COURSE STRUCTURE AND SYLLABUS

For

PETROLEUM ENGINEERING

(Applicable for batches admitted from 2016-2017)

DEPT OF PE &PCE, UCEK (A)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, Andhra Pradesh, India

I Year - I Semester

S. No.	Subjects	L	T	P	Credits
1-HS	English – I	4	--	--	3
2-BS	Mathematics - I	4	--	--	3
3-ES	Engineering Chemistry	4	--	--	3
4- ES	Elements of Mechanical Engineering	4	--	--	3
5-BS	Engineering Drawing	4	--	--	3
6-ES	Environmental Studies	4	--	--	3
7-HS	Engineering/Applied Chemistry Laboratory	--	--	3	2
8-BS	English - Communication Skills Lab – I	--	--	3	2
9-ES	Engineering Workshop	--	--	3	2
	Total Credits				**24**

I Year - II Semester

S. No.	Subjects	L	T	P	Credits
1-HS	English – II	4	--	--	3
2-BS	Mathematics – II(Numerical methods &Integral transforms)	4	--	--	3
3-BS	Mathematics – III (Differential equations)	4	--	--	3
4- BS	Engineering Physics	4	--	--	3
5-HS	Engineering Mechanics	4	--	--	3
6-ES	Computer Programming	4	--	--	3
7-BS	English - Communication Skills Lab - II	--	--	3	2
8-HS	Engineering /Applied Physics Lab	--	--	3	2
9-ES	Engineering /Applied Physics – Virtual Labs - Assignments	--	--	2	--
10	Computer Programming - Lab	--	--	3	2
	Total Credits				**24**

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II Year - I Semester

S. No.	Subjects	L	T	P	Credits
1	Complex Variables	4	--	--	3
2	Basic Electrical & Electronics Engineering	4	--	--	3
3	General Geology	4	--	--	3
4	Surveying & Offshore Structures	4	--	--	3
5	Chemical Process Calculations	4	--	--	3
6	Materials Science & Engineering	4	--	--	3
7	Basic Engineering (Mech. + Elec.) Lab	--	--	3	2
8	Geology & Surveying Lab	--	--	3	2
MC	Managerial Economics & Financial Analysis	2	--	--	--
	Total Credits				**22**

II Year - II Semester

S. No.	Subjects	L	T	P	Credits
1	Probability & Statistics	4	--	--	3
2	Momentum Transfer	4	--	--	3
3	Petroleum Geology	4	--	--	3
4	Thermodynamics for Petroleum Engineers	4	--	--	3
5	Process Heat Transfer	4	--	--	3
6	Petroleum Exploration	4	--	--	3
7	Momentum Transfer Lab	--	--	3	2
8	Process Heat Transfer Lab	--	--	3	2
MC	Professional Ethics & Human Values	2	--	--	--
	Total Credits				**22**

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III Year - I Semester

S. No.	Subjects	L	T	P	Credits
1	Management Science	4	--	--	3
2	Process Dynamics & Control	4	--	--	3
3	Process Instrumentation	4	--	--	3
4	Well Logging & Formation Evaluation	4	--	--	3
5	Drilling Technology	4	--	--	3
6	Mathematical Methods Lab	--	--	3	2
7	Instrumentation, Process Dynamics & Control Lab	--	--	3	2
8	Drilling Fluids Lab	--	--	3	2
9	Industrial Visits	--	--	-	-
MC	SWAYAM-NPTEL Courses	--	--	--	--
	Total Credits				**21**

III Year - II Semester

S. No.	Subjects	L	T	P	Credits
1	Well Completions, Testing & Servicing	4	--	--	3
2	Petroleum Production Engineering	4	--	--	3
3	Petroleum Reservoir Engineering-I	4	--	--	3
4	Petroleum Refinery & Petrochemical Engineering	4	--	--	3
5	**OPEN ELECTIVE** i. Electronic Instrumentation ii. Big Data Analytics iii. Alternative Energy Sources for Automobiles iv. Waste Water Management v. Fundamentals of Liquefied Natural Gas vi. Computational Fluid Dynamics	4	--	--	3
6	Drilling Simulation Lab	--	--	3	2
7	Petroleum Analysis Lab	--	--	3	2
8	Petroleum Reservoir Engineering Lab	--	--	3	2
9	Summer Internship (4-6 weeks)	--	--	--	--
MC	Mini Project	--	--	--	--
	Total Credits				**21**

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IV Year - I Semester

S. No.	Subjects	L	T	P	Credits
1	Integrated Asset Management	4	--	--	3
2	Petroleum Reservoir Engineering - II	4	--	--	3
3	Surface Production Operations	4	--	--	3
4	Oil & Gas Processing Plant Design	4	--	--	3
5	**Elective I** i. Natural Gas Hydrates ii. Pipeline Engineering iii. Horizontal Well Technology	4	--	--	3
6	**Elective II** i. Coal Bed Methane Engineering ii. Offshore Engineering iii. Reservoir Stimulation	4	--	--	3
7	IPR & Patents	--	2	--	--
8	Petroleum Equipment Design & Simulation Lab	--	--	2	2
9	Petroleum Reservoir Simulation Lab	--	--	2	2
	Total Credits				**22**

IV Year - II Semester

S. No.	Subjects	L	T	P	Credits
1	EOR Techniques	4	--	--	3
2	HSE & FE in Petroleum Industry	4	--	--	3
3	Petroleum Economics, Policies & Regulations	4	--	--	3
4	**Elective III** i. Shale Gas Reservoir Engineering ii. Subsea Engineering iii. Reservoir Modelling & Simulation	4	--	--	3
5	Seminar (SIP Report Presentation)	--	--	--	2
6	Project	--	--	--	10
	Total Credits				**24**

Total Course Credits = 48+44 + 42 + 46 = 180

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SYLLABUS

I Year - I Semester

L	T	P	C
4	**0**	**0**	**3**

ENGLISH-I

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I Year - I Semester	MATHEMATICS-I	L	T	P	C
		4	0	0	3

(Common to ALL branches of First Year B.Tech.)

Learning Objectives:

- The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
- The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.

UNIT I: Matrix Theory:

Rank-Echelon form-Normal form.
Eigen values - Eigen vectors– Properties – Cayley-Hamilton theorem - Inverse and powers of a matrix by using Cayley-Hamilton theorem- Diagonalization- Quadratic forms- Reduction of quadratic form to canonical form – Rank - Positive, negative and semi definite - Index – Signature.
Applications: Free vibration of a two-mass system.

UNIT II: Special functions:

Introduction to Improper Integrals-Beta and Gamma functions- Properties - Relation between Beta and Gamma functions- Evaluation of improper integrals.
Applications: Evaluation of integrals.

UNIT III: Multiple integrals:

Curve tracing: Cartesian, Polar and Parametric forms.
Multiple integrals: Double and triple integrals – Change of variables – Change of order of integration.

UNIT IV: Applications of Integration:
Length of curves, Finding Areas and Volumes. Volumes and Surfaces of solids of revolution.

UNIT V: Vector Differentiation:

Gradient- Divergence- Curl - Laplacian and second order operators -Vector identities.
Applications: Equation of continuity, potential surfaces

UNIT VI: Vector Integration:
Line integral –Conservative vector field – Potential function – Area- Surface and volume integrals- Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and related problems.
Applications: Work done, Force.

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Outcomes:

At the end of the course, student will be able to:

- Solve linear differential equations of first, second and higher order.
- Determine Laplace transform and inverse Laplace transform of various functions and use Laplace transforms to determine general solution to linear ODE.
- Calculate total derivative, Jocobian and minima of functions of two variables.

Text Books:

1. **B.S.Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **N.P.Bali**, Engineering Mathematics, Lakshmi Publications.

Reference Books:

1. **Greenberg,** Advanced Engineering Mathematics, 2nd edition, Pearson edn
2. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India
3. **Peter O'Neil,** Advanced Engineering Mathematics,7th edition, Cengage Learning.
4. **Srimanta Pal, Subodh C.Bhunia**, Engineering Mathematics, Oxford University Press.

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I Year - I Semester

L	T	P	C
4	0	0	3

ENGINEERING CHEMISTRY
(CE, ME, PCE, PE)

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

Learning Objectives:

- Plastics are nowadays used in household appliances; also they are used as composites (FRP) in aerospace and automotive industries.
- Fuels as a source of energy are a basic need of any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence they are introduced.
- The basics for the construction of galvanic cells are introduced. Also if corrosion is to be controlled, one has to understand the mechanism of corrosion which itself is explained by electrochemical theory.
- With the increase in demand, a wide variety of materials are coming up; some of them have excellent engineering properties and a few of these materials are introduced.
- Water is a basic material in almost all the industries, more so where steam is generated and also where it is supplied for drinking purposes.
- Materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries are introduced. Also lubrication is introduced.

UNIT I: HIGH POLYMERS AND PLASTICS

Polymerisation:- Introduction - Mechanism of polymerization - Stereo regular polymers – methods of polymerization (emulsion and suspension) - Physical and mechanical properties – ***Plastics*** as engineering materials: advantages and limitations – Thermoplastics and Thermosetting plastics – Compounding and fabrication (4/5 techniques)- Preparation, properties and applications of polyethene, PVC, Bakelite Teflon and polycarbonates

Elastomers :- Natural rubber - compounding and vulcanization - Synthetic rubbers: Buna S, Buna N, Thiokol and polyurethanes – Applications of elastomers.

Composite materials & Fiber reinforced plastics – Biodegradable polymers – Conducting polymers.

UNIT II: FUEL TECHNOLOGY

Fuels – Introduction – Classification – Calorific value - HCV and LCV – Problems - Dulong's formula – Bomb calorimeter – Numerical problems – Coal — Proximate and ultimate analysis – Significance of the analyses – Problems - Liquid fuels – Petroleum- Refining – Cracking – Synthetic petrol –Petrol knocking – Diesel knocking - Octane and Cetane ratings – Anti-knock agents – Power alcohol – Bio-diesel – Gaseous fuels – Natural gas, LPG and CNG – Combustion – Calculation of air for the combustion of a fuel – Flue gas analysis – Orsat apparatus – Numerical problems on combustion.

Explosives: - Rocket fuels

UNIT III: ELECTROCHEMICAL CELLS AND CORROSION

Galvanic cells - Reversible and irreversible cells – Single electrode potential – Electro chemical series and uses of this series- Standard electrodes (Hydrogen and Calomel electrodes) - Concentration Cells – Batteries: Dry Cell - Ni-Cd cells - Ni-Metal hydride cells - Li cells - Zinc – air cells.

Corrosion :- Definition – Theories of Corrosion (chemical & electrochemical) – Formation of galvanic cells by different metals, by concentration cells, by differential aeration and waterline corrosion – Passivity of metals – Pitting corrosion - Galvanic series – Factors which influence the rate of corrosion - Protection from corrosion – Design and material selection – Cathodic protection - Protective coatings: – Surface preparation – Metallic (cathodic and anodic) coatings - Methods of application on metals (Galvanizing, Tinning, Electroplating, Electroless plating).

UNIT IV: CHEMISTRY OF ADVANCED MATERIALS

Nano materials:- Introduction – Sol-gel method & chemical reduction method of preparation – Characterization by BET method and TEM methods - Carbon nano tubes and fullerenes: Types, preparation, properties and applications

Liquid crystals:- Introduction – Types – Applications

Super conductors:-Type –I, Type II – Characteristics and applications

Green synthesis:- Principles - 3or 4 methods of synthesis with examples – R_4M_4 principles

UNIT V: WATER TECHNOLOGY

Hard water:- Reasons for hardness – units of hardness - determination of hardness and alkalinity - Water for steam generation - Boiler troubles – Priming and Foaming, Scale formation, Boiler corrosion, Caustic embrittlement - Internal treatments - Softening of Hard water : Lime – Soda process, Zeolite process and numerical problems based on these processes and Ion Exchange process - Water for drinking purposes- Purification – Sterilization and disinfection : Chlorination, Break point chlorination and other methods – Reverse Osmosis and Electro Dialysis.

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UNIT VI: CHEMISTRY OF ENGINEERING MATERIALS AND FUEL CELLS

Refractories: **-** Definition, characteristics, classification, properties, failure of refractories

Lubricants: **-** Definition, function, Theory and mechanism of lubricants, properties (Definition and importance)

Cement: **-** Constituents, manufacturing, setting and hardening, deterioration of cement

Insulators: **-** Thermal and electrical insulators

Fuel cells: **-** Hydrogen Oxygen fuel cells – Methanol Oxygen fuel cells

Outcome: The advantages and limitations of plastic materials and their use in design would be understood. Fuels which are used commonly and their economics, advantages and limitations are discussed. Reasons for corrosion and some methods of corrosion control would be understood. The students would be now aware of materials like nano materials and fullerenes and their uses. Similarly liquid crystals and superconductors are understood. The importance of green synthesis is well understood and how they are different from conventional methods is also explained. The impurities present in raw water, problems associated with them and how to avoid them are understood. The advantages and limitations of plastic materials and their use in design would be understood. The commonly used industrial materials are introduced.

Standard Books:

1. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co.
2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2015 edition.

Reference Books:

1. Engineering Chemistry of Wiley India Pvt. Ltd., Vairam and others, 2014 edition (second).
2. Engineering Chemistry by Prasanth Rath, Cengage Learning, 2015 edition.
3. A text book of engineering Chemistry by S. S. Dara; S. Chand & Co Ltd., Latest Edition
4. Applied Chemistry by H.D. Gesser, Springer Publishers
5. Text book of Nano-science and nanotechnology by B.S. Murthy, P. Shankar and Others, University Press, IIM

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I Year - I Semester

L	T	P	C
4	0	0	3

ELEMENTS OF MECHANICAL ENGINEERING

Learning Objectives:

- The content of this course shall provide the student the basic concepts of various mechanical systems and exposes the student to a wide range of equipment and their utility in a practical situation. It shall provide the fundamental principles of materials, fuels, Steam, I.C. Engines, compressors, hydraulic machines and transmission systems that usually exist in any process plant.

UNIT –I:

Stresses and strains: kinds of – stress-strains, elasticity and plasticity, Hooks law, stress –strain diagrams, modules of elasticity, Poisson's ratio, linear and volumetric strain, relation between E, N, and K, bars of uniform strength, compound bars and temperature stresses.

UNIT–II:

Types of supports – loads – Shear force and bending moment for cantilever and simply supported beams without overhanging for all types of loads.

Theory of simple bending, simple bending formula, Distribution of Flexural and Shear stress in Beam section – Shear stress formula – Shear stress distribution for some standard sections

UNIT-III:

Thin cylindrical shells: stress in cylindrical shells due to internal pressures, circumferential stress, longitudinal stress, design of thin cylindrical shells, spherical shells, change in dimension of the shell due to internal pressure, change in volume of the shell due to internal pressure.

Thick Cylinders: Lame's equation- cylinders subjected to inside and outside pressures columns and Struts.

UNIT-IV:

Steam boilers and Reciprocating air compressors: Classification of boilers, essentialities of boilers, selection of different types of boilers, study of boilers, boiler mountings and accessories.

Reciprocating air compressors: uses of compressed air, work done in single stage and two-stage compression, inter cooling and simple problems.

UNIT-V:

Internal combustion engines: classification of IC engines, basic engine components and nomenclature, working principle of engines, Four strokes and two stroke petrol and diesel engines, comparison of CI and SI engines, comparison of four stroke and two stroke engines, simple problems such as indicated power, brake power, friction power, specific fuel consumption, brake thermal efficiency, indicated thermal efficiency and mechanical efficiency.

UNIT-VI:

Transmission systems: Belts –Ropes and chain: belt and rope drives, velocity ratio, slip, length of belt , open belt and cross belt drives, ratio of friction tensions, centrifugal tension in a belt, power transmitted by belts and ropes, initial tensions in the belt, simple problems.

Gear trains: classification of gears, gear trains velocity ratio, simple, compound –reverted and epicyclic gear trains.

Outcomes:

After completing the course, the student shall be able to determine:

- The stress/strain of a mechanical component subjected to loading.
- The performance of components like Boiler, I.C. Engine, Compressor, Steam/Hydraulic turbine, Belt, Rope and Gear.
- The type of mechanical component suitable for the required power transmission.

Text Books:

1. Strength of Materials and Mechanics of Structures, B.C.Punmia, Standard Publications and distributions, 9 th Edition, 1991.
2. Thermal Engineering, Ballaney,P.L., Khanna Publishers, 2003.
3. Elements of Mechanical Engineering, A.R.Asrani, S.M.Bhatt and P.K.Shah, B.S. Publs**.**
4. Elements of Mechanical Engineering, M.L.Mathur, F.S.Metha&R.P.Tiwari Jain Brothers Publs., 2009**.**

Reference Book:

1. Theory of Machines, S.S. Rattan, Tata McGraw Hil., 2004 & 2009.

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I Year - I Semester

L	T	P	C
4	0	0	3

ENGINEERING DRAWING

Learning Objectives: Engineering drawing being the principle method of communication for engineers, the objective is to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

UNIT-I:

Objective: To introduce the students to use drawing instruments and to draw polygons, Engg. Curves.

Polygons: Constructing regular polygons by general methods, inscribing and describing polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by general methods, cycloids, involutes, tangents & normals for the curves.

UNIT-II:

Objective: To introduce the students to use scales and orthographic projections, projections of points & simple lines.

Scales: Plain scales, diagonal scales and vernier scales

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.

UNIT-III:

Objective: The objective is to make the students draw the projections of the lines inclined to both the planes.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

UNIT-IV:

Objective: The objective is to make the students draw the projections of the plane inclined to both the planes.

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

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UNIT-V:

Objective: The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one of the planes.

UNIT-VI:

Objective: The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Outcomes:

- After undergoing this course, the student learnt the scales, various engineering curves and drawing the 2D and 3D objects.

Text Books:

1. Engineering Drawing, N.D. Butt, Chariot Publications.
2. Engineering Drawing, Agarwal & Agarwal, Tata McGraw Hill Publishers.

Reference Books:

1. Engineering Drawing, K.L. Narayana & P. Kannaiah, Scitech Publishers.
2. Engineering Graphics for Degree, K.C. John, PHI Publishers.
3. Engineering Graphics, PI Varghese, McGraw Hill Publishers
4. Engineering Drawing + AutoCAD, K Venugopal, V. Prabhu Raja, New Age.

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I Year - I Semester

L	T	P	C
4	0	0	3

ENVIRONMENTAL STUDIES

Course Learning Objectives:

The objectives of the course is to impart

1. Overall understanding of the natural recourses
2. Understanding of the ecosystem and its diversity
3. Acquaintance on various environmental challenges being induced because of the unplanned anthropogenic activities
4. An understanding of the assessment of impact of a developmental activity
5. Awareness on the social issues and environmental legislation and global treaties- Case studies of Minamita disease, Extinction of the Dodo, Bhopal tragedy, Polavaram Project, Narmada Valley, Mad Cow disease, Ganga Cleaning Program etc.

Course Outcomes:

The student should have knowledge on

1. The natural resources and their importance for the sustenance of the life and recognise the usefulness of the conservation of the natural resources
2. The concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web.
3. The biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity.
4. Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management practices.
5. Social issues both rural and urban environment and the possible means to combat the challenges.
6. The environmental legislations of India and the first global initiatives towards sustainable development.
7. Environmental Impact Assessment and the stages involved in EIA and the environmental audit.
8. Quantitative expression of values of Resources, Impacts, Green technologies etc.

Syllabus:

UNIT - I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information Technology in Environment and human health

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems

UNIT – II:

Natural Resources: Natural resources and associated problems

Forest resources – Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people

Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources

Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity

Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.

Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT – III:

Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social and aesthetic use. Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts - Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ measures.

UNIT – IV:

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, nuclear hazards. Role of an individual in prevention of pollution - Carbon trade - Pollution case studies.

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Solid Waste Management: Sources, classification, effects and control measures of urban and industrial solid wastes. Sanitary Landfilling, Composting, Incineration. Consumerism and waste products.

UNIT – V:

Social Issues and the Environment: Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act - Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation - Public awareness.

UNIT – VI:

Environmental Management: Environmental Impact Assessment and its significance, various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism.

Note: The student should submit a report individually on any issue related to Environmental Studies course and make a power point presentation.

Text Books:

1. R. Rajagopalan, Environmental Studies, 2nd Edition, 2011, Oxford University Press.
2. Shaashi Chawla: A Textbook of Environmental Studies. TMH, New delhi
3. P.N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Environmental Studies Pearson, Chennai

Reference Books:

1. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada .
3. Benny Joseph: Environmental Studies, Tata McGrawhill Co, NewDelhi
4. Piyush Malaviya, Pratibha Singh, Anoop singh: Environmental Studies, Acme Learning, New Delhi.

I Year - I Semester

L	T	P	C
0	0	3	2

ENGINEERING/APPLIED CHEMISTRY LABORATORY (*Common to all branches)*

1. Introduction to Chemistry laboratory – Molarity, Normality, Primary, secondary standard solutions, Volumetric titrations, Quantitative analysis
2. Determination of HCl using standard Na_2CO_3 solution.
3. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
4. Determination of $KMnO_4$ using standard Oxalic acid solution.
5. Determination of Ferrous iron using standard $K_2Cr_2O_7$ solution.
6. Determination of Copper using standard hypo solution.
7. Determination of temporary and permanent hardness of water using standard EDTA solution.
8. Determination of Iron by a Colorimetric method.
9. Determination of acetic acid by using sodium hydroxide (pH meter method).
10. Determination of HCl using standard Potassium hydrogen phthalate (by Conductometric method).
11. Determination of HCl using standard Potassium hydrogen phthalate (by Potentiometric method).
12. Determination of Mg^{++} in an antacid.
13. Determination of $CaCO_3$ present in an egg shell.
14. Determination of Vitamin C.

Of the above experiments at-least 10 assessment experiments should be completed in a semester.

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Outcomes: The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

Reference Books

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.
2. Dr. Jyotsna Cherukuris (2012) *Laboratory Manual of engineering chemistry-II*, VGS Techno Series

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I Year - I Semester

L	T	P	C
0	0	3	2

ENGLISH - COMMUNICATION SKILLS LAB- I

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I Year - I Semester

L	T	P	C
0	0	3	2

ENGINEERING WORKSHOP

ENGINEERING WORKSHOP:

Learning Objective: To impart hands-on practice on basic engineering trades and skills.

