific gravity bottles

13. Measurement of consistency of cement
    Equipment: vi-cat apparatus
14. Measurement of initial and final setting times of given cement slurry

15. Measurement of compressive strength of cement test moulds and effect of temperature and pressure on setting of the slurry.
    Equipment: Compressive strength testing machine

Outcomes:

- The students will be able to understand and assess quality of various muds and their applications in drilling. With this knowledge, well control issues will be better understood.
- The training in the laboratory provides the students to carry out good consultation jobs for healthy construction of open oil / gas wells.

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - I Semester		L	T	P	C
INDUSTRIAL VISITS(Local & Outside)					

Learning Objective:

- To make the students aware of industrial environment, culture, requirements, nature of jobs.

During the semester, all the students are required to visit minimum 6 major petroleum industries like ONGC, RIL, GAIL, Oil India Ltd, GSPC and Petroleum Refineries like, HPCL, IOCL and BPCL accompanied by two faculty members. After each visit, every student should submit a very brief report on the industry with flow diagrams and salient features of the processes that include safety and environmental aspects.

Outcomes:

The students will be able to:

- Differentiate between the academic training and its relevance to industry.
- Understand the industrial safety measures.

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - I Semester		L	T	P	C
MINI PROJECT					

Learning Objectives:

- To develop innovative and original ideas
- To promote team work

Three / four member teams will be formed to carry out the mini project (Phase 1) which is a mandatory course.Under the guidance of an instructor / faculty, each team is given a project in the following subjects at the beginning of I Semester of III year of the 4 – year B. Tech. Program.Mini project (**Phase 1**)deals with literature review.

Drilling Technology, Well Completions, Petroleum Production Engineering, Petroleum Reservoir Engineering, Deep water Exploration.

The project involves process and mechanical design calculations of an equipment / process/system and constructing a working model based on the above calculations. Finally, a report will be submitted in a standard format after sufficient literature review. The report will be assessed by the concerned instructor / faculty for the completion of the mini project.

Outcomes:

After successful completion of the mini project, students will be able to:

- Practice acquired knowledge within the chosen area of technology for project development.
- Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
- Work as an individual or in a team in development of technical projects.
- Communicate and report effectively project related activities and findings.

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III Year - I Semester		L	T	P	C
		0	0	2	0
Physical fitness Activities					