Note: At least two exercises to be done from each trade.
Trade:

Carpentry	1. T-Lap Joint
	2. Cross Lap Joint
	3. Dovetail Joint
	4. Mortise and Tenon Joint
Fitting	1. Vee Fit
	2. Square Fit
	3. Half Round Fit
	4. Dovetail Fit
Black Smithy	1. Round rod to Square
	2. S-Hook
	3. Round Rod to Flat Ring
	4. Round Rod to Square headed bolt
House Wiring	1. Parallel / Series Connection of three bulbs
	2. Stair Case wiring
	3. Florescent Lamp Fitting
	4. Measurement of Earth Resistance
Tin Smithy	1. Taper Tray
	2. Square Box without lid
	3. Open Scoop
	4. Funnel

I Year - II Semester

L	T	P	C
4	0	0	3

ENGLISH-II

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I Year - II Semester	**L**	**T**	**P**	**C**
	4	**0**	**0**	**3**

MATHEMATICS – II (Numerical Methods and Integral Transforms)
(Common to ALL branches of First Year B.Tech.)

UNIT I: Solution of Algebraic and Transcendental Equations:
Introduction- Bisection method – Method of false position –Secant Method- Iteration method – Newton-Raphson method.
Solution of linear systems – Gauss elimination - Gauss Jacobi and Gauss Seidel methods- Newton Raphson Method for non linear simultaneous equations. Power Method for finding Largest Eigenvalue – Eigenvector.

UNIT II: Interpolation:
Introduction– Finite differences- Forward differences- Backward differences –Central differences – Newton's forward and backward formulae – Interpolation with unequal intervals - Lagrange's and Newton's divided difference formula- Errors in polynomial interpolation.

UNIT III: Numerical Differentiation and Integration:
Numerical Differentiation (with equal and unequal interval), Numerical Integration-Trapezoidal rule, Simpson's $1/3^{rd}$ rule and $3/8^{th}$ rule.

UNIT IV: Numerical Solution of Ordinary Differential equations:
Condition for existence and uniqueness of a solution(statement only) - Solution of ordinary differential equations by Taylor's series- Euler's method – Modified Euler.
Runge-Kutta methods (second and fourth order) for first and second order initial value problems - Predictor and Corrector Methods (Adams-Bashforth and Milnes).

UNIT V: Laplace transforms:
Laplace transforms of standard functions-Shifting theorems - Transforms of derivatives and integrals – Unit step function –Dirac's delta function- Inverse Laplace transforms– Convolution theorem (with out proof).
Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

UNIT VI: Fourier Transforms:
Fourier integral theorem (without proof) – Fourier sine and cosine integrals - sine and cosine transforms – properties – inverse transforms – Finite Fourier transforms.

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Chairman	**Member**	**Member**	**Member**	**Member**

Shri J. Ravi Srinivas	Shri V. Sivarama Krishna	Dr. S.V.Naidu	Dr. P. King	Shri P. Chandra Mohan
Member	**Member**	**Member**	**Member**	**Member**

Text Books:

1. **B.S.Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **N.P.Bali**, Engineering Mathematics, Lakshmi Publications.

Reference Books:

1. **R.K. Jain, S.R.K. Iyengar, M.K. Jain,** Numerical Methods for Scientists and Engineering, New Age Publications.
2. **S.S. Sastry,** Introduction to Numerical Analysis, PHI.
3. **V. Ravindranath and P.Vijayalakshmi,** Mathematical Methods, Himalaya Publishing House.
4. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India
5. **David Kincaid, Ward Cheney**, Numerical Analysis-Mathematics of Scientific Computing, 3rd Edition, Universities Press.

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I Year - II Semester

L	T	P	C
4	0	0	3

MATHEMATICS – III (Differential Equations)
(Common to ALL branches of First Year B.Tech.)

Learning Objectives:

- The course is designed to equip the students with the necessary mathematical skills and techniques that are essential for an engineering course.
- The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.
- Understand the most basic numerical methods to solve simultaneous linear equations.

UNIT I: Partial differentiation:
Introduction- Homogeneous function-Euler's theorem-Total derivative-Chain rule-Generalized Mean value theorem for single variable (without proof)-Taylor's and Mc Laurent's series expansion of functions of two variables– Functional dependence- Jacobian.
Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT II:
Differential equations of first order and first degree:
Linear-Bernoulli-Exact-Reducible to exact.
Applications: Newton's Law of cooling-Law of natural growth and decay-Orthogonal trajectories-Electrical circuits- Chemical reactions.
Linear differential equations of higher order:
Non-homogeneous equations of higher order with constant coefficients with RHS term of the type e^{ax}, sin ax, cos ax, polynomials in x, e^{ax} V(x), xV(x)- Method of Variation of parameters.
Applications: LCR circuit, Simple Harmonic motion.

UNIT III: Fourier Series:
Introduction- Periodic functions – Fourier series of -periodic function - Dirichlet's conditions – Even and odd functions –Change of interval– Half-range sine and cosine series.

UNIT IV: First order Partial differential equations:
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

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UNIT V: Higher order Partial differential equations:
Solutions of Linear Partial differential equations with constant coefficients. RHS term of the type $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

UNIT VI: Applications of PDE:
Classification of second order partial differential equations, Method of separation of Variables- Solution of One dimensional Wave, Heat and two-dimensional Laplace equation and related problems.

Outcomes:

At the end of the Course, Student will be able to:

- Determine rank, Eigenvalues and Eigen vectors of a given matrix and solve simultaneous linear equations.
- Solve simultaneous linear equations numerically using various matrix methods.
- Determine double integral over a region and triple integral over a volume.
- Calculate gradient of a scalar function, divergence and curl of a vector function. Determine line, surface and volume integrals. Apply Green, Stokes and Gauss divergence theorems to calculate line, surface and volume integrals.

Text Books:

1. **B.S.Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **N.P.Bali**, Engineering Mathematics, Lakshmi Publications.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India
2. **Micheael Greenberg,** Advanced Engineering Mathematics, 9th edition, Pearson edn
3. **Dean G. Duffy,** Advanced engineering mathematics with MATLAB, CRC Press
4. **Peter O'neil,** Advanced Engineering Mathematics, Cengage Learning.
5. **Srimanta Pal, Subodh C.Bhunia**, Engineering Mathematics, Oxford University Press.

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University College of Engineering Kakinada (A), Dept. of PE & PCE,
R16, Regulations, Petroleum Engineering: BOS Held (15.04.2018)

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I Year - II Semester

L	T	P	C
4	0	0	3

ENGINEERING PHYSICS

(for non-circuital branches like ME, CE, PE, PCE etc)

Learning Objectives:

- Physics curriculum which is re-oriented to the needs of Circuital branches of graduate engineering courses offered by JNTU, kkd. that serves as a transit to understand the branch specific advanced topics. The courses are designed to:
- Impart concepts of Optical Interference, Diffraction and Polarization required to design instruments with higher resolution - Concepts of coherent sources, its realization and utility optical instrumentation.
- Study the Structure-property relationship exhibited by solid crystal materials for their utility.
- Tap the Simple harmonic motion and its adaptability for improved acoustic quality of concert halls.
- To explore the Nuclear Power as a reliable source required to run industries
- To impart the knowledge of materials with characteristic utility in appliances.

UNIT-I:

INTERFERENCE: Principle of Superposition – Coherent Sources – Interference in thin films (reflection geometry) – Newton's rings –working principle of Interferometers.

UNIT-II:

DIFFRACTION: Fraunhofer diffraction at single slit cases of double slit, N-slits & Circular Aperture (Qualitative treatment only)-Grating equation - Resolving power of a grating, Telescope and Microscope.

UNIT-III:

POLARIZATION: Types of Polarization-production - Nicol Prism -Quarter wave plate and Half Wave plate – Working principle of Polarimeter (Sacharimeter)

LASERS: Characteristics– Stimulated emission – Einstein's Transition Probabilities- Pumping schemes - Ruby laser – Helium Neon laser.

UNIT-IV:

ACOUSTICS: Reverberation time - Sabine's formula – Acoustics of concert-hall.

ULTRASONICS: Production - Ultrasonic transducers - Non-Destructive Testing Applications.

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UNIT-V:

CRYSTALLOGRAPHY & X-RAY DIFFRACTION: Basis and lattice – Bravais systems- Symmetry elements- Unit cell- packing fraction – coordination number- Miller indices – Separation between successive (h k l) planes – Bragg's law – Braggs X-ray spectrometer.

NUCLEAR ENERGY – SOURCE OF POWER: Mass defect & Binding Energy – Fusion and Fission as sources – Fast breeder Reactors.

UNIT-VI:

MAGNETISM: Classification based on Field, Temperature and order/disorder –atomic origin – Diamagnetism – Paramagnetism – Ferromagnetism- Hysteresis- applications of magnetic materials (Para &Ferro).

DIELECTRICS: Electric Polarization – Dielectrics in DC and AC fields – Internal field – Clausius Mossoti Equation - Loss, Breakdown and strength of dielectric materials – Ferroelectric Hysteresis and applications.

Outcomes: Construction and working details of instruments, ie., Interferometer, Diffractometer and Polarimeter are learnt. Study Acoustics, crystallography magnetic and dielectric materials enhances the utility aspects of materials.

List of Text Books:

1. A Text book of Engineering Physics – by Dr. M.N.Avadhanulu and Dr.P.G.Kshirasagar, S.Chand & Company Ltd., (2014)

2. Physics for Engineers by M.R.Srinivasan, New Age international publishers (2009)

List of Refference books:

1. Engineering Physics by D.K.Bhattacharya and Poonam Tandon , Oxford press (2015)

2. Applied Physics by P.K.Palanisamy , Scitech publications (2014)

3. Lasers and Non-Linear optics by B.B.Laud , Newage international publishers (2008)

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I Year - II Semester

L	T	P	C
4	0	0	3

ENIGINEERING MECHANICS

Learning Objectives:

- The students completing this course are expected to understand the concepts of forces and its resolution in different planes, resultant of force system, Forces acting on a body, their free body diagrams using graphical methods.
- They are required to understand the concepts of centre of gravity and moments of inertia and their application, Analysis of frames and trusses, different types of motion, friction and application of work - energy method.

UNIT – I

Objectives: The students are to be exposed to the concepts of force and friction, direction and its application.

Introduction to Engg. Mechanics – Basic Concepts.

Systems of Forces: Coplanar Concurrent Forces – Components in Space – Resultant – Moment of Force and its Application – Couples and Resultant of Force Systems.

Friction: Introduction**,** limiting friction and impending motion, coulomb's laws of dry friction, coefficient of friction, cone of friction

UNIT II: Objectives: The students are to be exposed to application of free body diagrams. Solution to problems using graphical methods and law of triangle of forces.

Equilibrium of Systems of Forces: Free Body Diagrams, , Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

UNIT – III: Objectives : The students are to be exposed to concepts of centre of gravity.

Centroid: Centroids of simple figures (from basic principles) – Centroids of Composite Figures

Centre of Gravity: Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, Pappus theorems.

UNIT IV: Objective: The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.

Area moments of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. **Mass Moment of Inertia:** Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, mass moment of inertia of composite bodies.

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UNIT – V: Objectives: The students are to be exposed to motion in straight line and in curvilinear paths, its velocity and acceleration computation and methods of representing plane motion.
Kinematics: Rectilinear and Curvelinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion. **Kinetics:** Analysis as a Particle and Analysis as a Rigid Body in Translation – Central Force Motion – Equations of Plane Motion – Fixed Axis Rotation – Rolling Bodies.

UNIT – VI: Objectives: The students are to be exposed to concepts of work, energy and particle motion
Work – Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion, Connected System-Fixed Axis Rotation and Plane Motion. Impulse momentum method.

TEXT BOOK:

1. Engg. Mechanics - S.Timoshenko & D.H.Young., 4th Edn - , Mc Graw Hill publications.

Course outcomes:

1. The student should be able to draw free body diagrams for FBDs for particles and rigid bodies in plane and space and problems to solve the unknown forces, orientations and geometric parameters.
2. He should be able to determine centroid for lines, areas and center of gravity for volumes and their composites.
3. He should be able to determine area and mass movement of inertia for composite sections
4. He should be able to analyze motion of particles and rigid bodies and apply the principles of motion, work energy and impulse – momentum.

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	T	P	C
I Year – II SEMESTER	**4**	**0**	**3**

COMPUTER PROGRAMMING

Learning Objectives:
Formulating algorithmic solutions to problems and implementing algorithms in C

- Notion of Operation of a CPU, Notion of an algorithm and computational procedure, editing and executing programs in Linux
- understanding branching, iteration and data representation using arrays
- Modular programming and recursive solution formulation
- Understanding pointers and dynamic memory allocation
- Understanding miscellaneous aspects of C
- Comprehension of file operations

UNIT-I: History and Hardware - Computer Hardware, Bits and Bytes, Components, Programming Languages - Machine Language, Assembly Language, Low- and High-Level Languages, Procedural and Object-Oriented Languages, Application and System Software, The Development of C Algorithms The Software Development Process.

UNIT – II: **Introduction to C Programming**

Identifiers, The main() Function, The printf() Function

Programming Style - Indentation,Comments, Data Types**,** Arithmetic Operations, Expression Types, Variables and Declarations, Negation, Operator Precedence and Associativity, Declaration Statements, Initialization. **Assignment -** Implicit Type Conversions, Explicit Type Conversions (Casts), Assignment Variations, Mathematical Library Functions, Interactive Input, Formatted Output, Format Modifiers.

UNIT -III: **Control Flow Relational Expressions - Logical Operators Selection**: if-else Statement, nested if, examples, Multi-way selection: switch, else-if, examples.

Repetition: Basic Loop Structures, Pretest and Posttest Loops, Counter-Controlled and Condition-Controlled Loops, The while Statement,The for Statement, Nested Loops, The do-while Statement.

UNIT – IV: **Modular Programming**

Function and Parameter Declarations, Returning a Value, Functions with Empty Parameter Lists, Variable Scope, Variable Storage Class, Local Variable Storage Classes

Global Variable Storage Classes, Pass by Reference, Passing Addresses to a Function

Storing Addresses, Using Addresses, Declaring and Using Pointers, Passing Addresses to a Function, Case Study: Swapping Values, Recursion - Mathematical Recursion, Recursion versus Iteration.

UNIT V: **Arrays &Strings**

Arrays

One-DimensionalArrays, Input and Output of Array Values, Array Initialization, Arrays as Function Arguments, Two-Dimensional Arrays, LargerDimensionalArrays- Matrices

Strings

String Fundamentals, String Input and Output, String Processing, Library Functions

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UNIT- VI: Pointers, Structures, Files

Pointers: Concept of a Pointer, Initialisation of pointer variables, pointers as function arguments, passing by address, Dangling memory, address arithmetic, character pointers and functions, pointers to pointers, Dynamic memory management functions, command line arguments.

Structures: Derived types,Structuresdeclaration, Initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit-fields.

Data Files : Declaring, Opening, and Closing File Streams, Reading from and Writing to Text Files, Random File Access

OUTCOMES:

- Understand the basic terminology used in computer programming
- Write, compile and debug programs in C language.
- Use different data types in a computer program.
- Design programs involving decision structures, loops and functions.
- Explain the difference between call by value and call by reference
- Understand the dynamics of memory by the use of pointers
- Use different data structures and create/update basic data files.

TEXT BOOKS:

1. ANSI C Programming, Gary J. Bronson, Cengage Learning.

2. Programming in C, Bl Juneja Anita Seth, Cengage Learning.

3. The C programming Language by Dennis Richie and Brian Kernighan, Pearson Education

REFERENCE:

1. C Programming, A Problem Solving Approach, Forouzan, Gilberg, CENGAGE

2. Programming with C, Bichkar, Universities Press

3. Programming in C, ReemaThareja, OXFORD

4. C by Example, Noel Kalicharan, Cambridge

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I Year - II Semester

L	T	P	C
0	0	3	2

ENGLISH-COMMUNICATION SKILLS LAB-II

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I Year - II Semester

L	T	P	C
0	0	3	2

APPLIED/ENGINEERING PHYSICS LAB
(Any 10 of the following listed experiments)

LIST OF EXPERIMENTS:

1. Determination of wavelength of a source-Diffraction Grating-Normal incidence.
2. Newton's rings – Radius of Curvature of Plano - Convex Lens.
3. Determination of thickness of a spacer using wedge flim and parallel interference fringes.
4. Determination of Rigidity modulus of a material- Torsional Pendulum.
5. Determination of Acceleration due to Gravity and Radius of Gyration- Compound Pendulum.
6. Melde's experiment – Transverse and Longitudinal modes.
7. Verification of laws of vibrations in stretched strings – Sonometer.
8. Determination of velocity of sound – Volume Resonator.
9. L- C- R Series Resonance Circuit.
10. Study of I/V Characteristics of Semiconductor diode.
11. I/V characteristics of Zener diode.
12. Characteristics of Thermistor – Temperature Coefficients.
13. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
14. Energy Band gap of a Semiconductor p - n junction.
15. Hall Effect in semiconductors.
16. Time constant of CR circuit.
17. Determination of wavelength of laser source using diffraction grating.
18. Determination of Young's modulus by method of single cantilever oscillations.
19. Determination of lattice constant – lattice dimensions kit.
20. Determination of Planck's constant using photocell.
21. Determination of surface tension of liquid by capillary rise method.

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I Year - II Semester

L	T	P	C
0	0	2	0

APPLIED/ENGINEERING PHYSICS - VIRTUAL LABS – ASSIGNMENTS
(Constitutes 5 marks of 30marks of Internal-component)

LIST OF EXPERIMENTS

1. Hall Effect
2. Crystal Structure
3. Hysteresis
4. Brewster's angle
5. Magnetic Levitation / SQUID
6. Numerical Aperture of Optical fiber
7. Photoelectric Effect
8. Simple Harmonic Motion
9. Damped Harmonic Motion
10. LASER – Beam Divergence and Spot size
11. B-H curve
12. Michelson's interferometer
13. Black body radiation

URL: www.vlab.co.in

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I Year – II SEMESTER

T	P	C
0	3	2

Computer Programming Lab

Learning Objectives:

- Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures and file programming.
- Acquire knowledge about the basic concept of writing a program.
- Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.
- Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.
- Role of Functions involving the idea of modularity.

Programming:

Exercise - 1 Basic

a). What is a OS Command, Familiarisation of Editors - vi, emacs
b) Using commands like mkdir, ls, cp, mv, cat, pwd, and man
c). C Program to Perform Adding, Subtraction, Multiplication and Division of two numbers From Command line

Exercise - 2 Basic Maths – Output

a) Write a C Program to Simulate 3 Laws at Motion
b) Write a C Program to convert Celsius to Fahrenheit and vice versa

Exercise - 3 Control Flow - I

a). Write a C Program to Find Whether the Given Year is a Leap Year or not.
b). Write a C Program to Add Digits & Multiplication of a number

Exercise – 4 Control Flow - II

a). Write a C Program to Find Whether the Given Number is

i) Prime Number

ii) Armstrong Number

b) Write a C program to print Floyd Triangle

c) Write a C Program to print Pascal Triangle

Exercise – 5 Functions

a).Write a C Program demonstrating of parameter passing in Functions and returning values.

b).Write a C Program illustrating Fibonacci, Factorial with Recursion without Recursion

Exercise – 6 Control Flow - III

a). Write a C Program to make a simple Calculator to
Add, Subtract, Multiply or Divide Using switch…case

b). Write a C Program to convert decimal to binary and hex (using switch call function the function)

Exercise – 7 Functions - Continued

Write a C Program to compute the values of sin x and cos x and e^x values using Series expansion. (use factorial function)

Exercise – 8 Arrays

Demonstration of arrays

a). Search-Linear.

b). Sorting-Bubble, Selection.

c). Operations on Matrix.

Exercises - 9 Structures

a). Write a C Program to Store Information of a Movie Using Structure

b). Write a C Program to Store Information Using Structures with Dynamically Memory Allocation

c). Write a C Program to Add Two Complex Numbers by Passing Structure to a Function

Exercise - 10 Arrays and Pointers

a). Write a C Program to Access Elements of an Array Using Pointer

b). Write a C Program to find the sum of numbers with arrays and pointers.

Exercise – 11 Dynamic Memory Allocations

a). Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.

b). Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function.

Understand the difference between the above two programs

Exercise – 12 Strings

a). Implementation of string manipulation operations **with** library function.
- i) copy
- ii) concatenate
- iii) length
- iv) compare

b) Implementation of string manipulation operations **without** library function.
- i) copy
- ii) concatenate
- iii) length
- iv) compare

Exercise -13 Files

a). Write a C programming code to open a file and to print it contents on screen.
b). Write a C program to copy files

Exercise - 14 Files Continued

a).Write a C program merges two files and stores their contents in another file.
b). Write a C program to delete a file.

OUTCOMES:

- Apply and practice logical ability to solve the problems.
- Understand C programming development environment, compiling, debugging, and linking and executing a program using the development environment.
- Analysing the complexity of problems, Modularise the problems into small modules and then convert them into programs

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- Understand and apply the in-built functions and customised functions for solving the problems.
- Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems.
- Document and present the algorithms, flowcharts and programs in form of user-manuals

Note:

a) All the Programs must be executed in the Linux Environment. (Mandatory)
b) The Lab record must be a print of the LATEX (.tex) Format.

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II Year - I Semester

L	T	P	C
4	0	0	3

COMPLEX VARIABLES

Learning Objectives:

- The aim of this course is to introduce the special functions, their generating functions and the algebra, geometry and calculus of functions of a complex variable. The emphasis will be on gaining a geometric understanding of complex analytic functions as well as developing computational skills in employing the powerful tools of complex analysis for solving theoretical and applied problems.

UNIT-I:
Functions of a complex variable:
Introduction -Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions – Milne – Thompson method.
Applications: Potential between parallel plates, coaxial cylinders, potential in angular regions.

UNIT-II:
Elementary functions and Mapping:
Exponential, trigonometric, hyperbolic functions and their properties – General power Z (c is complex), principal value.
Applications: Polar plots of sinusoidal transfer function. (Section 7.3 of reference book 5)

UNIT-III:
Complex integration:
Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula -Liouville Theorem - Morera's Theorem.
Applications: Circulation along closed curve, conservative fields.

UNIT-IV:
Power series:
Radius of convergence – Taylor's series,-Maclaurin's series -Laurent series- Singular point – Isolated singular point – pole of order m – essential singularity.

UNIT-V:

Evaluation of Integrals:

Residue – Residue theorem

Application: Types of real integrals:

(a) Improper real integrals $\int_{-\infty}^{\infty} f(x)dx$ (b) $\int_{c}^{c+2\pi} f(\cos\theta, \sin\theta)d\theta$

(c) $\int_{-\infty}^{\infty} e^{imx} f(x)dx$ (d) Integrals by indentation

UNIT -VI:

Transformation by exp z, ln z, z^2, z^n (n positive integer), Sin z, Cos z, z+a/z, Translation, rotation, inversion and bilinear transformation –fixed point- cross ratio – properties-invariance of circles.

Applications: Mapping theorem (without proof) with application to stability analysis of closed loop systems, Nyquist stability criterion and its Remarks.(Section 7.5 of reference book 5)

Outcomes:

At the end of the course, student will be able to:

- Solve linear differential equations of first, second and higher order.
- Determine Laplace transform and inverse Laplace transform of various functions and use Laplace transforms to determine general solution to linear ODE.
- Calculate total derivative, Jocobian and minima of functions of two variables.

Text Books:

1. Higher Engineering Mathematics, B.S.Grewal, 43rd Edition, Khanna Publishers.
2. Advanced Engineering Mathematics, Micheael Greenberg, 2nd Edition, Pearson Edn.

Reference Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiley-India.
2. Complex Analysis for Mathematics and Engineering, John H Mathews, Russell W. Howell, 5th Edition, Jones and Bartlett Publishers, 2006.
3. Fundamentals of Complex Analysis, Saff, E.B and A.D Snider, 3rd Edition, Pearson, 2003.
4. A First course in Complex Analysis with Application, Dennis G. Zill and Patrick Shanahan,Jones and Bartlett Publishers, 2011.
5. Modern Control Engineering, Katsuhiko Ogata,5th Edition, Pearson Publishers.

University College of Engineering Kakinada (A), Dept. of PE & PCE,
R16, Regulations, Petroleum Engineering: BOS Held (15.04.2018)

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II Year - I Semester

L	T	P	C
4	0	0	3

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Learning Objectives:

This is a basic course designed to make the student:

- Learn the basic principles of electrical laws and analysis of networks.
- Understand the principle of operation and construction details of DC machines.
- Understand the principle of operation and construction details of transformer.
- Understand the principle of operation and construction details of alternator and 3-Phase induction motor.
- Study the operation of PN junction diode, half wave, full wave rectifiers and OP-AMPs.
- Learn the operation of PNP and NPN transistors and various amplifiers.

UNIT-I:

Electrical Circuits: Basic definitions, Types of network elements, Ohm's Law, Kirchhoff's Laws, inductive networks, capacitive networks, series, parallel circuits and star-delta and delta-star transformations.

UNIT-II:

DC Machines: Principle of operation of DC generator – emf equation - types – DC motor types –torque equation – applications – three point starter, swinburn's Test, speed control methods.

UNIT-III:

Transformers: Principle of operation of single phase transformers, emf equation, losses, efficiency and regulation.

UNIT-IV:

AC Machines: Principle of operation of alternators – regulation by synchronous impedance method, Principle of operation of 3-Phase induction motor–slip–torque characteristics - efficiency – applications.

UNIT-V:

Rectifiers & Linear ICs: PN junction diodes, diode applications(Half wave and bridge rectifiers), Characteristics of operation amplifiers (OP-AMP), Application of OP-AMPs(inverting, non -inverting,integrator and differentiator).

UNIT-VI:

TRANSISTORS: PNP and NPN junction transistor, transistor as an amplifier, single stage CE Amplifier, frequency response of CE amplifier, concepts of feedback amplifier.

Outcomes:

At the end of the course, the student will be able to:

- Analyze the various electrical networks.
- Understand the operation of DC generators,3-point starter and conduct the Swinburn's Test.
- Analyze the performance of transformer.
- Explain the operation of 3-phase alternator and 3-phase induction motors.
- Analyze the operation of half wave, full wave rectifiers and OP-AMPs.
- Explain the single stage CE amplifier and concept of feedback amplifier.

Text Books:

1. Electronic Devices and Circuits, R.L. Boylestad and Louis Nashelsky, 9th Edition, PEI/PHI, 2006.
2. Electrical Technology: Vol – I, Electrical Fundamentals & Vol – II Machines and Measurement, Surinder Pal Bali, Pearson, 2013.
3. Electrical Circuit Theory and Technology, John Bird, 4th Edition, Elsevier, 2010.

Reference Books:

1. Electrical Technology, Naidu, M. and S. Kamakshaiah, Tata McGraw-Hill, 2006.
2. Fundamentals of Electrical Engineering, Rajendra Prasad, 2nd Edition, PHI Learning, 2009.
3. Basic Electrical Engineering, Nagasarkar, T. K. and M. S. Sukhya, 2nd Edition, Oxford Publications, 2009.
4. Industrial Electronics, Mithal, G. K., 9th Edition, Khanna Publishers, 2000.

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II Year - I Semester

L	T	P	C
4	0	0	3

GENERAL GEOLOGY

Learning Objectives:

- This basic course in general geology is designed to train the students to understand the basics of geology, viz: formation of earth, layers of earth, different types of rocks, formation of sedimentary basins and the micro fossils and their relationship to oil and gas accumulation.
- It exposes the students to different geological environments relates to petroleum industry.

UNIT-I:
Dimensions of earth, structure, composition and origin of earth-envelops of the Earth- crust, mantle, core. Internal dynamic process- Plate tectonics- Continental drift, Earthquake and Volcanoes, External dynamic process- weathering, erosion and deposition.

UNIT-II:
Fundamental concepts in Geomorphology-geomorphic processes - distribution of landforms-drainage patterns –development, Landforms in relation to rocks types, paleo-channels, buried channels.

UNIT-III:
Geological work of rivers, wind, ocean, glaciers and the landforms created by them. Identification of different structural features encountered in oil exploration viz: joints, faults, folds, unconformities.

UNIT-IV:
Origin of igneous, sedimentary and metamorphic rocks. Sedimentary structures and textures - petrographic character of conglomerate, sandstone, shale, lime stones and dolomites.

UNIT-V:
Introduction to sedimentary basins and deltaic systems; Topographic maps, Thematic maps, Topographic and Thematic profiles.

UNIT-VI:
Paleontology: Introduction to Paleontology, Fossils and Fossilization.
Micropaleontology - Palynology: Distribution of microfossils - Foraminifera, Radiolaria, Conodonts, Ostracodes, Diatoms; Importance of micro fossils in oil exploration.

Outcomes:

After completion of the course, the students will be able to:

- Discern the dimension of earth structure, composition, origin of earth, formation of earth. It deals essence of scientific studies dealing with the origin, age, structure of the earth and with the evolution, modification, and extinction of various surface and subsurface physical features.
- Understand the land forms as geomorphology, physiography and to gain a better perspective conforming to the present day thinking on the aspects of geology.
- Be impressed by the fact that the subject is not static and will more likely keep his mind open to new ideas.
- Understand the origin of different kinds of igneous, sedimentary, metamorphic rocks that can be understood in terms of their tectonic setting.
- Gain the knowledge on fundamentals of sedimentary basins and paleontology and their significance to the petroleum industry.

Text Books:

1. Engineering Geology, Bell, F.G., 2nd Edition, ButterworthHeimann,2007.
2. Text book of Geology, Mukherjee, P.K., The World Press Pvt. Ltd., 2005.

Reference Books:

1. Elements of Mineralogy, Gribble, C. D., Rutley's, 27th Edition. CBS Publishers, 2005.
2. Principles of Physical Geology, David Duff, Homes, Nelson Thornes Ltd; 4th Revised edition, 1992.
3. Text Book of Physical Geology, Mahapatra, G.B., CBS Publishers, 2002.
4. Principles of Engineering Geology, Bangar, K.M., 2nd Edition, Standard Publishers, 2009.
5. Structural Geology, M. P. Billings, 2nd ed, Englewood Cliffs, N.J. : Prentice-Hall, 1954.

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II Year - I Semester

L	T	P	C
4	0	0	3

SURVEYING AND OFFSHORE STRUCTURES

Learning Objectives: The students will be trained to

- Demonstrate the principles of surveying for the measurement of distance and angles.
- Explain the concepts of leveling and contouring.
- Introduce the concepts of advanced surveying and implementation in shoreline surveying.
- Demonstrate the principles of sea surveying.
- Introduce the concepts of wave and current data collection.
- Explain various stages of fixed offshore structure in view of the operation.
- Introduce the concept and types of compliant structures.
- Demonstrate the basic terminology and floatation principles of floating structures.

UNIT – I:

Distance and Direction: Objectives, Principles and classifications of Surveying, chain, tape, Electronic distance measurements, Meriadians Azimuths and Barings, declination, computation of angle.

Theodolite: Theodolite, description, uses and adjustments – temporary, measurement of horizontal and vertical angles. Principles of Electronic Theodolite.

UNIT – II:

Leveling and Contouring: Concept and Terminology, Temporary- method of leveling. Characteristics and Uses of contours- methods of conducting contour surveys and their plotting.

UNIT –III:

Introduction to Advanced Surveying: Total Station and Global positioning system
hydrographic surveying: Introduction- Shoreline Surveys- Sounding Methods.

UNIT –IV:

Subsea surveying and geomatics, introduction to the principles of subsea surveying and geomatics including bathymetry and seismic survey, positioning systems (surface positioning, visual positioning techniques) distance from shore & water depth, generation of surface waves in oceans, wave data collection, and current data collection.

UNIT –V:

Functions of offshore structures, fixed offshore structures, types of fixed structures, fabrication, transportation, installation and operation of offshore structures, construction of offshore concrete structures, definition of compliant structures, types of complaint structures.

UNIT –VI:

Floating structures, basic hydrostatics, center of gravity, center of buoyancy, displacement, law of floatation, draft, keel, Simpson's rule for areas and centroids, second moments of area, moments of inertia, mass moment of inertia, calculation of metacentric height, stability of floating structures, definition of neutrally and positively buoyant structures.

Outcomes: After successful completion of the course, the student can understand

- The basic principles and significance of measurement of distance and direction
- Horizontal and vertical angles
- Principles, importance and measurement of angles using Theodolite
- Concepts and terminology in contour mapping
- Measurement and to plotting the contour maps
- Basics of total station and GPS
- Shore line survey and basics of acoustics, application in the field.
- Basics of sea surveying and bathymetry, importance of bathymetry survey, seismic survey, positioning and wave and current data collection and significance of data collection.
- Types and functions of fixed offshore structures, methodology of fabrication transportation, installation and operation of fixed offshore structures, Significance and types of compliant structures.
- The basic principles of floatation and stability of floating structures.

Text Books for Units I-III:

- Punmia, B.C., Ashok Kumar Jain and Arun Kumar Jain , Surveying (Vol – 1, 2) ; Higher Surveying, Vol 3, Laxmi Publications, 2005.
- Duggal S K, Surveying (Vol – 1 & 2), Tata McGraw Hill, 2004.
- Venkataramaiah, C., Text book of Surveying, Universities Press, 1996.

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Member	**Member**	**Member**	**Member**	**Member**

Text Books for Units IV-VI:

- Subrata K. Chakrabarti, Handbook of Offshore Engineering, Volume 1, Elsevier, 2005.
- Barrass, C. B. and D. R. Derret, Ship Stability for Masters and Mates, 7th Edition, Butterworth-Heinemann, 2012.
- Gerwick, Jr., C., Construction of Marine and Offshore Structure, 3rd Edition, CRC Press, 2007

Reference Books for Units IV-VI:

- Faltinsen, O., Sea Loads on Ships and Offshore Structures, Cambridge University Press, 1993
- Dean, E. T. R., Offshore Geotechnical Engineering: Principles and Practice, ICEP, 2009
- Paik, J. M., and T. Anil Kumar, Ship-Shaped Offshore Installations: Design, Building and Operation, Cambridge University Press, 2007
- Yong Bai and QiangBai, Subsea Engineering Handbook, (Chapter 4), Gulf Professional Publishing, 2012
- Mohamed A. EL-Reedy, Offshore Structures, Design, Construction and Maintenance, Gulf Professional Publishing

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II Year - I Semester

L	T	P	C
4	0	0	3

CHEMICAL PROCESS CALCULATIONS

Learning Objectives:
The subject of chemical process calculations is intended to make the students understand mainly the calculations involved in material and energy balances of process units. The students will be trained to:

- Understand and correctly implement unit conversions in process calculations.
- Understand and apply theoretical knowledge towards problem solving.
- Analyze and solve elementary material balances in physical and chemical processes.
- Analyze and solve elementary energy balances in reactive and non-reactive processes.
- Formulate and solve combined material and energy balances.
- Realize the relevance of thermodynamics in process calculations.
- Carry out complex process calculations using MS Excel.

UNIT-I:
Stoichiometric relation: Basis of calculations, Methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales.
Behavior of Ideal gases: Kinetic theory of gases, Application of ideal gas law, Gaseous mixtures, Gases in chemical reactions.

UNIT-II:
Vapor pressure: Liquefaction and liquid state, vaporization, boiling point, Effect of temperature on vapor pressure, Antoine equation, Vapor pressure plots, Estimation of critical properties, Vapor pressure of immiscible liquids and ideal solutions, Raoult's law, Non-volatile solutes.

UNIT-III:
Humidity and Saturation: Relative and percentage saturation or dew point, wet bulb and dry bulb temperature, Use of humidity charts for engineering calculations.

UNIT-IV:
Material balances: Tie substance, Yield, Conversion, Processes involving chemical reactions.
Material balance calculation involving drying, dissolution and crystallization; Processes involving recycles, bypass and purge.

UNIT-V:

Thermo-physics: Energy, energy balances, Heat capacity of gases, liquid and mixture solutions. Kopp's rule, Latent heats, Heat of fusion and Heat of vaporization, Trouton's rule, Kistyakowsky equation for non polar liquids enthalpy and its evaluation.

Thermo-chemistry: Calculation and applications of heat of reaction, combustion, formation and neutralization, Kirchoff's equation, enthalpy concentration change, calculation of theoretical and actual flame temperatures.

UNIT-VI:

Combustion Calculations: Introduction to fuels, Calorific value of fuels, coal, liquid fuels, Gaseous fuels, air requirement and flue gases, Combustion calculations, Incomplete combustion, Material and energy balances, Thermal efficiency calculations.

Outcomes:

A student who successfully completes this course will be able to:

- Learn all background information/charts/datasheets required to carry out process calculations. Some of these are vapor pressure correlations, latent heat correlation, steam tables, psychrometric charts, enthalpy-concentration diagrams etc.,
- Formulate and solve simple and moderately complex process calculations associated to industrially prominent chemical processes and technologies.
- Conceptualize an integrated methodology that encompasses the knowledge in other subjects (Physical Chemistry, Thermodynamics and Mathematics) and MS Excel for a systematic and structured approach towards chemical process calculations.
- Analyze chemical processes through the power of modeling and computation. These include back-calculation methods, inventory losses and revenue related assessment etc.

Text Books:

1. Chemical Process Principles, Part -I, Material and Energy Balances, Hougen O A, Watson K. M. and Ragatz R.A., 2nd Edition, CBS Publishers & distributors, New Delhi, 2010.
2. Basic Principles and Calculations in Chemical Engineering, D.H. Himmelblau, 7th Edition. PHI, New Delhi, 2009.

Reference Books:

1. Elementary Principles of Chemical Processes, R. M. Felder and R. W. Rousseau, 3rd Ed., Wiley, 1999.
2. Handbook Chemical Engineering Calculations, N. Chopey, 3rd Edition, Mc-Graw Hill, 2004.
3. Stoichiometry, Bhatt, B. I., Thakore S. B., 5th Ed., Tata Mc-Graw Hill Education 2010.

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II Year - I Semester

L	T	P	C
4	0	0	3

MATERIALS SCIENCE & ENGINEERING

Learning objectives:

This subject is intended to:

- Provide all the technical/engineering inputs to the learner to choose or select suitable materials of construction of chemical/petrochemical process equipment, piping and internals.
- Impart expertise to the material so that it meets the specific life expectancy, by reducing the shutdown frequency.
- Learn the techniques in minimizing equipment breakdown and increasing the on-stream factor.
- To gain knowledge in choosing/selecting the material such that it withstands the severe process operating conditions such as cryogenic, high temperature, high pressure, acidic, basic, stress induced chemical/petrochemical environments keeping view the reliability and safety of the process equipment.

UNIT-I:

Classification of engineering materials, Levels of Structure, Structure-Property relationships in materials, Crystal Geometry and non-crystalline (amorphous) states; Lattice –Bravais lattices, Crystal systems with examples; Lattice co-ordinates, Miller and Miller- Bravais Indices for directions and planes: ionic, covalent and metallic solids; Packing factors and packing efficiency, Ligancy and coordination number; Structure determination by Brag's X-ray diffraction method.

UNIT-II:

Crystal Imperfections-Classification-point defects-Estimation of point defects-Dislocations-classification(edge and screw)-Surface defects-Dislocation motion and its relevance to mechanical and chemical properties –Stress & Strain relationship and diagrams for different materials(metals, non-metals, rubbers and plastics and polymers)-Elastic and plastic deformation-Slip -stress required to move a dislocation; Multiplication of dislocations –Dislocation reactions, Effect on mechanical behavior of materials, Strain hardening/work hardening –Dynamic recovery and recrystallization.

UNIT-III:

Fracture and failure of materials: Ductile fracture analysis - Brittle fracture analysis - Fracture toughness - Ductile-Brittle transition - Fatigue fracture-theory, creep and mechanism –Methods to postpone the failure and fracture of materials and increase the life of the engineering components /structures.

UNIT-IV:

Solid –liquid and solid-solid equilibria for metals and alloys, Phase rule, Phase diagram for pure metals (single component system), alloys (binary systems), Micro structural changes during cooling, Lever rule and its applications, Typical phase diagrams: Homogeneous and heterogeneous systems, formation of Eutectic, Eutectoid mixtures, Non-equilibrium cooling, Binary Systems (phase diagrams) for study: Cu-Ni/Bi-Cd/Pb-Sn/ Fe-C /Al-Cu.

UNIT-V:

Materials for chemical and petrochemical industrial process equipment, Effect of alloying on mechanical and chemical behavior of materials, Applications of heat treatment methods for strengthening of engineering materials.

Composite structures and their advantages over conventional materials, Matrix-reinforcement properties and evaluation of strength properties with different orientation of reinforcement, Applications, Nano materials, Synthesis and characterization.

UNIT-VI:

Stability criteria of materials in chemical/petrochemical industrial environments; Corrosion and Oxidation of materials; Basic mechanisms-types of corrosion; Corrosion testing and evaluation; Prevailing methods to combat corrosion; Coatings – metallic, non-metallic, passivity, cathodic protection – internal corrosion mechanisms and its control.

Outcomes:

After the course, the students will be able to:

- Equipped with knowledge to understand material selection diagram, evaluation of equipment life and prediction of life of the equipment.
- Acquiring the abilities to carryout reliability studies.
- Ready to carryout equipment failure analysis and propose the remedial measures.

Text Books:

1. Materials Science and Engineering, Raghavan, V., 5th Edition, PHI, New Delhi, 2009.
2. Material Science and Engineering, Ravi Prakash, William F. Smith and Javed Hashemi, 4th Edition, Tata-McGraw Hill, 2008.

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Shri J. Ravi Srinivas **Member**	Shri V. Sivarama Krishna **Member**	Dr. S.V.Naidu **Member**	Dr. P. King **Member**	Shri P. Chandra Mohan **Member**

Reference Books:

1 Elements of Material Science and Engineering, Lawrence H. Van Vlack, 6th Edition, Pearson, 2002.
2 Materials Science and Engineering, Bala Subramaniam, R., Callister's, Wiley, 2010.
3. Corrosion Engineering, Mars G. Fontana, Tata-McGraw Hill, 2005.

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II Year - I Semester

L	T	P	C
0	0	3	2

BASIC ENGINEERING (Mech + Elec) LABORATORY

Any SIX experiments from each section
Section A: Mechanical Engineering Laboratory:

Learning Objectives:

- To impart practical exposure on the performance evaluation methods of various mechanical components like, I.C. Engine, Hydraulic turbine, Hydraulic pump, Air compressor etc. and also understand the various processes that can be performed on a lathe machine.

List of Experiments:

1. Draw the valve timing diagram of a 4-stroke diesel engine and port timing diagram of a 2-stroke petrol engine.
2. Perform load test on a 4-stroke I.C .Engine and draw the performance curves.
3. Pattern design and making – for one casting drawing.
4. Taper turning and thread cutting on a Lathe machine.
5. Performance on an Impulse/Reaction Hydraulic Turbine.
6. Performance of Centrifugal/Reciprocating Pump.
7. Find the volumetric efficiency, isothermal efficiency of an Air compressor.

Outcomes:

- The student will be able to predict the performance of several mechanical components and operate a lathe machine to produce the required job work.

Section B: Electrical Engineering Laboratory:

Learning Objectives:

This course imparts knowledge to the students to:

- Learn the estimation of efficiency of a DC machine as motor & generator.
- Learn the estimation of efficiency of transformer at different load conditions & power factors.
- Study the performance of a 3-Phase induction motor by conducting direct test.
- Pre-determine the regulation of an alternator by Synchronous impedance method.
- Understand the speed control of a DC shunts motor.
- Study the performance of a DC shunts motor by conducting direct test.

The following experiments are required to be conducted as compulsory experiments:

1. Swinburne's test on D.C. Shunt machine. (Predetermination of efficiency of a given D.C. Shunt machine working as motor and generator).
2. OC and SC tests on single phase transformer (Predetermination of efficiency and regulation at given power factors)
3. Brake test on 3-phase Induction motor (Determination of performance characteristics)
4. Regulation of alternator by Synchronous impedance method.
5. Speed control of D.C. Shunt motor by
   a) Armature Voltage control b) Field flux control method
6. Brake test on D.C Shunt Motor

Outcomes:

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

- Estimate the efficiency of a DC machine as motor & generator.
- Estimate the efficiency of transformer at different load conditions & power factors.
- Understand the performance of a 3-Phase induction motor by conducting direct test.
- Pre-determine the regulation of an alternator by Synchronous impedance method.
- Control the speed of a DC shunt motor by Field flux control method & Armature Voltage control method.
- Understand the performance characteristics of a DC shunt motor by conducting direct test.

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II Year - I Semester

L	T	P	C
0	0	3	2

GEOLOGY LAB & SURVEYING LAB

GEOLOGY LAB

Experiments	Objective	Outcome: Student can understand
1. Location of observed outcrops on the Top sheet. Geological mapping and Traversing.	To identify location of outcrops on the topo sheet, geological mapping.	Plotting geological mapping.
2. Measurement of the strike, dip and apparent and true thickness of the outcrops.	To measure strike and dip. To learn representation of strike and dip in different locations such as hills beach etc.	Plotting strike and dip in different geological locations such as hills, river banks, beaches etc.
3. Carrying out sampling of the outcrops for petrological, palynological and paleontological studies.	To collect samples for petrological, palynological and paleontological studies.	Collection of samples of outcrops for different studies and the importance of such studies.
4. Preparation of the geological map of the area, structure contour maps and isopach maps for different stratigraphic levels.	To train for drawing area geological map, structure contour and isopach maps.	How to use the maps to estimate reservoir area and thickness.
5. Preparation of litho stratigraphic columns, litho stratigraphic correlation, geological cross sections.	To find importance of litho stratigraphic columns, plotting geological cross sections.	Plotting litho strati-graphic column and geological cross sections.
6. Preparation of structural contour map and location of Oil Water Contact (OWC)	To determine the location of oil-water contact in the reservoir.	Confirmation of the height of the oil bearing sand.
7. Interpretation of isopach map and depositional model.	To train reading of isopach map and depositional model.	Reading of isopach map and depositional model.

8. Field trips to the different deltaic environments of Godavari delta	To make students to do geology survey in Godavari delt using above mentioned methods	Student can be in a position to plot geological map, strike, dip and litho stratigraphic column etc. at any chosen location.

SURVEYING LAB

Experiments	Objective	Outcome: Student can understand
• Study of linear measuring instruments and chain surveying.	To teach linear measurement system and chain surveying.	Student can learn the meaning of linear measuring instrument. Chain surveying and measuring horizontal distances.
• Study of theodolite and traversing with theodolite.	To teach measurement of angles.	Using theodolite, precision and its applications in various fields. Measuring angles in horizontal and vertical planes.
• Study of levels and ordinary leveling with tilting level, Profile leveling.	To teach measurement of leveling.	Student can learn meaning of bench mark, fixing up bench mark, Importance of leveling, leveling in a horizontal plane. Measurement of vertical distances. Representation of vertical distances. Using tilting level, accuracy in measurement of angles, its advantages and disadvantages. Meaning of profile leveling and plotting a profile level diagram.
• Study of total station and measurement with total station.	To teach measuring of distances and angles at a time.	Using total station, its advantages with conventional measuring instruments. Measuring angles and distances using total station and data processing after the measurements. Applications of total station in various fields such as mining, construction etc.
• Study of Global Positioning System (GPS) and measurement with	To teach dynamic data acquisition.	Importance of GPS and its applications in various fields. Measurement of and any dynamic data with respect to

GPS.		time for example wave height.
Measurement and errors	To teach sources of errors and minimizing measurement errors.	Minimizing of measurement errors.

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II Year - I Semester	**L**	**T**	**P**	**C**
	2	**0**	**0**	**0**

MC
MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Unit-I:

(*The Learning objective of this Unit is to understand the concept of Managerial Economics and its relationship with other disciplines, Concept of Demand and Demand forecasting)

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.

(**The Learner is equipped with the knowledge of estimating the Demand for a product and the relationship between Price and Demand).

Unit – II:

(*The Learning objective of this Unit is to understand the concept of Production function, Input Output relationship, different Cost Concepts and Concept of Cost-Volume-Profit Analysis)

Production and Cost Analyses:
Concept of Production function- Cobb-Douglas Production function- Leontief production function - Law of Variable proportions-Isoquants and Iso-costs and choice of least cost factor combination-Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs, Cost–Volume-Profit analysis-Determination of Breakeven point(simple problems)-Managerial significance and limitations of Breakeven point.

(**One should understand the Cost Concepts for decision making and to estimate the least cost combination of inputs)

Unit – III:
(*The Learning Objective of this Unit is to understand the Nature of Competition, Characteristics of Pricing in the different market structures and significance of various pricing methods).

Introduction to Markets & Pricing Methods:
Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination –Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing.

(** One has to understand the nature of different markets and Price Output determination under various market conditions).

Unit – IV:
(*The Learning objective of this Unit is to know the different forms of Business organization and their Merits and Demerits and the concepts of Business Cycles)

Types of Business Organization and Business Cycles:
Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms – Business Cycles : Meaning and Features – Phases of a Business Cycle.

(**One should equipped with the knowledge of different Business Units and different stages of business cycle)

Unit – V:
(*The Learning objective of this Unit is to understand the different Accounting Systems, preparation of Financial Statements and uses of different tools for performance evaluation)

Introduction to Accounting and Financing Analysis:
Introduction to Double Entry System – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow statements (Simple Problems)

(**The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis).

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Unit – VI:

(*The Learning objective of this Unit is to understand the concept of Capital Budgeting and to know the techniques used to evaluate investment proposals by using different methods).

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital Budgeting- 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)

(**The Learner is able to evaluate various investment proposals with the help of capital budgeting techniques for decision making).

Note: * Learning Objective
** Learning Outcome

TEXT BOOKS:

1. Dr. N. AppaRao, Dr. P. Vijay Kumar: 'Managerial Economics and Financial Analysis', Cengage Publications, New Delhi – 2011
2. Dr. A. R. Aryasri – Managerial Economics and Financial Analysis, TMH 2011
3. Dr. B. Kuberudu and Dr. T. V. Ramana: Managerial Economics & Financial Analysis, Himalaya Publishing House, 2014.

REFERENCES:

1. Prof. J.V.Prabhakararao, Prof. P. Venkatarao. 'Managerial Economics and Financial Analysis', Ravindra Publication.
2. V. Maheswari: Managerial Economics, Sultan Chand.2014
3. Suma Damodaran: Managerial Economics, Oxford 2011.
4. VanithaAgarwal: Managerial Economics, Pearson Publications 2011.
5. Sanjay Dhameja: Financial Accounting for Managers, Pearson.
6. Maheswari: Financial Accounting, Vikas Publications.
7. S. A. Siddiqui& A. S. Siddiqui: Managerial Economics and Financial Analysis, New Age International Publishers, 2012
8. Ramesh Singh, Indian Economy, 7thEdn., TMH2015
9. Pankaj Tandon A Text Book of Microeconomic Theory, Sage Publishers, 2015
10. ShailajaGajjala and Usha Munipalle, Univerties press, 2015

II Year - II Semester

L	T	P	C
4	0	0	3

PROBABILITY& STATISTICS

Learning Objectives:

- To acquaint students with the fundamental concepts of probability and statistics and to develop an understanding of the role of statistics in engineering. Also to introduce numerical techniques to solve the real world applications.

UNIT-I:
Discrete Random variables and Distributions:
Introduction-Random variables- Discrete Random variable-Distribution function-Expectation-Moment Generating function-Moments and properties.
Discrete distributions: Binomial, Poisson and Geometric distributions and their fitting to data.

UNIT-II:
Continuous Random variable and distributions:
Introduction-Continuous, Random variable-Distribution function-Expectation-Moment Generating function-Moments and properties.
Continuous distribution: Uniform, Exponential and Normal distributions, Normal approximation to Binomial distribution -Weibull, Gamma distribution.

UNIT-III:
Sampling Theory:
Introduction - Population and samples- Sampling distribution of means (σ known)-Central limit theorem- t-distribution- Sampling distribution of means (σ unknown)- Sampling distribution of variances -χ^2 and F-distributions- Point estimation- Maximum error of estimate - Interval estimation.

UNIT-IV:
Tests of Hypothesis:
Introduction –Hypothesis-Null and Alternative Hypothesis- Type I and Type II errors –Level of significance - One tail and two-tail tests- Tests concerning one mean and proportion, two means-Proportions and their differences- ANOVA for one-way and two-way classified data.

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UNIT-V:

Curve fitting and Correlation:

Introduction - Fitting a straight line –Second degree curve-exponential curve-power curve by method of least squares-Goodness of fit.

Correlation and Regression – Properties.

UNIT-VI:

Statistical Quality Control Methods:

Introduction - Methods for preparing control charts – Problems using x-bar, p, R charts and attribute charts.

Text Books:

1. Probability and Statistics for Engineering and the Sciences, Jay l.devore, 8th Edition,Cengage.
2. Probability and Statistics for Engineering, Richards A Johnson, Irvin Miller and Johnson E Freund.9th Edition,PHI.

Reference Books:

1. Probability and Statistics Engineers and the Scientists,Shron L.Myers, Keying Ye, Ronald E Walpole,8th Edition, Pearson 2007.
2. Introduction to Probability and Statistics, William Menden Hall, Robert J. Bever and Barbara Bever, Cengage learning, 2009.
3. Introduction to Probability and Statistics Engineers and the Scientists, Sheldon, M. Rosss, 4th Edition, Academic Foundation, 2011.
4. Applied Statistics for Engineers and Physical Scientists, Johannes Ledolter and Robert V.Hogg, 3rd Edition, Pearson,2010.

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II Year - II Semester

L	T	P	C
4	0	0	3

MOMENTUM TRANSFER

Learning Objectives:

This course involves the fundamentals of fluid flow by including both theory and the applications of fluid flow in chemical engineering. Basic concepts of fluid mechanics will be taught to make the students to:

- Understand basic concepts associated to fluid flow such as viscosity, shear, Newtonian and non-Newtonian fluids etc.
- Learn and apply continuity and Navier Stokes equations as fundamental equations for the analysis of chemical processes.
- Learn and apply the concept of boundary layer theory and governing mathematical equations for Newtonian and non-Newtonian fluid flows.
- Learn and apply Bernoulli's equation for various simple and complex cases of fluid flow.
- Understand the basic differences between compressible and incompressible fluid flows and suitably adapt, modify and apply suitable correlations for compressible fluid flows.
- Have sound knowledge with respect to various important fluid flows related machinery and equipment. Emphasis shall be towards various types of pumps, compressors and blowers.
- Master the relevant theory for the application of fluid flow past solid surfaces. Emphasis is towards drag and pressure drop correlations for packed and fluidized beds.
- Understand various accessories required for fluid flow such as fittings and valves and their relevance towards variation in pressure drop correlations.
- Understand the knowledge related to various fluid flow measuring devices (Venturi, Orifice, Rotameter and Pitot Tube).

UNIT-I:

Basic concepts of dimensional analysis, Nature of fluids, Hydrostatic equilibrium, Applications of fluid statics.

Fluid flow phenomena - Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers.

UNIT-II:

Basic equation of fluid flow –Mass balance in a flowing fluid; continuity, differential momentum balance; Equations of motion, macroscopic momentum balances, Mechanical energy equations,

Inviscid flow: concepts of Source, sink, vortex, flow over a solid sphere/cylinder, Superposition of flows: Concept of flow separation.

UNIT-III:

Incompressible Newtonian / Non-Newtonian flow in pipes and channels- Shear stress and skin friction in pipes, laminar flow in pipes and channels, Turbulent flow in pipes and channels, Friction from changes in velocity or direction, Losses in pipes.

UNIT-IV:

Flow of compressible fluids- Definitions and basic equations, Processes of compressible flow, Isentropic flow through nozzles, Adiabatic frictional flow and Isothermal frictional flow.

UNIT-V:

Flow past immersed bodies, Drag and Drag coefficient, Flow through beds of solids, Motion of particles through fluids.

Fluidization, Conditions for fluidization, Minimum fluidization velocity, Types of fluidization, Expansion of fluidized bed, Applications of fluidization, Continuous fluidization, Slurry and pneumatic transport.

UNIT-VI:

Transportation and Metering of fluids- Pipes, fittings and valves, Pumps: positive displacement and centrifugal pumps and compressors, fans and blowers; Measurement of flowing fluids: full bore meters, insertion meters.

Outcomes:

By mastering the fluid mechanics course, the student shall be able to:

- Analyze fluid flow in circular and non-circular conduits.
- Do calculations associate to the estimation of friction factor and pressure drop in circular conduits.
- Do calculations involving Bernoulli's equation for the transport of acidic, alkaline, hydrocarbon and miscellaneous incompressible fluids in pipelines.
- Calculate the pressure drops and energy requirements associated to compressible fluid flow in circular and rectangular ducts.
- Estimate pressure drop in packed and fluidized beds.
- Rigorously carry out various calculations associated to fluid flow in various types of pumps, fans and blowers.
- Calculate, analyze and calibrate various flow measuring devices.

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Text Books:

1. Unit Operations of Chemical Engineering, McCabe, W. L., J. C. Smith & Peter Harriot McGraw-Hill, 7th Edition, 2001.
2. Transport Processes and Unit Operations, Christie J. Geankoplis, PHI, 2003.

Reference Books:

1. Introduction to Fluid Mechanics, Fox, R.W. and A. T. McDonald, 5th Edition, John Wiley& Sons, 1998.
2. Chemical Engineering, Vol-1: Fluid flow, Heat Transfer and Mass Transfer, J. M. Coulson and J. F. Richardson, Pergamon Press, 4th Edition,1990.
3. Fluid Mechanics for Chemical Engineers, Noel De Nevers, Tata McGraw-Hill, 2011.
4. Fluid Flow for Chemical and Process Engineers, Bragg R and F. A. Holland, 2nd Edition, Hodder Stoughton Educational, 1995.
5. Fluid Flow for the Practicing Chemical Engineer, Patrick Abulencia, J and Louis Theodore, John wiley and Sons, 2009.

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II Year - II Semester

L	T	P	C
4	0	0	3

PETROLEUM GEOLOGY

Learning Objectives:

- This is a basic course in petroleum geology. The students will be exposed to different source, reservoir and cap-rocks, characterization of reservoir rocks, classification of reservoir pore space, permeability, migration and entrapment, temperature-pressure conditions for the generation of oil and gas from sediments.

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, Subsurface pressure temperature conditions for the generation of oil and gas from the source sediments, Oil window.

UNIT-II:

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, Concept of Shale oil.

UNIT-III:

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 of cap rocks.

UNIT-IV:

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, Evidence for migration, Oil and gas seepages.

UNIT-V:

Entrapment of hydrocarbons: Entrapment and accumulation of hydrocarbons, Classification and types of traps: Structural, stratigraphic and combination type of traps, Traps associated with salt domes.

UNIT-VI:

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

Outcomes:

After successful completion of the course, the students are expected to:

- Identify different source rocks from which hydrocarbons are generated.
- Discern about origin of source rocks, formation of good source rocks, different characterization of reservoir rocks, classification, nomenclature and different source of reservoir rocks, pore space, porosity and its types.
- Gain knowledge of how and why fluid hydrocarbons migrate from a source rock to reservoir rock, entrapment and accumulation of hydrocarbons.
- Do tectonic classification, stratigraphy evaluation and hydrocarbon accumulation of KG basin, Cambay basin and Mumbai off-shore.

Text Book:

1. Geology of Petroleum, A.I. Levorsen, 2nd Edition. CBS, Publishers, 2006.

Reference Books:

1. Elements of Petroleum Geology, Richard, C. Selley, Elsevier, 1997.
2. Sedimentary basins of India- ONGC bulletin.
3. Unconventional Petroleum Geology, Caineng Zou et al., Elsevier, 2013.

II Year - II Semester

L	T	P	C
4	0	0	3

THERMODYNAMICS FOR PETROLEUM ENGINEERS

Learning Objectives:
This course is designed to make the students:

- Understand zeroth, first and second laws of thermodynamics.
- Discern various thermodynamic properties such as internal energy, specific volume, enthalpy, entropy, specific heat etc. from fundamental correlations.
- Learn the application of various thermodynamic laws for the analysis of chemical processes.
- Understand the concept and models of residual and excess Gibbs energy and the associated calculations for VLE, VLLE, SVE and SLE.
- Learn the application of the laws of thermodynamics for hydrocarbon (both liquid and gas) characterization, handling, storage and transport.

UNIT-I:
Introduction: The scope of thermodynamics, defined quantities; temperature, volume, pressure, work, energy, heat, Joules Experiments, SI units.
The first law and other basic concepts: The first law of thermodynamics, thermodynamic state and state functions, enthalpy, The steady-state steady flow process, Equilibrium, The reversible process, constant-V and constant- P processes, heat capacity.

UNIT-II:
Volumetric properties of pure fluids: The PVT behavior of pure substances, virial equations, the ideal gas, the applications of the virial equations, Cubic equations of state, generalized correlations for gases.

UNIT-III:
The second law of thermodynamics: Statements of the second law, heat engines, thermodynamic temperature scales, thermodynamic temperature and the ideal-gas scale, Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, the third law of thermodynamics. Mollier diagram and steam tables.

UNIT-IV:

Thermodynamic properties of fluids: Property relations for homogeneous phases, Residual properties, Generalized property correlations for gases.

Thermodynamics of flow processes; Principles of conservation of mass and energy for flow systems, Analysis of expansion processes; turbines, throttling; compression processes – compressors and pumps; Calculation of ideal work and lost work, Examples on hydrocarbons and natural gas.

UNIT-V:

Solution thermodynamics: Basic concepts of chemical potential, Phase equilibria, partial properties, fugacity coefficient, residual and excess Gibbs free energy, Correlations for the estimation of fugacity coefficient, Residual and excess Gibbs energy in vapor liquid equilibria.

UNIT-VI:

Phase Equilibria: Gamma/Phi formulation of VLE, VLE from Virial equations of state and cubic equations of state, Introduction to Vapor- Liquid–Liquid equilibrium (VLLE), Solid-Liquid equilibrium (SLE) and Solid-Vapor equilibrium (SVE), Equilibrium adsorption of gases on solids.

Outcomes:

After completion of the course, the students shall be able to:

- Become conversant with all the basic concepts of thermodynamics and gain working knowledge in open, closed, isothermal, isobaric and isentropic processes.
- Use thermodynamic tables and diagrams for the estimation of internal energy, specific volume, enthalpy and entropy.
- Apply equations such as ideal gas law, Vander Waal's equation and other cubic equations of state for the characterization of chemical process parameters.
- Determine efficiencies of turbines, pumps, compressors, blowers and nozzles.
- Rigorously use residual and excess Gibbs free energy models for design of oil and natural gas processing systems.

Text Book:

1. Introduction to Chemical Engineering Thermodynamics, Smith, J. M., H. C. Van Ness and M.M. Abbott, 6th Edition, 8th reprint, McGraw Hill, 2006.

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Chairman	**Member**	**Member**	**Member**	**Member**

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Member	**Member**	**Member**	**Member**	**Member**

Reference Books:

1. Characterization and Properties of Petroleum Fractions, M. R. Riaze, ASTM, International, 2005.
2. Equation of State and PVT analysis, Tarek Ahmed, Gulf publishing company, 2007.
3. Engineering and Chemical Thermodynamics, Koretsky, M. D., John Wiley & Sons, 2004.
4. Introductory Chemical Engineering Thermodynamics, Richard Elliott, J. and Carl T. Lira, 2nd Edition, Prentice Hall, 2012.
5. Chemical, Biochemical and Engineering Thermodynamics, Stanley Sandler, 4th Edition, Wiley India Pvt. Ltd, 2006.
6. Thermodynamics: Applications in Chemical Engineering and the Petroleum Industry, Vidal, J., Edition Technip, 2003.
7. Chemical and Process Thermodynamics, Kyle, B.G., 3rd Edition, PHI Learning, 2008.
8. Chemical Engineering Thermodynamics, Thomas E. Dauber, McGraw Hill, 1985.

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II Year - II Semester

L	T	P	C
4	0	0	3

PROCESS HEAT TRANSFER

Learning Objectives:

- This course is designed to introduce a basic study of the phenomena of heat transfer to carry out thermal design/ heat transfer process design for heat exchange systems such as process heat exchangers, reboilers, air/utility coolers/condensers, furnaces, boilers, super-heaters, evaporators, driers, cooling towers etc. The principles involve the estimation of overall heat transfer coefficients, heat transfer surface area, pressure drop involved in single-phase and multi-phase flow regimes.
- The students will be trained to acquire skills to carry out the detailed mechanical design of heat exchangers such as number tubes, selection of shell and tube material, estimate number of baffles and also provide necessary information regarding TEMA classification.

UNIT-I:

Introduction: Nature of heat flow, conduction, convection, natural and forced convection, and radiation.

Heat transfer by conduction in Solids: Fourier's law, thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres, thermal contact resistance, plane wall: variable conductivity.

Unsteady state heat conduction: Equation for one-dimensional conduction, Semi-infinite solid, finite solid.

UNIT-II:

Principles of heat flow in fluids: Typical heat exchange equipment, countercurrent and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference, variable overall coefficient, multi-pass exchangers, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.

UNIT-III:

Heat Transfer to Fluids without Phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

UNIT-IV:

Natural convection: Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar flow heat transfer.

Heat transfer to fluids with phase change: Heat transfer from condensing vapors, heat transfer to boiling liquids.

UNIT-V:

Radiation: Emission of radiation**,** absorption of radiation by opaque solids, radiation between surfaces, combined heat transfer by conduction, convection and radiation.

Evaporators: Types of Evaporators, performance of tubular evaporators, vapor recompression.

UNIT-VI:

Heat Exchange Equipment: General design of heat exchange equipment, heat exchangers, condensers, boilers and calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchanger effectiveness (NTU method).

Outcomes:

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

- Understand the basic laws of heat transfer.
- Account for the consequence of heat transfer in thermal analyses of engineering systems.
- Analyze problems involving steady state heat conduction in simple geometries.
- Develop solutions for transient heat conduction in simple geometries.
- Obtain numerical solutions for conduction and radiation heat transfer problems.
- Understand the fundamentals of convective heat transfer process.
- Evaluate heat transfer coefficients for natural convection.
- Evaluate heat transfer coefficients for forced convection inside ducts.
- Evaluate heat transfer coefficients for forced convection over exterior surfaces.
- Analyze heat exchanger performance by using the method of log mean temperature difference.
- Analyze heat exchanger performance by using the method of heat exchanger effectiveness.
- Calculate radiation heat transfer between black body surfaces as well as grey body surfaces.

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Text Books:

1. Unit Operations of Chemical Engineering, McCabe, W.L., J.C Smith and Peter Harriott, 7th Edition, McGraw-Hill, 2005.
2. Heat Transfer, Y.V.C. Rao, Universities Press (India) Pvt. Ltd., 2001.

Reference Books:

1. Process Heat Transfer, D.Q. Kern, Tata- McGraw-Hill, 1997.
2. Heat Transfer, Holman, J.P., 9th Edition, Tata McGraw-Hill, 2008.
3. Schaum's Outline of Heat Transfer, Donald Pitts and L. E. Sisson, 2nd Edition, McGraw-Hill, 1998.
4. A Text Book on Heat Transfer, Sukhatme, P., 5th Edition, Universities Press (India) Pvt. Ltd., 2005.
5. Heat Transfer: Principles and Applications, Binay Dutta, K., PHI Learning, 2009.
6. Chemical Engineering: Fluid Flow, Heat Transfer and Mass Transfer, Coulson, J.M.; Richardson, J.F.; Backhurst, J.R.; Harker, J.H., Vol.1, 6th Edition, Reed Elsevier India, 2006.

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II Year - II Semester

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PETROLEUM EXPLORATION

Learning Objectives:

- The course for petroleum exploration is aimed at the students to have a broad knowledge of exploration history in India. The students should know what are the basic methods; which are used in petroleum exploration with special emphasis on gravity/magnetic and more importantly the students should understand in detail about the Seismic methods which are the back bone of the whole gamut of oil exploration, knowledge of mapping different oil bearing structure.
- At the same time sedimentology and biostratigraphy are also important to understand the sedimentary sequences holding hydrocarbons as the knowledge of these will help in the log interpretation also.

UNIT-I:

Introduction: Overview of petroleum exploration in India, Introduction to Geophysical/Geological methods used in petroleum exploration.

UNIT-II:

Sedimentological and biostratigraphic approaches in hydrocarbon exploration.

UNIT-III:

Basic concepts of Gravity/Magnetic methods: Newton's gravitational law- Units of gravity- Gravity measuring instruments- Gravity survey- Gravity anomalies- Gravity data reduction- Drift- latitude- Elevation and free air correction- Free air & bouguer anomalies- Gravity response of simple shapes- Interpretation of gravity anomalies- Application of gravity methods. The geomagnetic field- Magnetic anomalies- Magnetic survey-instruments- Field method of magnetic surveys- Reduction of magnetic data - Diurnal correction and geomagnetic correction- Interpretation of magnetic anomaly- Response of magnetic method for different type of bodies and geological structure- Application of magnetic surveys both overland and from air.

UNIT-IV:

Basic Concepts of seismic methods: Seismic refraction surveys- Geometry of refracted path, planar interface – Two-layer case with horizontal interface- Methodology of refraction profiling- Recording instruments & energy sources- Corrections applied to refraction data, Interpretation of refraction data - Application of seismic refraction method.

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UNIT-V:

Geometry of reflected ray path: Single horizontal reflector- The reflection seismograph and seismogram (Seismic traces)- Importance of seismic reflection survey over seismic refraction survey technique- Common depth point (CDP) profiling and stacking- 2D, 3D, & 4D seismic surveys - Field procedures and principles - Time corrections applied to seismic data- Data processing - Introduction to 2D, 3D & 4D data acquisition, interpretation of reflection data for identification of drillable structures.

UNIT-VI:

Well seismic shooting for velocity determination and Vertical Seismic Profiling (VSP) – Different types of VSP surveys viz. 3D, offset VSP.

Outcomes:

- It gives insight to the students to have a broad based understanding of the seismic exploration, viz. its acquisition methods, processing and interpretation, as they have already had geology in IInd year course. The knowledge of these methods will go a long way along with the other subject i. e., well logging and formation evaluation for them to opt for upstream industry jobs if they so desire.
- Students should be able to interpret GM & Seismic data for identification of oil bearing structures.

Text Books:

1. Introduction to Geophysical Prospecting, Milton B. Dobrin, and Carl H. Savit, 4th Edition, McGraw Hill, 1988.
2. Outlines of Geophysical Prospecting: A Manual for Geologists, M.B. Ramachandra Rao, EBD Educational Pvt. Ltd., 1993.
3. Field Geophysics, John Milsom and Asger Eriksen, 4th Edition, John Wiley, 2011.

Reference Books:

1. Elements of Geology: Oil and Gas Exploration Techniques, J. Guillemot, Technip 1991.
2. Hydrocarbon Well Logging Recommended Practice, Society of Professional Well Log Analysts.
3. Open – Hole Log Analysis and Formation Evaluation, Richard M. Batemons, International Human Resources Development Corporation, Bostan, 1985.
4. Well Logging for Earth Scientists, Darwin V. Ellis, Julian M. Singer, Springer, 2007.
5. Fundamentals of Well Log Interpretation: The Acquisition of Data, Oberto Serra, Elsevier, 1984.
6. Well Logging Handbook, Oberto Serra, Editions Technip, 2008.

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II Year - II Semester

L	T	P	C
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MOMENTUM TRANSFER LAB

Learning Objectives:

- Fundamentals of momentum transfer will be demonstrated in a series of laboratory exercises like determination of discharge coefficient of orifice, venturi, notches, friction factors in pipes, pressure drop in packed and fluidized beds, fluid viscosity, characteristics of centrifugal pump, characterization of fluid flow, verification of Bernoulli's theorem, and measurement of point velocities. Hands-on experience and communication skills will be achieved.

List of Experiments:

1. Identification of laminar and turbulent flows; Major equipment - Reynolds apparatus.
2. Measurement of point velocities; Major equipment - Pitot tube setup.
3. Verification of Bernoulli's equation; Major equipment – Bernoulli's Apparatus.
4. Calibration of Rotameter; Major equipment – Rotameter Assembly.
5. Variation of Orifice coefficient with Reynolds Number; Major equipment - Orifice meter Assembly.
6. Determination of Venturi coefficient; Major equipment – Venturi meter Assembly.
7. Friction losses in Fluid flow in pipes; Major equipment - Pipe Assembly with provision for Pressure measurement.
8. Pressure drop in a packed bed for different fluid velocities; Major equipment - Packed bed with Pressure drop measurement.
9. Pressure drop and void fraction in a fluidized bed; Major equipment - Fluidized bed with Pressure drop measurement.
10. Studying the coefficient of contraction for a given open orifice; Major equipment - Open Orifice Assembly.
11. Studying the coefficient of discharge in a V-notch; Major equipment - V-notch Assembly.
12. Studying the Characteristics of a centrifugal pump; Major equipment - Centrifugal Pump.
13. Viscosity determination using Stoke's law; Major equipment–Terminal Velocity determination column.

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Outcomes:

After completion of the course**,** students will be able to do the following:

- Operate fluid flow equipment and instrumentation.
- Collect and analyze data using momentum transfer principles and experimentation methods.
- Prepare reports following accepted writing and graphical techniques.
- Perform exercises in small teams.
- Demonstrate principles discussed in momentum transfer lecture course.
- Demonstrate appropriate work habits consistent with industry standards.

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II Year - II Semester

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PROCESS HEAT TRANSFER LAB

Learning Objectives:

- Fundamentals of process heat transfer will be demonstrated in a series of laboratory exercises like determination of thermal conductivities of composite wall and metal rod, natural convective and forced convective heat transfer coefficients, both film and overall coefficients, Stefen-Boltzman constant, emissivity of a metal plate etc. Students will achieve hands-on experience and acquire communication skills while conducting experiments in a team.

List of Experiments:

1. Determination of total thermal resistance and thermal conductivity of composite wall.
2. Determination of thermal conductivity of a metal rod.
3. Determination of natural convective heat transfer coefficient for a vertical rod.
4. Determination of critical heat flux point for pool boiling of water.
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe
6. Determination of overall heat transfer coefficient in double pipe heat exchanger.
7. Study of the temperature distribution along the length of a pin-fin under natural and forced convection conditions
8. Estimation of un-steady state film heat transfer coefficient between the medium in which the body is cooled.
9. Determination of Stefan – Boltzmann constant.
10. Determination of emissivity of a given plate at various temperatures.

Outcomes:

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

- Understand the basics of experimental techniques for heat transfer measurements.
- Operate the heat transfer equipment like heat exchangers
- Process experimental data and obtain correlations to predict heat transfer coefficients for design of heat transfer systems.
- Conduct the experiments at R & D level in the industry
- Understand the professional and ethical responsibilities in the field of heat transfer.
- Produce a written laboratory report.

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II Year - II Semester

L	T	P	C
2	0	0	0

MC

PROFESSIONAL ETHICSAND HUMAN VALUES

Learning Objectives:

- To give basic insights and inputs to the student to inculcate Human values to grow as a responsible human beings with proper personality.
- Professional Ethics instills the student to maintain ethical conduct and discharge their professional duties.

UNIT – I:

(* This chapter provides the student, a detailed classification of Human Values, Universal Values and Fundamental Values and character).

Human Values:

Morals, Values and Ethics – Integrity –Trustworthiness - Work Ethics – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value Time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.

(** The student, after learning different values would now be able to assess the reality in the broader sense).

UNIT – II:

(* This chapter provides an introduction of Ethics and Engineering Ethics, Profession and Professionalism and different Ethical Theories and their applications).

Principles for Harmony:

Truthfulness – Customs and Traditions -Value Education – Human Dignity – Human Rights – Fundamental Duties - Aspirations and Harmony (I, We & Nature) – Gender Bias - Emotional Intelligence – Salovey – Mayer Model – Emotional Competencies – Conscientiousness.

(** The Student is exposed to Engineering Ethics and Ethical Theories in their professional and personal life).

UNIT – III:

(*This chapter gives a brief description on the importance and relation between the Engineering standards and Society, role of engineers as managers and consultants, Role of codes).

EngineeringEthics and Social Experimentation:

Need of Engineering Ethics - Senses of Engineering Ethics- Profession and Professionalism —Self Interest - Moral Autonomy – Utilitarianism – Virtue Theory - Uses of Ethical Theories - Deontology- Types of Inquiry –Kohlberg's Theory - Gilligan's Argument –Heinz's Dilemma - Comparison with

Standard Experiments — Learning from the Past –Engineers as Managers and Consultants – Role of Codes – Codes and Experimental Nature of Engineering.
(** The student now learns the importance of social experimentation in Engineering and different roles played by an Engineer).

UNIT – IV:
(*This chapter offers various cases relating to Safety and Risk, Responsibility of an Engineer towards Safety and Risk).
Engineers' Responsibilities towards Safety and Risk:
Concept of Safety - Safety and Risk – Types of Risks – Voluntary v/sInvoluntary Risk – Consequences - Risk Assessment – Accountability – Liability - Reversible Effects - Threshold Levels of Risk - Delayed v/sImmediate Risk - Safety and the Engineer – Risk-Benefit Analysis-Accidents.
(** The student realizes the importance of Safety and understood the Risk- Benefit analysis).

UNIT – V:
(* This chapter deals with achieving collegiality, different senses of Loyalty, Professional Rights and Responsibilities, Acceptance of Bribes/Gifts, Occupational Crimes and the Concept of Whistle Blowing).
Engineers' Duties and Rights:
Concept of Duty - Professional Duties – Collegiality - Techniques for Achieving Collegiality – Senses of Loyalty - Consensus and Controversy - Professional and Individual Rights –Confidential and Proprietary Information - Conflict of Interest-Ethical egoism - Collective Bargaining – Confidentiality - Gifts and Bribes -Occupational Crimes- Industrial Espionage- Price Fixing-Whistle Blowing.
(** The student gets exposed to different life skills, Professional Rights and Responsibilities and would be able to know and differentiate good and bad sides of the profession).

UNIT – VI:
(* This Lesson imparts a universal outlook of issues relating to Globalization and its affects, Environmental Issues, Ethics related to Computers, Research and Intellectual Property Rights).
Global Issues:
Globalization and MNCs –Cross Culture Issues - Business Ethics – Media Ethics - Environmental Ethics – Endangering Lives - Bio Ethics - Computer Ethics - War Ethics – Research Ethics - Intellectual Property Rights.
(** The Learner would be able to be familiar with Globalization and its affects, Environmental hazards, Ethics related to Research and Computers and the knowledge related to IPRs).

- Related Cases Shall be dealt where ever necessary.

Note: (* Learning Objectives)
(** Outcomes)

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References:

1. Professional Ethics by R. Subramaniam – Oxford Publications, New Delhi.
2. Ethics in Engineering by Mike W. Martin and Roland Schinzinger - Tata McGraw-Hill – 2003.
3. Professional Ethics and Morals by Prof.A.R.Aryasri, DharanikotaSuyodhana - Maruthi Publications.
4. Engineering Ethics by Harris, Pritchard and Rabins, Cengage Learning, New Delhi.
5. Human Values & Professional Ethics by S. B. Gogate, Vikas Publishing House Pvt. Ltd., Noida.
6. Engineering Ethics & Human Values by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd – 2009.
7. Professional Ethics and Human Values by A. Alavudeen, R.Kalil Rahman and M. Jayakumaran – University Science Press.
8. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill - 2013
9. Human Values And Professional Ethics by Jayshree Suresh and B. S. Raghavan, S.Chand Publications

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III Year - I Semester

L	T	P	C
4	0	0	3

MANAGEMENT SCIENCE

Unit I:

(*The Learning objective of this Unit is to understand the concept and nature of Management, Evolution of Management theories, Motivation and leadership Styles).

Introduction to Management: Concept –nature and importance of Management –Generic Functions of Management – Evaluation of Management thought- Theories of Motivation – Decision making process- Principles of organization – Organizational topology- International Management: Global Leadership and Organizational behavior EffectivenessGLOBE) structure

(**The learner is equipped with the concept and functions of Management, Theories of Motivation and Styles of Leadership).

Unit II:

(The Learning objective of this Unit has to Equip with the concepts of Operations, project management and inventory control).

Operations Management: Principles and Types of Management – Work study- Statistical Quality Control- Control charts (X- chart, R-chart,P-chart andC-chart) Simple problems- Materials Management: Need for Inventory control- EOQ, ABC analysis (simple problems) and Types of ABC analysis (HML, SDE, VED and FSN analyses).

(**The learner is able to understand the methods of quality control and different concepts of Inventory Management Techniques).

Unit III:

(* The Objective of this unit is to understand the main functional areas of organization i.e., Financial Management, Production Management, Marketing Management, Human Resource Management, Product Life Cycle and Channels of Distribution).

Functional Management: Concept of HRM, HRD and PMIR- Functions of HR Manager- Wage payment plans(Simple Problems) – Job Evaluation and Merit Rating - Marketing Management: Functions of Marketing – Marketing strategies based on product Life Cycle and Channels of distribution.

(**At the end of this chapter the learner is able to understand the different functional areas in an organization and their responsibilities).

Unit IV:

(*Theobjective of this unit is to understand the concepts of Network Analysis)

Project Management: (PERT/CPM): Development of Network – Difference between PERT and CPM Identifying Critical Path- Probability- Project Crashing (Simple Problems)

(**Thelearner is able to control and implement the project with in schedule time).

Unit V:

(*Theobjective of this unit is to equip with the concept and practical issues relating to Strategic Management).

Strategic Management: Vision, Mission, Goals, Strategy – Elements of Corporate Planning Process – Environmental Scanning – SWOT analysis- Steps in Strategy Formulation and Implementation, Generic Strategy Alternatives, Global strategies, theories of Multinational Companies.

(**The learner is able to familiar with the meaning of Vision, Mission, Goals and Strategies of the Organization and to prepare the strategies of organization).

Unit VI:

(*The Learning objective of this unit is to equip with the contemporary management practices, i.e., MIS, MRP, JIT and ERP etc.)

Contemporary Management Practices: Basic concepts of MIS, MRP, Just-in-Time(JIT) system, Total Quality Management(TQM), Six sigma and Capability Maturity Model(CMM) Levies, Supply Chain Management , Enterprise Resource Planning (ERP), Business Process outsourcing (BPO), Balanced Score Card.

(**The Learner is able to understand the various contemporary issues in Management Practices like TQM and BPO etc.)

Note: * Learning Objective
** Learning Outcome

Text Books

1. Dr. P. Vijaya Kumar & Dr. N. Appa Rao, '*Management Science'* Cengage,Delhi, 2012.
2. Dr. A. R. Aryasri, *Management Science'* TMH 2011.

Reference Books:

1. Koontz &Weihrich: 'Essentials *of management'* TMH 2011
2. Seth &Rastogi: Global Management Systems, Cengage learning , Delhi, 2011
3. Robbins: Organizational Behaviour, Pearson publications, 2011
4. KanishkaBedi: Production & Operations Management, Oxford Publications, 2011
5. Philip Kotler & Armstrong: Principles of Marketing, Pearson publications
6. Biswajit Patnaik: Human Resource Management, PHI, 2011
7. Hitt and Vijaya Kumar: Starategic Management, Cengage learning
8. Prem Chadha: Performance Management, Trinity Press(An imprint of Laxmi Publications Pvt. Ltd.) Delhi 2015.
9. Anil Bhat& Arya Kumar : Principles of Management, Oxford University Press, New Delhi, 2015.

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III Year - I Semester

L	T	P	C
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PROCESS DYNAMICS AND CONTROL

Learning objectives:

- Visualize and understand the behavior 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 behavior 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.

UNIT-II:
Response of first order systems in series, higher order systems: Second order and transportation lag. Control systems Controllers and final control elements.

UNIT-III:
Block diagram of a Petrochemical rector control system. Closed loop transfer functions, Transient response of simple control systems..

UNIT-IV:
Stability Criterion, Routh Test, Root locus, Transient response from root locus, Application of root locus to control systems Introduction to frequency response.

UNIT-V:
Control systems design by frequency response. Advanced control strategies, Cascade control, Feed forward control, ratio control, Smith predictor, dead time compensation, internal model control.

UNIT -VI:
Controller tuning and process identification. Control valves.

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 behavior of a process.
- Design and operate control valves.

Text Book:

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

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.
7. Modern Control Engineering, Katsuhiko Ogata, 5th Edition, Prentice Hall, 2010.
8. Principles and Practices of Automatic Process Control, Carlos A. Smith, Armando B. Corripio, 3rd International Edition, John Wiley and Sons, 2005.

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III Year - I Semester

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PROCESS INSTRUMENTATION

Learning Objectives:

- To learn the basic elements of an instrument and its static and dynamic characteristics.
- To study various types of industrial thermometers.
- To learn basic concepts of various types of composition analysis.
- To learn various types of instruments for measurement of pressure, vacuum, head, density, level and flow measurement.
- To get an overview of various recording, indicating and signaling instruments, transmission of instrument readings, instrumentation diagrams, control center, process analysis and digital instrumentation.

UNIT-I:

Fundamentals: Elements of instruments, static and dynamic characteristics -Basic concepts of response of first order type instruments.

Industrial Thermometers-1: Mercury in glass thermometer - Bimetallic thermometer - Pressure spring thermometer, Static accuracy and response of thermometry.

UNIT-II:

Industrial Thermometers-2: Thermo-electricity - Industrial thermocouples – Thermocouple wires-Thermocouple wells and response of thermocouples; Thermal coefficient of resistance-Industrial resistance-thermometer bulbs and circuits-Radiation receiving elements-Radiation photo electric and optical pyrometers.

UNIT-III:

Composition analysis: Spectroscopic analysis by absorption, emission, mass and color measurement spectrometers - Gas analysis by thermal conductivity, analysis of moisture.

Pressure, vacuum and head: Liquid column manometers - Measuring elements for gauge pressure and vacuum-indicating elements for pressure gauges - Measurement of absolute pressure - Measuring pressure in corrosive liquids - Static accuracy and response of pressure gauges.

UNIT-IV:

Density and specific gravity measurements- Direct measurement of liquid level - Pressure measurement in open vessels - Level measurements in pressure vessels - Measurement of interface level - Density measurement and level of dry materials.

UNIT-V:

Flow Meters: Head flow meters - Area flow meters - Open channel meters - Viscosity meters - Quantity meters - Flow of dry materials - Viscosity measurements.

UNIT-VI:

Recording instruments - Indicating and signaling instruments - Transmission of instrument readings - Controls center - Instrumentation diagram - Process analysis - Digital instrumentation, SCADA systems.

Outcomes:

The students will be able to:

- Understand the basic elements of an instrument and its characteristics.
- Become familiar with various types of instruments for the measurement of various process variables like temperature, pressure, vacuum, head, level, composition, flow and density.
- Get a clear perspective of various recording, indicating, signaling instruments and transmission of instrument readings.
- Get an understanding of instrumentation diagrams, control center, process analysis and digital instrumentation.

Text Books:

1. Industrial Instrumentation, Donald P. Eckman, CBS, 2004.
2. Instrumentation and Control Systems, K. Padma Raju, Y.J. Reddy, McGraw Hill Education, 2016.

Reference Books:

1. Principles of Industrial Instrumentation, Patranabis, 2nd Edition, Tata McGraw-Hill, 1996.
2. Process Control and Instrumentation Technology, Curtis D. Johnson, 3rd Edition, Prentice Hall, 1988.
3. Process Instrumentation Applications Manual, Bob Connell, 2nd Edition, McGraw-Hill, 1995.

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III Year - I Semester

L	T	P	C
4	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.

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.

UNIT-VI:
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.

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III Year - I Semester

L	T	P	C
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DRILLING TECHNOLOGY

Learning Objectives:

- To understand various aspects involved in drilling a well.
- To understand the plan 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.

UNIT-I:

Overview of drilling: Drilling plan - GTO -Types of drilling, Rotary bit technology - Drilling string basics. Drilling fluid properties - Drilling fluid hydraulics calculations - Bit Hydraulics – Optimization - Swab & Surge pressures - Mud hydraulics analysis report - Lost circulation. Disposing of the drilling fluids waste and drill cuttings waste.

UNIT-II:

Hydrostatic pressure, Pore pressure, Causes of abnormal pore pressure, abnormal pore pressure evaluation - Mud logging methods - Measurement while drilling & logging while drilling data - Direct measurements of pore pressure - Formation integrity tests – Fracture gradient determination – Theory of wellbore – FIT procedural Guidelines – Predicting fracture gradient: HPHT well design.

UNIT-III:

Wellbore stability – Determination of the magnitude and direction of the in-situ stress - Determination of rock properties, Failure criteria – Stress distribution around a wellbore - Procedure for determining safe mud weights to prevent hole collapse, Preventing borehole instability - Gas behavior in a well – Kick tolerance, How to calculate kick tolerance – Influence of FG on kick tolerance – Kick tolerance while drilling – Kick tolerance graph – Modifying the kick tolerance – Use of kick tolerance to calculate wellbore pressures.

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UNIT-IV:

Casing: Functions of casing – Types of casing – Casing properties and specifications – Casing connections – Factors influencing casing design – Collapse criterion – Burst criterion – Combination strings – Tension criterion - Compression loads – Biaxial effects – Triaxial analysis – Triaxial load capacity diagram, Casing seat selection method.

Cementation: Introduction to cement slurries - Typical field calculations - Cementing nomenclature - Cement additives – Cementation of liners.

UNIT-V:

Directional drilling: Applications - Well planning - Down-hole motors - Deflection tools and techniques - Face orientation - Direction control with rotary assemblies - Navigation drilling systems; Horizontal wells – Well profile design considerations – Torque and drag – Horizontal borehole stability – Extended reach well design – Multilateral wells.

UNIT-VI:

Stuck pipe, well control: Kicks - Kick control - Pressure control theory – BOP - Special kick problems and procedures to free the pipes and Fishing operations. Types of fishing tools, Case studies of blow out control and fishing operations.

Outcomes:

The students will be able to:

- Apply drilling concepts of a well from planning to rig mobilization to the location.
- Apply the concept of a drill string design for drilling.
- Select the suitable drilling fluids during drilling.
- Do casing and cementation design.
- Carry out directional drilling.
- Troubles shoot well control, stuck pipe and fishing problems.
- Select the proper drilling equipment.

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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.

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.

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III Year - I Semester

L	T	P	C
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MATHEMATICAL METHODS LAB

Learning Objective:

To train the students in writing MATLAB code, executing and doing what if analysis of the variations in the parameters for various problems using mathematical methods.

1. Determination of Molar volume and Compressibility from Redlich - Kwong Equation.
2. Calculation of Flow rate in a pipeline.
3. Correlation of the Physical properties.
4. Compressibility factor variation from vanderWaals Equation.
5. Isothermal compression of gas using RK/SRK/PR Equation of State.
6. Thermodynamic properties of steam from RK/SRK/PR Equation of State.
7. Solution of Stiff Ordinary Differential Equations.
8. Iterative Solution of ODE boundary value problems.
9. Shooting method for solving two-point boundary value problems.
10. Expediting the solution of systems of nonlinear algebraic equations.
11. Solving differential algebraic equations –DAEs.
12. Method of lines for Partial Differential Equations.

Outcome:

The students will be able to write MATLAB code and solve typical problems encountered in petroleum engineering subjects.

Textbook:

1. Problem solving in Chemical and Biochemical Engineering with POLYMATH, Excel and MATLAB, Michael B. Cutlip and Mordechai Shacham, Prentice Hall, 2008.

III Year - I Semester

L	T	P	C
0	0	3	2

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. Determination of time constant & transportation lag for mercury in glass thermometer with and without thermal well.
2. Sinusoidal response of mercury in glass thermometer with and without thermal well.
3. Study of dynamic response of single tank liquid level system.
4. Study of dynamic response of two tank non-interacting liquid level system.
5. Study of dynamic response of two tank interacting liquid level system.
6. Determination of damping coefficient for U-tube:
    a) Water manometer
    b) Mercury manometer
7. 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

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

11. 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:

- 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
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DRILLING FLUIDS LAB

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 Baroid rheometer
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 compressive strength of cement test moulds and effect of temperature and pressure on setting of the slurry.
    Equipment: Compressive strength testing machine
13. Measurement of compressive strength of cement test moulds and effect of chemicals on flash setting and retardation
    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 conversation jobs for healthy construction of open oil / gas wells.

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III Year - I Semester

L	T	P	C
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INDUSTRIAL VISITS

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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III Year - I Semester

L	T	P	C
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MC
SWAYAM - NPTEL Courses

Learning Objectives:

- To avail the expertise in a specific subject from nation-wide reputed faculty, through MOOC (Massive Open Online Course)
- To develop the ability for self-actualization and in getting opportunity for life-long learning

There are a good number of relevant MOOCs courses that are available in NPTEL (National Program on Technology Enhanced Learning) under the auspices of SWAYAM (Study Webs of Active-Learning for Young Aspiring Minds) program. Suitable course(s) will be selected by Head of the Department, in consultation with faculty members.

A coordinator will be nominated by the Head of the Department for the conduct of SWAYAM – NPTEL courses. The selected topics may be reviewed /modified annually, depending on the course relevance / availability in the SWAYAM Program. Performance of Student will be evaluated, on par with other subjects of the semester.

Outcomes:

After successful completion of the SWAYAM-NPTEL Course, students will be able to:

- Overcome the digital divide in acquiring fast developing technologies / knowledge and be part of digital revolution.
- Acquire subject specific expert knowledge from National Resource Pool.
- Understand his /her academic / professional priorities for future development.

III Year - II Semester

L	T	P	C
4	0	0	3

WELL COMPLETIONS, TESTING & SERVICING

Learning Objectives:

- Knowledge of surface and subsurface equipment.
- Planning and designing of well completion 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:
Well completion: Types of wells- Completion functions- Types of completion.

UNIT-II:
Mechanical aspects of well testing- Logging equipment used in perforation methods and perforation equipment.

UNIT-III:
Packers: Function – Application - Proper selection - Packer setting – Packer loads - water / gas shut off, horizon separation etc.

UNIT-IV:
Completion equipment (SSD, SSSV, mandrels, locks etc.) - Data acquisition in wells - Fiber optics - Permanent gauges - Memory gauges - Intelligent completion equipment.

UNIT-V:
Tubing string design (dimension, materials and connections etc.) based on pressure, temperature, operating conditions – Media - Safety requirements.
Drill Stem Testing: General Procedure and considerations - Test tool components and arrangement - Analysis of Test data.

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UNIT-VI:

HPHT and horizontal well completions - Workover equipment and wireline tools - Scrubbing unit - Coil tubing completion and work over design and execution.

Outcomes:

The student will be able to:

- Have the knowledge of various equipment used in & on wells.
- Have the knowledge of DST/RFT to know the initial potential of the wells.
- Plan and design the well completion depending of the casing policy and the number of objectives available in the well.
- Plan for suitable safety valves in sub surface as well as on well head for the safe operation of the high pressure and high temperature wells.
- Become a good work over engineer to repair and maintenance of a sick well.
- Be a good CTU (Coil Tubing unit) operator whenever rigs less operation are required to be taken up.

Text Books:

1. Well Completion and Servicing, D. Perrin, Micheal Caron, Georges Gaillot, Editions Technip, 1999.
2. Primer of Well Service, Workover and Completion, Petroleum Extension Service (PETEX), University of Texas at Austin, 1997.

Reference Books:

1. Well Completion Design, Jonathan Bellarby, Elsevier, 2009.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.
3. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.
4. Well Testing, John Lee, Society of Petroleum Engineers, 1982.

III Year - II Semester

L	T	P	C
4	0	0	3

PETROLEUM PRODUCTION ENGINEERING

Learning Objectives:
The students will be made to learn:

- Fundamental concepts in petroleum production engineering.
- Reservoir fluids, efficient flow to the surface without damaging the reservoir dynamics/drive mechanisms.
- Various surface equipment's for process oil and gas after flow from wells.
- Sick well identification and remedial stimulation operations.
- Application of suitable artificial lifts on reservoir energy depletion.
- Crisis management.

UNIT-I:
Petroleum production system over all view: Production from various types of reservoir based on drive mechanisms, field development method, Properties of Oil: GOR, density, viscosity, pour point, properties of gas: specific gravity, compressibility, molecular weight, calorific value, formation volume factor.

UNIT-II:
Reservoir deliverability: Flow regimes - transient, steady state, pseudo steady state IPR for various types of wells, well bore performance – single & multiphase liquid flow in oil wells, single phase & mist flow in gas wells; Choke performance – sonic & subsonic flow, single & multiphase flow in oil & gas wells; Well deliverability - nodal analysis, Well decline analysis.

UNIT-III:
Artificial lift methods - I: Sucker rod pumping system- Selection of unit and types of unit, Load & power requirements, Performance analysis, dynagraph; Other lift systems - electrical submersible pumps: principle, design & operation; hydraulic piston pumping, progressive cavity pumping, plunger lift, hydraulic jet pumping.

UNIT-IV:

Artificial Lift Methods - II: Gas lift system: types, evaluation of potential compression requirements, study of flow characteristics, principles of compression, types of compressors, selection of gas lift valves, types of valves, principles of valve operation, setting & testing, design of installations.

UNIT-V:

Production Stimulation: Well problem identification- sick well analysis; Matrix acidizing-Design for sandstone & carbonate reservoirs, Hydraulic fracturing – formation fracture pressure, geometry, productivity of fractured wells, hydro-fracture design, selection of fracturing fluid, propant, post frac evaluation.

UNIT-VI:

Production Optimization: Self flowing wells, wells on artificial lift, separator, pipeline network, gas lift facilities, producing fields.

Outcomes:

After the course, the students will be able to:

- Determine the well head pressure, down-hole pressure and operating oil/ gas flow rates of the reservoir.
- Identify formation damage and find remedial methods to bring the well back into production.
- Screen, design and operate artificial lifts on reservoir pressure depletions.
- Handle in case of any crisis at drilling/production installations.
- Process oil and gas before supply to refinery/consumers.
- Contribute to reservoir management as production engineers to prolong the reservoir life with optimum production.

Text Books:

1. Petroleum Production Engineering: A Computer Assisted Approach, BoyunGuo, William C. Lyons, Ali Ghalambor, Elsevier Science & Technology Books, 2007.
2. Petroleum Production Systems, M. J. Economides, A. Daniel Hill & C. E. Economides, Prentice Hall, 1994.

Reference Books:

1. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.
2. The Technology of Artificial Lift Method, Vol. 1, Brown E., Pennwell Books, 1977.

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III Year - II Semester

L	T	P	C
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PETROLEUM RESERVOIR ENGINEERING-I

Learning Objectives:

- To impart knowledge in the basic concepts like PVT analysis for oil, Material balance applied to oil reservoir, Darcy's law and applications, well inflow estimation for stabilized flow conditions.
- To make them suitable as reservoir engineers for petroleum industry.

UNIT-I:

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.

UNIT-II:

PVT analysis for oil: Definition of the basic PVT parameters – Collection of fluid samples - Determination of the basic parameters in the laboratory and conversion for field operating conditions - Alternative manner of expressing PVT lab analysis results - Complete PVT analysis.

UNIT-III:

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.

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UNIT-VI:

Well inflow estimation for stabilized flow conditions: Semi steady state solution – Steady state solution – Example of the application of the stabilized inflow equations – Generalized form of inflow equation under semi steady state conditions.

Outcomes:

The students will be able to:

- Do calculations on basic PVT analysis of the specific reservoir of various sands.
- Estimate the reserves of various sands of the reservoir from well data.
- Calculate the formation damage and can recommend suitable stimulation operations to reverse the wells.

Text Books:

1. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17th Impression 1998).
2. B. C. Craft – M. Hawkins Applied Petroleum Reservoir Engineering, Third Edition, Revised by Ronald E. Terry & J. Brandon Rogers, Prentice Hall, New York, 2014.

Reference Books:

1. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing, 2006.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham &Trotman Inc. 1986.
3. Basic Reservoir Engineering, Rene Cosse, Editions Technip, 1993.
4. Petroleum Reservoir Engineering, James W Amyx, Daniel M. Bass Jr., Robert L. Whiting, McGraw Hill, 1960.

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III Year - II Semester

L	T	P	C
4	0	0	3

PETROLEUM REFINERY & PETROCHEMICAL ENGINEERING

Learning Objectives:

- To understand the properties and their significance of crude oils and petroleum fractions.
- To understand, design and analyze the various petroleum refinery processes including primary, secondary and supporting processes.
- To understand the process technologies for the petrochemical products.

UNIT-I:

Introduction: Overall refinery operations & Indian scenario.

Refinery feed stocks: Crude oil classification - Composition and properties - Composition of petroleum crude suitable for asphalt/coke manufacture – Evaluation of crude oils.

UNIT-II:

Petroleum Products and their specifications: LPG – Gasoline - Diesel fuels - Jet and turbine fuels – Lube oils - Heating oils – Residual fuel oils - Wax and Asphalt- Petroleum coke - All Product specifications - Product blending.

UNIT-III:

Crude distillation: Atmospheric and Vacuum distillation units, Auxiliary equipment such as desalters, pipe-still heaters and heat exchanger trains etc.

Catalytic reforming and isomerization: Catalytic reforming processes (for petroleum and petrochemical feed stocks) – Isomerization Processes - Feed stocks - Feed preparation – Process variables - Yields.

UNIT-IV:

Thermal & Catalytic cracking processes: Visbreaking- Delayed Coking –Fluid Catalytic cracking and Hydrocracking - Feed stocks — Catalysts - Process variables –Product Recoveries-Yield estimation.

Hydrotreating & Hydroprocessing: Naphtha, Kerosene, Diesel, VGO & Resid, Hydrotreating / Hydroprocessing – Feed stocks – Process description and Process variables.

UNIT-V:

Petrochemical Industry: – Indian Petrochemical Industry- Feed stocks – Process description and Process variables - Naphtha cracking-Gas cracking and Gas reforming.

UNIT-VI:

Chemicals from gas reforming: Methanol- Acetic acid- Ammonia and urea.
Chemicals from ethylene: Ethylene oxide-Monoethylene glycol - Ethyl benzene-Styrene.
Polymers: LDPE, HDPE & LLDPE and Polypropylene – PVC - Polystyrene.

Outcomes:

The students will be able to gain the knowledge for applications as follows:

- For a given crude assay, how to handle and store the crude oil.
- What will be the yield, quality of the product, estimation for the primary processes and treatment considerations.
- Maximize the profitable products and minimize the quality giveaway.
- Ability to process the opportunity crudes (e.g. Blending with other crudes) to maximize the throughput and gross margin.
- Application of suitable Hydroprocessing/treatment technologies to meet product qualities and to minimize the CAPEX & OPEX (capital and operating expenditure).
- Application of suitable thermal/catalytic conversion (cracking) processes for Vacuum gas oil/Resid upgradation and to produce desired fuel blend components and petrochemical feed stocks.
- Application of suitable processes (such as alkylation, reforming, isomerization) for converting light ends/ naphtha cuts to meet the desired gasoline blends.
- Understanding of various petrochemical feed stocks and their origin from refining/gas processes.
- Knowledge of various petrochemical products in the market and best available technologies to produce them.

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Text Books:

1. Petroleum Refining: Technology and Economics, J.H. Gary and G. E. Handwerk, 4th Edition, Marcel Dekkar, Inc., 2001.
2. Elements of Petroleum Processing, D S Jones, Wiley 1995.
3. Petrochemical Process Technology, ID Mall, Macmillan India Ltd., 2007.

Reference Books:

1. Petroleum Refining Engineering, WL Nelson, 4th Edition, McGraw Hill Company, 1958.
2. Chemical Technology of Petroleum, W. S. Gruese and D.R. Stevens, McGraw Hill, 1960.
3. Fundamentals of Petroleum Chemical Technology, P Belov, Mir Publishers, 1970.
4. Petrochemical Processes, A. Chauvel and G.Lefebvre, Volume 1 & 2, Gulf Publishing Company, 1989.
5. Chemistry of Petrochemical Processes, Sami Mater, Lewis F. Hatch, 2nd Edition, Gulf Professional Publishing, 2001.
6. Chemicals from Petroleum: An Introductory Survey, Waddams, A.L., 4th Edition, Gulf Publishing, 1978.
7. Handbook of Petrochemicals Production Processes, R.A. Meyers, TRW,Inc., 2005.
8. Petrochemical Processes Handbook, Hydrocarbon Processing, 2010.

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III Year - II Semester

L	T	P	C
4	0	0	3

ELECTRONIC INSTRUMENTATION
(OPEN ELECTIVE)

UNIT-I:
Introduction:
(a) **Measurement Errors:** Gross errors and systematic errors, Absolute and relative errors, Accuracy, Precision, Resolution and Significant figures.
(b) **Voltmeters and Multimeters:** Introduction Multi range voltmeter, extending voltmeter ranges, Loading, AC voltmeter using Rectifiers – Half wave and full wave, Peak responding and True RMS voltmeters.

UNIT-II:
Digital Instruments: Digital Voltmeters – Introduction, DVM's based on V – T, V – F and Successive approximation principles, Resolution and sensitivity, General specifications, Digital Multi-meters, Digital frequency meters, Digital measurement of time.

UNIT-III:
Oscilloscopes: Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch.
Special Oscilloscopes: Delayed time-base oscilloscopes, Analog storage, Sampling and Digital storage oscilloscopes.

UNIT-IV:
Signal Generators: Introduction, Fixed and variable AF oscillator, Standard signal generator, Laboratory type signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator, Sweep frequency generator, Frequency synthesizer.

UNIT-V:
Measurement of resistance, inductance and capacitance: Whetstone's bridge, Kelvin Bridge; AC bridges, Capacitance Comparison Bridge, Maxwell's bridge, Wein's bridge, Wagner's earth connection.

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UNIT-VI:

Transducers & Miscellaneous: Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Inductive transducer, Differential output transducers, LVDT, Piezoelectric transducer, Photoelectric transducer, Photovoltaic transducer, Semiconductor photo devices, Temperature transducers-RTD, Thermocouple.

Display devices: Digital display system, classification of display, display devices, LEDs, LCD displays; Bolometer and RF power measurement using Bolometer; Introduction to Signal conditioning.

Text Books:

1. Electronic Instrumentation, H. S. Kalsi, TMH, 2004.
2. Electronic Instrumentation and Measurements, David A Bell, PHI / Pearson Education, 2006.

Reference Books:

1. Principles of Measurement Systems, John P. Beately, 3rd Edition, Pearson Education, 2000.
2. Modern Electronic Instrumentation and Measuring Techniques, Cooper D & A D Helfrick, PHI, 1998.
3. Electronic and Electrical Measurements and Instrumentation, J. B. Gupta, S. K. Kataria & Sons, Delhi.
4. Electronics & Electrical Measurements, A K Sawhney, Dhanpat Rai & Sons, 9th edition.
5. Instrumentation & Control Systems, K. Padmaraju, Y.J. Reddy, McGraw Hill Education, 2016.

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III Year –II SEMESTER

T	P	C
4	0	3

BIG DATA ANALYTICS

(Elective - 1)

OBJECTIVES:

- Optimize business decisions and create competitive advantage with Big Data analytics
- Introducing Java concepts required for developing map reduce programs
- Derive business benefit from unstructured data
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm
- To introduce programming tools PIG & HIVE in Hadoop echo system.

UNIT-I:

Data structures in Java: Linked List, Stacks, Queues, Sets, Maps; Generics: Generic classes and Type parameters, Implementing Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization

UNIT-II:

Working with Big Data: Google File System, Hadoop Distributed File System (HDFS) – Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, Job Tracker, Task Tracker), Introducing and Configuring Hadoop cluster (Local, Pseudo-distributed mode, Fully Distributed mode), Configuring XML files.

UNIT-III:

Writing MapReduce Programs: A Weather Dataset, Understanding Hadoop API for MapReduce Framework (Old and New), Basic programs of Hadoop MapReduce: Driver code, Mapper code, Reducer code, Record Reader, Combiner, Partitioner

UNIT-IV:

Hadoop I/O: The Writable Interface, Writable Comparable and comparators, Writable Classes: Writable wrappers for Java primitives, Text, Bytes Writable, Null Writable, Object Writable and Generic Writable, Writable collections, Implementing a Custom Writable: Implementing a Raw Comparator for speed, Custom comparators

UNIT-V:

Pig: Hadoop Programming Made Easier

Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin

UNIT-VI:

Applying Structure to Hadoop Data with Hive:

Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, Querying and Analyzing Data

OUTCOMES:

- Preparing for data summarization, query, and analysis.
- Applying data modeling techniques to large data sets
- Creating applications for Big Data analytics
- Building a complete business data analytic solution

TEXT BOOKS:

1. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC
2. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly
3. Hadoop in Action by Chuck Lam, MANNING Publ.
4. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss

REFERENCE BOOKS:

1. Hadoop in Practice by Alex Holmes, MANNING Publ.
2. Hadoop MapReduce Cookbook, Srinath Perera, Thilina Gunarathne

SOFTWARE LINKS:

1. Hadoop:http://hadoop.apache.org/
2. Hive: https://cwiki.apache.org/confluence/display/Hive/Home
3. Piglatin: http://pig.apache.org/docs/r0.7.0/tutorial.html

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III Year - II Semester

L	T	P	C
4	0	0	3

ALTERNATIVE ENERGY SOURCES FOR AUTOMOBILES (OPEN ELECTIVE)

Learning Objectives:

- To impart the necessity of finding alternative energy sources for automobiles. To understand merits and demerits, performance characteristics of various sources of fuels and their comparison.

UNIT-I:

Objective: The objective is to introduce the use and the application of different fuel types and characteristics. The student will be able to understand Solar photo-voltaic conversion and working principles.

Introduction: Need for non-conventional energy sources. Energy alternative: solar, photo-voltaic, Hydrogen, Bio mass. Electrical - their merits and demerits.

Solar photo-voltaic conversion, Collection and storage of solar energy, Collection devices, flat plate collectors, concentrating type collectors, Principles and working of photo-voltaic Conversion, Applications to automobiles.

UNIT-II:

Objective: The objective is to expose the student about energy from bio-mass performance characteristics.

Energy from Bio mass: Photosynthesis, Photosynthetic oxygen production, Energy plantation. Bio gas production from organic waste, Description and types of Bio gas plants, Application and limitations - Merits and demerits performance characteristics and their comparison.

UNIT-III:

Objective: The objective is to expose the students to study and understand basic principles of hydrogen energy and thermo-chemical production.

Hydrogen Energy: Properties of hydrogen, Sources of Hydrogen, Thermodynamics of water splitting production of hydrogen, Electrolysis of water;,Thermal decomposition of water. Thermo-chemical production, Biochemical production.

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UNIT-IV:

Objective: To learn various factors to be considered in hydrogen fuel usage, and to study performance. Design and study of future possibilities of electric automobiles.

Hydrogen fuel, Storage and transportation methods, Applications to engines modifications necessary, precautions and safety measures - Performance characteristics in engine and their comparison.

Electric Automobiles: Design considerations, limitations. Opportunities for improvement Batteries, problems. Future possibilities, capacities, types, material requirement.

UNIT-V:

Objective: To learn various factors to be considered in hydrogen fuel usage, study of performance. Design and study of future possibilities of electric automobiles. Applicability of electric cars, major parts, battery charging, HVAC, requirements, comparative use of fuel and energy;, Availability of energy for recharging; Impacts on use of fuel and energy; Impact on urban air quality, impact on price, material requirement traction motors and types.

UNIT-VI:

Objective: To study the use of turbines in automobiles and Design of turbochargers for automobiles.

Hybrid vehicle, benefits, types of HEVs, hybrid maintenance and service.

Use of turbines in cars, arrangement, control merits and de-merits, Design of turbochargers for automobiles, their usefulness on the performance, Use of fuel cells in automobiles.

O**utcomes:**

- The students completing the course will be able to understand the ever increasing quality of life. This phenomenon imposes high demand on conventional fossil fuels. Hence search for alternate fuels is a continuous phenomenon. The student will have an overview of various alternate fuels along with their merits and limitations.

Text Books:

1. Non-conventional Sources of Energy, G.D. Rai, Khanna Publications.
2. Electric Automobiles, William Hamilton, PHI.
3. Alternative Fuel Technology, Erjavec and Arias, Cengage Learning

Reference Books:

1. Solar Energy, S.P. Sukhatme, Tata McGraw Hill.
2. Energy Technology, S. Rao & B.B. Larulekar, Khamma Lab.
3. Principles of Solar Engineering, Frank Kreith & Jan F. Krieder, McGraw Hill.
4. Solar Energy -thermal Process, J.A. Duffie&W.A. Beckman, McGrawHill.

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III Year - II Semester

L	T	P	C
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WASTE WATER MANAGEMENT
(OPEN ELECTIVE)

Course Learning Objectives:

The course will address the following:

1. Enables the student to distinguish between the quality of domestic and industrial water requirements and wastewater quantity generation
2. To impart knowledge on selection of treatment methods for industrial wasteswater
3. To know the common methods of treatment in different industries
4. To acquire knowledge on operational problems of common effluent treatment plant

Course Outcomes:

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

a. Suggest treatment methods for any industrial wastewater
b. Learn the manufacturing process of various industries
c. Student will be in a position to decide the need of common effluent treatment plant for the industrial area in their vicinity

SYLLABUS:

UNIT – I:

Industrial water Quantity and Quality requirements: Boiler and cooling waters–Process water for Textiles, Food processing, Brewery Industries, power plants, fertilizers, sugar mills

UNIT – II:

Miscellaneous Treatment: Use of Municipal wastewater in Industries – Advanced water treatment - Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, elutriation, Removal of Iron and Manganese, Removal of Colour and Odour.

UNIT – III:

Basic theories of Industrial Wastewater Management: Industrial waste survey - Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis -Wastewater characterization-Toxicity of industrial effluents-Treatment of wastewater-unit operations and processes-Volume and Strength reduction – Neutralization – Equalization and proportioning- recycling, reuse and resources recovery

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UNIT – IV:

Industrial wastewater disposal management: discharges into Streams, Lakes and oceans and associated problems, Land treatment - Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges- Recirculation of Industrial Wastes- Effluent Disposal Method

UNIT – V:

Process and Treatment of specific Industries-1: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Steel plants, Fertilizers, Textiles, Paper and Pulp industries, Oil Refineries, Coal and Gas based Power Plants

UNIT – VI:

Process and Treatment of specific Industries-2: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Tanneries, Sugar Mills, Distillers, Dairy and Food Processing industries, Pharmaceutical Plants

Text book

1. Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, New Delhi.
2. Industrial Wastewater Treatment by KVSG Murali Krishna.
3. Industrial Wastewater treatment by A.D. Patwardhan, PHI Learning, Delhi
4. Wastewater Treatment for Pollution Control and Reuse, by Soli. J Arceivala, Shyam R Asolekar, Mc-Graw Hill, New Delhi; 3rd Edition

References

1. Industrial Water Pollution Control by W. Wesley Eckenfelder, Mc-GrawHill, Third Edition
2. Wastewater Engineering by Metcalf and Eddy Inc., Tata McGrawhill Co., New Delhi
3. Wastewater Treatment- Concepts and Design Approach by G.L. Karia & R.A. Christian, Prentice Hall of India.
4. Unit Operations and Processes in Environmental Engineering by Reynolds. Richard, Cengage Learning.

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III Year - II Semester

L	T	P	C
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FUNDAMENTALS OF LIQUEFIED NATURAL GAS
(OPEN ELECTIVE)

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:

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-III:

Supporting Functional Units in LNG Plants: Gas pretreatment: 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-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.

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UNIT-V:

LNG Shipping Industry & Major Equipment in LNG Industry: LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations.

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

UNIT-VI:

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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III Year - II Semester

L	T	P	C
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COMPUTATIONAL FLUID DYNAMICS
(OPEN ELECTIVE)

Learning Objectives:

- Understanding the governing equations of fluid dynamics and the difference between conservation and non-conservations form of equations.
- Various methods available for solutions of partial differential equations.
- Use of boundary conditions for solutions of these equations.
- Understanding the role of finite elemental methods for solutions of fluid dynamics problems.
- Understanding the concept of stability.
- Understanding various software's available for solving fluid dynamics problems.

UNIT-I:

Basic Philosophy of CFD: Governing equations of Fluid Dynamics, Incompressible Inviscid flows sources and vortex panel methods.

UNIT-II:

Mathematical properties of fluid dynamic equations – Discretization of partial differential equations, Courant-Friedrichs-Lewy (CFL) condition: Stability of numerical solution of simple convection equation for one-dimensional flows, Introduction to Finite-Difference and Finite-Volume methods.

UNIT-III:

Transformations and Grids, Explicit finite Differential methods – Some selected applications to Inviscid and viscous flows.

UNIT-IV:

Boundary layer equations and methods of solution.

UNIT-V:

Implicit time dependent methods for Inviscid and viscous compressible flows, with a discussion of the concept of Numerical dissipation.

UNIT-VI:

Introduction to finite element methods in computational fluid dynamics – Weighted residual formulation – Weak formulation – Piece wise defined shape functions – Numerical integration – Partial construction of a weak formulation – Examples.

Outcomes:

The students will be able to:

- Use of finite difference method and finite volume method for practical applications.
- Use of software tools available for arriving at some problems of interest.
- Distinguish different flow regimes while performing numerical analysis.
- Use of source and vortex panel method of inviscid flow to practical problems.
- Arrive at pressure and flow distribution for complicated flow systems.

Text Books:

1. Computational Fluid Dynamics: An Introduction, John F. Wendt, John David Anderson, Springer, 2009.
2. Computational Fluid Dynamics – The Basics with Applications (1-5 Chapters), John D. Anderson, Jr., McGraw – Hill, Inc., New York, 1995.

Reference Books:

1. Numerical Heat Transfer and Fluid flow, S.V. Patankar, Taylor & Francis, 1980.
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Versteeg, H.K., and Malalasekera W., 2nd Edition, Prentice Hall, 2007.
3. Computational Fluid Flow and Heat Transfer, Muralidhar, K. Sundarajan, T., Narosa Publishing House, 1995.

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III Year - II Semester

L	T	P	C
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DRILLING SIMULATION LAB

Learning Objectives:

- Drilling simulation lab familiarizes student not only the normal drilling operations but also abnormal conditions in drilling.
- The student can get acquaintance with the drilling operations preventing abnormal conditions like Wall kicks, Blowouts, Mud losses etc.
- The student can have the knowledge how to handle the BOP, Panels, Choke manifold, Remote panel etc., in case of any emergency situation.
- Drilling simulation lab covers all abnormal drilling operations that help the student to have total knowledge of the drilling in live conditions.

The following experiments are to be carried out using a drilling simulator:

1. **Familiarization and line-up of operational components – I**: Sand pipe manifold, draw work console, drilling console.
2. **Familiarization and line-up of operational components – II:** Blow out preventer (BOP) panel, choke manifold, remote panel.
3. **Operation of major components:** Mud pumps, operating slow circulation rate, operating the rotary table, pulling weight on bit running in and pulling out of hole, remote choke panel operating.
4. **Kick identifications and well shut in procedures:** Setting flow alarms (deviation mud volume), setting flow alarms for return mud volume, identifying kick warning signs, Utilizing shut in procedures to kill well, well control computations.
5. Studies on the effect of weight on drill bit and rotary speed on the rate of penetration and wear of the bit.
6. Studies on the effect of mud density and flow rate on the penetration and wear of the bit.

Outcomes:

The student will be able to:

- Familiarizewith abnormal drilling operations and handle any drilling situation without any panic.
- Be conversant with the BOP, control panel, remote control panel etc.
- To identify the abnormal activities much in advance and plan to prevent the Kick, Blowout etc.
- Become a very good drilling engineer by improving the rate of drilling even in critical conditions.

III Year - II Semester

L	T	P	C
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PETROLEUM ANALYSIS LAB

Learning Objectives:

- The objective of the petroleum analysis lab is to determine the physical and transport properties like Reid vapor pressure, Viscosity, Smoke point, Flash point & Fire point, Aniline point, Cloud & Pour point, Softening point, Calorific value, Water content of different petroleum products by conducting laboratory experiments using different apparatus and to determine the distillation characteristics of petroleum products.

List of Experiments:

1. Determination of Distillation characteristics of Crude Oil, Gasoline, Diesel and Kerosene.
2. Determination of Reid Vapor Pressure of Crude oil & Gasoline.
3. Determination of Viscosity of Diesel and Transformer oils.
4. Determination of Smoke Point of Kerosene.
5. Determination of Carbon Residue of petroleum oils.
6. Determination of Flash & Fire points of gasoline, kerosene and other products.
7. Estimation of Water content in petroleum products.
8. Estimation of Calorific value of solid, liquid and gaseous fuels.
9. Determination of Aniline point of Gasoline and Diesel oil.
10. Determination of Softening point of bitumen.
11. Determination of Cloud & Pour Points of petroleum products.
12. Detection of Corrosiveness of petroleum products

Outcomes:

- The students will be able to handle various apparatus/equipment in determining the physical and transport properties of different petroleum products and also will be able to analyze the various products of petroleum components.

III Year - II Semester

L	T	P	C
0	0	3	2

PETROLEUM RESERVOIR ENGINEERNG LAB

Learning Objectives:

- The students are made to understand experimental determinations of reservoir (Oil as well as gas) properties such as Porosity, Absolute & Relative permeability, Capillary pressure, Fluid properties like Density, Viscosity and Surface tension etc.

List of Experiments:

1. Determination of effective porosity by gas expansion method.
   Equipment: Helium Porosimeter (Nitrogen gas can be used in place of helium).
2. Determination of porosity and pore size distribution by mercury injection.
   Equipment: Mercury Porosimeter.
3. Measurement of surface tension & interfacial tension with the ring Tensiometer.
   Equipment: Tensiometer.
4. Determination of fluid density using Pycnometer and hydrometer methods.
   Equipment: Pycnometer and hydrometer.
5. Liquid viscosity measurement using capillary tube viscometer (Ostwald type).
   Equipment: Capillary tube viscometer.
6. Determination of capillary pressure of reservoir rock (core) using porous plate method.
   Equipment: Capillary pressure cell.
7. Measurement of contact angle (between oil, water and solid surface) using imaging method.
   Equipment: The image system set-up.
8. Measurement of air permeability.
   Equipment: Constant head Permeameter with the Hassler cell.
9. Absolute permeability measurement of water.
   Equipment: The Darcy apparatus.
10. Determination of relative permeability of oil-water using unsteady state method.
    Equipment: Relative permeability apparatus.
11. Determination of relative permeability of gas-oil using unsteady state method.
    Equipment: Relative permeability apparatus.

Outcomes:

- The students will become conversant in experimental procedures to acquire process, analyze and interpret the reservoir and reservoir fluid data.
- This laboratory work makes the students to become good reservoir engineers.

III Year - II Semester

L	T	P	C
0	0	0	0

SUMMER INTERNSHIP
(4–6 WEEKS)

Every Student should undergo summer training (summer internship program) in a petroleum oil & gas producing industry/ petroleum machinery manufacturing industry for 4-6 weeks and submit a report.

Learning Objectives:
The student is guided (through the Industry representative) to learn the following aspects:

- Application of the engineering skills, learned in class room, in real world.
- Working as a team to deliver the results along with senior engineering professionals, technicians, managers etc.
- Work safely in industrial environment.
- Result oriented approach in plant operation, troubleshooting and engineering work.
- Present and / or report the work / project outcomes to various disciplines, departments & interest groups with confidence.

Outcomes:
The student shall be able to independently carryout the following tasks:

- Work safely in Industrial environment.
- Work with various interest groups, disciplines, professionals, managers, technicians etc.
- Polish the engineering skills by applying the knowledge in day-to-day operation, trouble-shooting and minor-modifications.
- Building relations with University and Industry that will help mutual cooperation over long-term.

L	T	P	C
0	0	0	0

III Year - II Semester

MC
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 which is a mandatory courses. Under the guidance of an instructor / faculty, each team is given a project in the following subjects at the beginning of II Semester of III year of the 4 – year B. Tech. Program.

Drilling Technology, Well Completions, Petroleum Production Engineering, Petroleum Reservoir Engineering.

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 along with the model. The model and report will be assessed by the concerned instructor / faculty for the completion of the mini project –II.

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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IV Year - I Semester

L	T	P	C
4	0	0	3

INTEGRATED ASSET MANAGEMENT

Learning Objectives:

- The students will learn the general principles of asset management, integrated petroleum, reservoir management and integrated oil & gas asset management.
- Introduces the student to the processes and modeling paradigms needed to develop the skills to increase reservoir output, profitability and decrease speculation.
- Develop references to recognize the technical diversity of modern reservoir management teams.
- Develop an overview of reservoir management, fluids, geological principles used to characterization and two key reservoir parameters.
- Expose to modeling tools and additional exercises are included on a companion website.
- Seamlessly brings together concepts and terminology, creating an interdisciplinary approach for solving everyday problems.

UNIT-I:
Asset Management: The corporate dimension – Data gathering – Interpreting the main data.

UNIT-II:
Developing a decision making frame work: Populating asset management plans – Creating a strategic outline and business case for investment – The corporate asset management plan; Developing an integrated asset management and capital planning system: Overview.

UNIT-III:
Reservoir management concepts – Reservoir management process – Data acquisition, analysis and management.

UNIT-IV:
Reservoir performance analysis and forecast – Reservoir management economics – Reservoir management case studies.

UNIT-V:

Industrial asset management strategies for the oil and gas sector: Over view of Onshore and Offshore assets – Integration and optimization methodology – A case study in OPEX of the assets – Evaluation of asset performance.

UNIT-VI:

An asset management model – Typical oil field workflow – Workflows for asset management – An automated approach to data quality management – Change management – Risk based asset management model.

Outcomes:

The students will be able to:

- Understand the working principles of an oil and gas asset management.
- Optimize the functions of each segment of an asset.
- Understand the concepts & terminology and develop an interdisciplinary approach for solving everyday problems.

Text Books:

1. A guide to Asset Management and Capital Planning in Local authorities, CIPFA, 2008.
2. The Big Picture: Integrated Asset Management Cedric Bouleau et al, Oil field Review, 2007/2008.
3. Integrated Petroleum Reservoir Management, A team approach, Abdus Satter and Ganesh C. Thakur, Pennwell Books, Tulsa, 1994.
4. Integrated Reservoir Asset Management: Principles and Best Practices: Fanchi John R Fanchi, Ph.D, Publisher: Elsevier Science¸ Imprint-Gulf Professional Publishing, 2010. (SBN-10 -012382088X; SBN-13-9780123820884).

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IV Year - I Semester

L	T	P	C
4	0	0	3

PETROLEUM RESERVOIR ENGINEERING-II

Learning Objectives:

- To make the students learn fundamentals as well as advanced topics in reservoir engineering like The constant terminal rate solution and its applications to oil well testing, gas well testing, natural water influx, immiscible displacement, material balance of unconventional gas reservoir, coal bed methane, tight gas reservoirs, gas hydrates.

UNIT-I:

The constant terminal rate solution of the radial diffusivity equation and its application to oil well testing: The constant terminal rate solution – Transient, semi steady state and steady state flow conditions – Dimensionless variables – General theory of well testing – The Mathews, Brons, Hazebroek pressure build up theory - Pressure build up analysis techniques – Multi Rate Drawdown testing – The effects of partial well completion – After flow analysis.

UNIT-II:

Gas well testing: Linearization and solution of the basic differential equation for the radial flow of a real gas – The Russel, Goodrich et. al. Solution technique – The Al Hussainy, Ramey Crawford solution techniques – Non-Darcy flow – Determination of the non- Darcy coefficient F - The constant terminal rate solution for the flow of a real gas – General theory of gas well testing – Multi rate testing of gas wells.

UNIT-III:

Pressure build up testing of gas wells: Pressure build up analysis in solution gas drive reservoirs-Analysis of well tests using type curves- Interference and Pulse Tests - Flow after flow tests in gas wells- Isochronal & modified isochronal tests- Use of pseudo pressure in gas well test analysis- Injection Well Testing.

UNIT-IV:

Natural water influx: The unsteady state water influx theory of Hurst and Van Everdingen and its application in history matching – The approximate water influx theory of Fetkovich for finite aquifers predicting the amount of water influx – Application of influx calculation techniques to steam soaking.

UNIT-V:

Immiscible displacement: Physical assumptions and their implication – The fractional flow equation – Buckley-Leverette one dimensional displacement – Oil recovery calculation – Displacement under segregated flow conditions – Allowance for the effect of finite capillary transition zone in displacement calculations – Displacement in stratified reservoir.

UNIT-VI:

Unconventional Gas Reservoirs: Material balance equation for conventional and unconventional gas reservoirs- Coal bed methane - Tight gas reservoirs - Gas hydrates - Shallow gas reservoirs.

Outcomes:

The students will be able to:

- Carry out the interpretation of Well Test Data.
- Estimate the reserves of various sands of the reservoir along with water production.
- Calculate the formation damage and water in flux, according he can recommend proper stimulation jobs.
- Learn the advanced topics like Coal bed methane and Gas hydrates.
- Recommend for tight gas reservoirs with proper hydro-fracturing.
- Learn how to acquire the data through well testing in dynamic and closed conditions.
- Estimate the long term profiles of the reservoirs.

Text Books:

1. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17th Impression 1998).
2. Advanced Reservoir Engineering, Tarek Ahmed and Paul D. McKinney, Gulf Professional Publishing, Elsevier, 2005.
3. B. C. Craft – M. Hawkins, Ronald E. Terry & J. Brandon Rogers, 3rd revised Edition, Prentice Hall, New York, 2014.

Reference Books:

1. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing, 2006.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham &Trotman Inc. 1986.
3. Basic Reservoir Engineering, Rene Cosse, Editions Technip, 1993.
4. Petroleum Reservoir Engineering, James W Amyx, Daniel M. Bass Jr., Robert L. Whiting, McGraw Hill, 1960.

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IV Year - I Semester

L	T	P	C
4	0	0	3

SURFACE PRODUCTION OPERATIONS

Learning objectives:

- Operate and maintain the surface equipment installed in GGS/GCS.
- Smooth operation of equipment with minimum manpower and handling more crude oil/gas.
- Priority to safety operations so that free of even minor accidents.
- Have the knowledge of various Acts of safety and environmental protection.
- Understand modes of transportation types of storage.
- Distribution & Custody transfer.
- Pressure maintenance & Reservoir performance monitoring.

UNIT-I:

Production facilities: Various types of facilities Controlling the process - Basic system configuration design & selection of facilities: Wellhead and manifold- Separation - Initial separation pressure - Stage Separation, Selection of Stages, Process flow sheets, P&IDs, monitoring well performance testing & optimization of flow.

UNIT-II:

Two phase liquid and gas separation: Functional sections of a gas-liquid separator - Inlet diverter section- Liquid collection section- Gravity settling section - Mist extractor section - Equipment description of different separators - Scrubbers - Slug catchers - Selection considerations - Vessel internals- Mist extractors - Potential operating problems.

Three phase oil, gas and water separation: Equipment description - Horizontal separators - Derivation of equation- Free -water knockout - Flow splitter - Horizontal three-phase separator with or without liquid "Boot" - Vertical separator - Selection considerations - Vessel internals- Coalescing plates- Turbulent flow coalesces and potential operating problems.

UNIT-III:

Crude oil treating: Equipment description of various treaters and heaters - Indirect and fired heaters - Heater sizing - Vertical heater-treaters - Coalescing media - Horizontal heater treaters - Electrostatic heater - treaters - Oil dehydrators - Emulsion treating theory Agitation - Emulsifying agents - Demulsifiers - Field optimization - Emulsion treating methods - General considerations - Chemical addition - Amount of chemical - Bottle test considerations - Chemical selection.

Oil desalting systems: Oil desalting systems - Equipment description of desalters - Mixing equipment - Process description - Single stage desalting - Two stage desalting; Monitoring of oil quality.

UNIT-IV:

Storage facilities, measurements - custody transfer, marketing - transportation modes & dispatch - Gas dehydration compression - measurements custody transfer marketing - transportation dispatch.

Fire protection systems for tank farm pumping /compressor stations.

UNIT-V:

Produced water treating systems: Characteristics of produced water - Sand and other suspended solids - Dissolved gases - Oil in water emulsions - Dissolved oil concentrations - Dispersed oil – Toxicants - Gravity separation – Coalescence – Dispersion – Flotation – Filtration - Equipment description - Retention time and performance considerations - Design of produced water treating systems. Disposal standards - Disposal methods - Offshore & Onshore operations.

UNIT-VI:

Water injection facilities, Sources of water, Treatment system, Pumping, Chemical dosing, Identification wells, Patterns of injections well performance monitoring - reservoir monitoring.

Outcomes:

The students can:

- Do the efficient separation of oil and gas.
- Maintain the quality of oil, required by the refineries.
- Work on the various control systems fitted on the separators/heater-treaters, so that smooth operation of GGS/GCS can be maintained.
- Figure out the crude oil emulsions produced from various wells and can treat such crudes to the required oil quality.

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- Work with various safety systems fitted from well to the surface equipment's storage, pumping stations and can ensure accident free operation till the oil is supplied to refiners and gas to consumers.
- Perceive the treatment of produced water and disposal of the same as per the norms laid by regulatory authorities
- Carry out pressure maintenance & monitoring of reservoir performance to improve recovery.

Text Books:

1. Petroleum and Gas Field Processing, H. K. Abdel-Aal and Mohamed Aggour and M.A. Fahim, Marcel Dekkar Inc., 2003.
2. Surface Production Operations, Ken Arnold & Maurice Stewart, Vol. 1 & 2, 3rd Edition, Gulf Professional Publishing, 2008.

IV Year - I Semester

L	T	P	C
4	0	0	3

OIL & GAS PROCESSING PLANT DESIGN

Learning Objectives:

- The students are made to learn the design of all types of separators, pumps & compressors, heat exchangers, oil treaters, desalters, gas treating systems, different types of valves and flaring systems
- Imparting knowledge on material of construction and mechanical design of the petroleum equipment.

UNIT-I:

Design principles and sizing of gas - oil separators: Principles of phase separators - Sizing of vertical & horizontal two-phase and three phase separators - Optimum pressure - Design of single and multistage flash vaporization equipment - Materials of construction and mechanical design of separators.

UNIT-II:

Fluid Flow Equipment Design: Basic concepts of fluid handling equipment & design - Pumps - Compressors - Blowers.

UNIT-III:

Design of principles and sizing of heat exchangers: Process design of Shell &Tube heat exchangers - Double pipe heat exchangers - Plate and frame heat exchangers - Air cooled heat exchangers - Heat recovery units - Fired heaters - Materials of construction & mechanical design of heat exchangers.

UNIT-IV:

Design principles and sizing crude oil treaters: Sizing horizontal and vertical treaters - Design of LTX units and line treaters - Material of construction and mechanical design.

Design principles and sizing of crude desalting equipment - Design principles and sizing of equipment for produced water treatment and disposal.

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UNIT-V:

Design principles and sizing of acid gas treating system: Design of H_2S and CO_2 absorbers and strippers using amine solutions – Design of rich/lean amine exchanger - Design of amine cooler - Material of construction - Mechanical design.

Process design of glycol and solid bed dehydration systems - Materials of construction & mechanical design.

UNIT-VI:

Design principles and sizing of pressure relief valves, vents, other relieving devices- Selection criteria- Location- Maintenance- Design of flaring systems.

Outcomes:

The students will be able to:

- Design of all types of separators, pumps & compressors, heat exchangers, oil-treaters, de salters, gas treating systems, different types of valves and flaring systems with necessary details.
- Specify the material of construction for the petroleum equipment.
- Carry out the mechanical design of the petroleum equipment.

Text Books:

1. Petroleum and Gas Field Processing, H.K. Abdel- Aal, Mohamed Aggover, M.A. Fahim, Marcel Dekkar Inc., 2003.
2. Surface Production Operations, Ken Arnold, Maurice Stewart, Butterworth Heinemann, Vol 1 & 2, 1999.

Reference Book:

1. Engineering Data Book, 12th Edition (Electronic), FPS Version, Volume I & II, Gas Processers Suppliers Association (GPSA), 2005.

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IV Year - I Semester

L	T	P	C
4	0	0	3

NATURAL GAS HYDRATES
(ELECTIVE-I)

Learning Objectives:
This course is designed to introduce a basic study of natural gas hydrates and its properties. The student will be imparted the knowledge of:

- Overview of NGH and classification of NGH.
- Hydrate formation by using different methods.
- Exhibiting hydrate formation and dehydration processes.
- Different physical and chemical properties of NGH.
- Deactivating the hydrates using heat and pressure.

UNIT-I:
Introduction: Overview of natural gas hydrates- Natural gas- Water molecule- Hydrates- Water and natural gas- Free-Water- Heavy water- Units.
Hydrate types and formers: Type I hydrates- Type II hydrates- Size of the guest molecule- n-Butane- Other hydrocarbons and non-hydrocarbon molecules- Chemical properties of potential guests- Liquid hydrate formers- Type H hydrates- Hydrate forming conditions- Pressure-Temperature- Composition- Other hydrate formers- Mixtures- Examples.

UNIT-II:
Hydrate formation hand calculation methods: Gas gravity method- K-Factor method- Baillie-Wichert method- Comments on these methods- Examples.
Hydrate formation computer methods: Phase equilibrium- Van der Waals and Platteeuw-Parrish and Prausnitz-Ng and Robinson methods- Calculations- Commercial software packages- Accuracy of these programs- Dehydration- Examples.

UNIT-III:
Inhibiting hydrate formation with chemicals: Freezing point depression- Hammer-Schmidt equation- Nielsen-Bucklin equation- New method- Brine solutions- Comment on the simple methods- Advanced calculation methods- Inhibitor vaporization- Comment on injection rates- Kinetic inhibitors- Examples.
Dehydration of natural gas: Water content specification-Glycol dehydration- Molecular sieves- Refrigeration- Examples.

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UNIT-IV:

Combating hydrates using heat and pressure: Use of heat- Heat loss from a buried pipeline- Line heater deign- Two-Phase heater transfer- Depressurization- Melting a plug with heat- Examples.

UNIT-V:

Physical properties of hydrates: Molar mass - Density- Enthalpy of fusion- Heat capacity- Thermal conductivity- Mechanical properties- Volume of gas in hydrate- Ice versus hydrate- Examples.

Phase diagrams: Phase rule- Comments about phases- Single component systems- Binary systems- Phase behavior below 0°C- Multicomponent systems- Examples.

UNIT-VI:

Water content of natural gas: Equilibrium with liquid water- Equilibrium with solids- Examples.

Outcomes:

After successful completion of the course the students will be able to:

- Have good knowledge in dealing with NGH.
- Model different forms of hydrate formation using both hand calculations and computer methods.
- Understand different properties of NGH.
- Design line heaters for effective transportation.
- Have knowledge of different equilibriums of liquid water and solids with natural gas.
- Understand the challenges of NGH.

Text Books:

1. Natural Gas Hydrates: A Guide for Engineers, John J. Carroll, Gulf Professional Publishers, 2003.
2. Clathrate Hydrates of Natural Gases, E. Dendy Sloan, Jr., C. Koh, 3rd Edition, CRC Press, 2007.

Reference Book:

1. Natural Gas Hydrates in Flow Assurance, E. Dendy Sloan, C. Koh, A. K. Sum, A. L. Ballard, J. Creek, M. Eaton, N. McMullen, T. Palermo, G. Shoup and L. Talley, Elsevier, 2010.

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IV Year - I Semester

L	T	P	C
4	0	0	3

PIPELINE ENGINEERING
(ELECTIVE-I)

Learning Objectives:

- Operations and maintenance of flow lines or trunk pipe lines.
- Understanding of well fluids for proper designing of flow lines/trunk pipe lines.
- Obtaining the permissions to laying of pipe line as per the State/DGMS regulations.
- Operation and maintenance of gas compressors.
- Handling of flammable fluids like gas, oil condensate to check the accident free operation.
- Protection from internal/external corrosion of pipe lines by suitable methods.

UNIT-I:

Elements of pipeline design: Fluid properties – Environment - Effects of pressure and temperature - Supply/Demand scenario - Route selection - Codes and standards - Environmental and hydrological considerations – Economics - Materials/Construction – Operation - Pipeline protection - Pipeline integrity monitoring.

Pipeline route selection, survey and geotechnical guidelines: Introduction - Preliminary route selection - Key factors for route selection - Engineering survey - Legal survey - Construction / As-built survey - Geotechnical design.

UNIT-II:

Natural gas transmission: General flow equation – Steady state - Impact of gas molecular weight and compressibility factor on flow capacity - Flow regimes - Widely used steady-state flow equations – Summary of the impact of different gas and pipeline parameters on the gas flow efficiency – Pressure drop calculation for pipeline in series and parallel – Pipeline gas velocity – Erosional velocity – Optimum pressure drop for design purposes – Pipeline packing – Determining gas leakage using pressure drop method – Wall thickness/pipe grade – Temperature profile – Optimization process – Gas transmission solved problems.

UNIT-III:

Gas compression: Types of compressors – Compressor drivers – Compressor station configuration – Thermodynamics of isothermal and adiabatic gas compression – Temperature change in adiabatic gas compression – Thermodynamics of polytropic gas compression – Gas compressors in series – Centrifugal compressor horsepower – Enthalpy / Entropy charts (Mollier diagram) – Centrifugal compressor performance curve- Reciprocation compressors.

Coolers: Gas coolers – Air-cooled heat exchangers –Heat transfer equations for coolers – Fan air mass flow rate – Required fan power – Gas pressure drop in coolers – Iterative procedure for calculations based on unknown T_2.

UNIT-IV:

Liquid flow and pumps: Fully developed laminar flow in a pipe – Turbulent flow – Centrifugal pumps – Retrofitting for centrifugal pumps (Radial-flow) – Pump station control – Pump station piping design.

Transient flow in liquid and gas pipelines: Purpose of transient analysis – Theoretical fundamentals and transient solution technique – Applications – Computer applications.

UNIT-V:

Pipeline mechanical design: Codes and standards – Location classification – Pipeline design formula – Expansion and flexibility – Joint design for pipes of unequal wall thickness – Valve assemblies – Scraper traps – Buoyancy control – Crossings – Depth of cover – Aerial markings – Warning signs.

Pipeline construction: Construction – Commissioning.

UNIT-VI:

Materials selection: Elements of design – Materials designation standards.

Pipeline protection, Instrumentation and Pigging: Pipeline coating – Cathodic protection – Cathodic protection calculations for land pipelines – Internal corrosion – Flow meters and their calibration – Sensors – Pigs.

Outcomes:

The students will be able to:

- Understanding pipeline designing and maintenance.
- Repair and maintenance of pipeline in short time to avoid production loss.
- Plan for suitable corrosion protection methods to improve the life of the pipeline.

Text Books:

1. Pipeline Design and Construction: A Practical Approach, M. Mohitpour, H. Golshan and M.A. Murray, 2nd Edition, ASME Press, 2007.
2. Pipeline Engineering, Henry Liu, Lewis Publishers (CRC Press), 2003.

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Reference Books:

1. Piping Calculation Manual, E. Shashi Menon, McGraw-Hill, 2004.
2. Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair, George A. Antaki, CRC Press, 2003.
3. Pipeline Planning and Construction Field Manual, E. Shashi Menon, Gulf Professional Publishing, 2011.
4. Pipeline Rules of Thumb Handbook, E. W. McAllister, 7th Edition, 2009.
5. Liquid Pipeline Hydraulics, E. Shashi Menon, Mareel Dekker, Inc., 2004.
6. Gas Pipeline Hydraulics, E. Shashi Menon, Taylor & Francis, 2005.

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IV Year - I Semester

L	T	P	C
4	0	0	3

HORIZONTAL WELL TECHNOLOGY
(ELECTIVE-I)

Learning Objectives:

This course introduces fundamentals of horizontal wells by dealing with reservoir and production characteristics of horizontal wells and respective challenges.

The students will be able to:

- Understand the basics of horizontal wells and its reservoir properties.
- Have knowledge of different types of horizontal wells.
- Differentiate between horizontal and vertical fractured wells.
- Understand the testing and flow performance using different equations.
- Gain knowledge on critical rates of flow and challenges during different rates of flow like gas and water coning.

UNIT-I:

Overview of horizontal well technology: Introduction- Limitations of horizontal wells- Horizontal well applications- Drilling techniques- Horizontal well length based upon drilling techniques and drainage area limitations- Completion techniques.

Reservoir engineering concepts: Skin factor- Skin damage for horizontal wells- Effective wellbore radius r'_w - Productivity index, *f*- Flow regimes- Influence of areal anisotropy.

UNIT-II:

Steady-state solutions: Steady-state productivity of horizontal wells- Effective wellbore radius of a horizontal well- Productivity of slant wells- Comparison of slant well and horizontal well productivities- Formation damage in horizontal wells- Field histories.

Influence of well eccentricity: Introduction- Influence of well eccentricity- Drilling several wells- Horizontal wells at different elevations.

UNIT-III:

Comparison of horizontal and fractured vertical wells: Vertical well stimulation- Types of fractures- Comparison of horizontal wells and finite conductivity fractures- Horizontal wells in fractured reservoirs- Fractured horizontal wells.

UNIT-IV:

Transient well testing: Introduction-Mathematical solutions and their practical implications- Generalized flow regimes- Pressure response- Detailed well testing flow regimes- Pressure derivatives - Wellbore storage effects- Practical Considerations.

UNIT-V:

Pseudo-steady state flow: Generalized pseudo-steady state equation for vertical wells- Shape factors for vertical wells- Shape factors for fractured vertical wells- Shape factors of horizontal wells- Horizontal well pseudo-steady state productivity calculations- Inflow performance of partially open horizontal wells- Inflow performance relationship (IPR) for horizontal wells in solution gas-drive reservoirs- Predicting horizontal well performance in solution gas-drive reservoirs.

UNIT-VI:

Water and gas coning in vertical and horizontal wells: Critical rate definition- Vertical well critical rate correlations- Critical rate by production testing- Decline curve analysis- Water breakthrough in vertical wells- Vertical well post-water breakthrough behavior- Characteristics of water cut versus recovery factor plots- Water and gas coning in horizontal wells- Horizontal well breakthrough time in a bottom water drive - Critical rate for horizontal well in edge-water drive reservoir - practical considerations.

Outcomes:

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

- Have an overview of horizontal well technologies.
- Perform flow performance calculations of horizontal wells.
- Perform mathematical solutions to transient well testing for different flow regimes.
- Solve challenges for different flow rates.
- Design a horizontal well.

Text Book:

1. Horizontal Well Technology, S. D. Joshi, PennWell Publishing Company, 1991.

Reference Book:

1. Horizontal Wells: Formation Evaluation, Drilling and Production Including Heavy Oil Recovery, Roberto Aguilera, G. M. Cordell, G. W. Nicholl, J. S. Artindete, M. C. Nq., Gulf Publishing Co., 1991.

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IV Year - I Semester

L	T	P	C
4	0	0	3

COAL BED METHANE ENGINEERING
(ELECTIVE-II)

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.

UNIT-II:
Geological influences on cleat formation of coals – Coal chemistry – Significance of rank – Cleat system and natural fracturing.

UNIT-III:
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.

UNIT-IV:
Reservoir Analysis: Coal as a reservoir - Permeability-Porosity-Gas flow-Reserve analysis-Well spacing and drainage area-Enhanced recovery.

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UNIT-V:

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.

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

UNIT-VI:

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.

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

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 and production of CBM.
- Design a CBM well.

Text Books:

1. Coal Bed Methane: Principles and Practice, R. E. Rogers, 3rd Edition, Prentice Hall, 1994.
2. Coal Bed Methane, Robert A. Lamarre, American Association of Petroleum Geologists, 2008.

Reference Books:

1. Fundamentals of Coal Bed Methane Reservoir Engineering, John Seidle, Pennwell Corp., 2011.
2. Coal Bed Methane, Society of Petroleum, 1992.
3. A Guide to Coal Bed Methane Operations, B. A. Hollub, Society of Petroleum, 1992.

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IV Year - I Semester

L	T	P	C
4	0	0	3

OFFSHORE ENGINEERING
(ELECTIVE-II)

Learning Objectives

- Introduce different types of deep water offshore structures and challenges
- Introduce Concept of wave theory for linear and nonlinear waves.
- Estimation of wave loads on small and large bodies
- Estimation different types of loads on offshore structures such as gravity, wind, wave and current loads
- Detailed design of fixed offshore structures
- Concepts of floating structures
- Fundamental aspects of semisubmersible, TLP, spar and installation methodologies
- Design aspects of risers

UNIT-I

Overview of offshore structures: Introduction- Deepwater challenges- Functions of offshore structures- Offshore structure configurations- Bottom-Supported fixed structures- Compliant structures- Floating structures- Classification societies and industry standard groups.

Novel and small field offshore structures: Introduction- Overview of oil and gas field developments- Technical basis for developing novel offshore structures- Other considerations for developing novel offshore structures- Novel field development systems- Future field development options.

UNIT-II

Ocean environment: Introduction- Ocean water properties- Wave theory- Breaking waves- Internal waves- Sea spectrum- Sea states- Wave-driven current- Loop current- wind and wind spectrum- Offshore environment by location.

Loads and responses: Introduction- Gravity loads- Hydrostatic loads- Resistance loads- Current loads on structures- Steady and dynamic wind loads on structures- Wave loads on structures- Applicability of Morison force vs Diffraction force- Steady wave drift force- Slow-Drift wave forces- Varying wind load- Impulse loads- Response of structure- Applicability of response formula.

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Member	**Member**	**Member**	**Member**	**Member**

UNIT-III

Fixed offshore platform design: Field development and concept selection activities- Basic and detailed design of a fixed jacket. Analysis and design aspects of Jack-up rigs.

UNIT-IV

Floating offshore platform design: Introduction- Floating platform types- Design of floaters- Floating production storage and offloading systems, Mobile offshore drilling units (MODU), Station keeping of MODU's, Single Point Mooring (SPM) and Single Buoy Mooring (SBM) systems, water injection platforms.

UNIT-V

Semi submersibles- Tension leg platforms- Spar design- Hull structure- Construction and installation. Deep water station keeping technologies,

UNIT-VI

Drilling and production risers: Drilling risers- Production risers- Vortex induced vibration of risers-Design aspects.

Outcomes

The student will be able to:

- Identify type of offshore structure and recommend a specific offshore structure for a given site condition and requirements of the platform.
- Estimate water particle kinematics using linear Airy's wave theory and estimate maximum wave force and overturning moment for a fixed vertical circular cylinder.
- Use of diffraction theory for a large body
- Analysis and design of fixed offshore structure
- Perform mass distribution of different structures such as floating structure, TLP and Spar.
- Design aspects of Risers

Text Book:

1. Handbook of Offshore Engineering, S. Chakrabarti, Volume 1 & 2, Elsevier, 2005.

IV Year - I Semester

L	T	P	C
4	0	0	3

RESERVOIR STIMULATION
(ELECTIVE-II)

Learning Objectives: To impart knowledge in

- Basic concepts of rock mechanics and their relevance to design stimulation task in a petroleum reservoir.
- Development and analysis of Simple 2D, Pseudo 3D and Real 3D analytical models to represent hydraulic fracturing.
- Working knowledge of fracturing fluids and their additives.
- Working knowledge of the rheology of fracturing fluids and their properties.
- Data requirements for the design of a fracturing task.
- Pressure decline analysis and interpretation techniques.
- Practical limitations in fracture design.
- Prediction of fracture height and various approaches for post-treatment measurements.
- Evaluation of post treatment and performance of fractured wells.

UNIT-I:

Reservoir justification of stimulation treatments: Introduction - Fundamentals of pressure transient analysis- Well and reservoir analysis.

Elements of rock mechanics: Basic concepts- Pertinent rock properties and their measurement- In-Situ stress and its determination.

UNTI-II:

Modeling of hydraulic fractures: Conservation laws and constitutive equations- Fracture propagation models- Fluid flow modeling- Acid fracturing.

Fracturing fluid chemistry: Water base fluids- Oil base fluids- Multiphase fluids- Additives- Execution.

UNIT-III:

Fracturing fluid proppant and characterization: Rheology- Shear and temperature effects on fluid properties- Foam fracturing fluids- Slurry rheology- Proppant transport- Fluid loss- Formation and fracture damage- Proppants.

Pre-Treatment data requirements: Types of data- Sources of data- Dynamic downhole testing.

UNIT-IV:

Fracturing diagnosis using pressure analysis: Basic relations- Pressure during pumping- Analysis during closure- Combined analysis pumping and closure- Field procedures.

The optimization of propped fracture treatments: Physical systems and mathematical formulations- Treatment optimization design procedure- Parametric studies of fracture design variables.

UNIT-V:

Considerations in fracture design: Size limitations- Considerations with predetermined size or volume- Benefits of high proppant concentrations- Effect of reservoir properties- Effects of perforations on fracture execution.

Fracture-Height predictions and post-treatment measurements: Linear fracture-mechanics modeling for fracture height- Fracture-height prediction procedures- Techniques to measure fracture height.

UNIT-VI:

Post-treatment evaluation and fractured well performance: Selected references before the finite conductivity fracture models- Cinco and Samaniego model- Comments on damaged and chocked fractures- Post-fracture well analysis- Interpretation for finite conductivity fracture wells with wellbore storage- Comparison of production forecasts for untreated and fractured wells- Calculation of the fracture length and conductivity of long-flowing wells.

Outcomes:

The students will be able to:

- Gain working knowledge of various approaches of fracturing approaches.
- Assimilate data for the design of stimulating treatment.
- Design and analyze fracturing approaches for petroleum reservoir stimulation.
- Solve practical problems in reservoir fracturing and remedies to resolve the same.

Text Book:

1. Reservoir Stimulation, Michael. J. Economides, Kenneth G. Nolte, 2nd Edition, Prentice Hall, 1989.

Reference Books:

1. Oil Well Stimulation, Robert S. Schechter, Prentice Hall, 1992.
2. Modern Fracturing Enhancing Natural Gas Production, Michael J. Economides, Tony Martin, ET Publishing, 2007.

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IV Year - I Semester

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INTELLECTUAL PROPERTY RIGHTS AND PATENTS
(Common to all Branches)

Unit - I

(* To acquire a detailed understanding of IPR Laws, the student has to-

- know the increasingly assumed role of Intellectual Property Rights globally with the rapid pace of technological and scientific innovations created by the human intellect.
- study and understand the TRIPS and how to enhance the protection of different IPRs).

Introduction to Intellectual Property Rights (IPR):

Concept of Property - Introduction to IPR – International Instruments - WIPO - TRIPS – WTO - Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Uses and Misuse of Intellectual Property Rights.

(** The student is expected to be able to:

- understand, identify and distinguish between different kinds of IPRs
- know the IPR Laws relating to Patents, Copyrights, Trademarks, Industrial Designs, Trade Secrets, Geographical Indications and Traditional Knowledge).

Unit - II

(* It provide knowledge to the student about Copyright, which is -

- an exclusive right given to the creative and artistic works and producers of cinematograph films thereby protecting and rewarding the creativity.
- ensures moral and economic rights of Authors of those creative works, which induces others to do the same is the basis for socio- economic progress of the society).

Copyrights and Neighboring Rights:

Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers **–** Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedies- Semiconductor Chip Protection Act.

(** The student is expected to be able to:

- understood the various components of copyright law, its protection and enforcement.

- Know the application of copyright law, its duration and advantages in the digital era).

Unit - III

(* To acquire knowledge about Patent, an exclusive right granted for-

- inventions arising from the human intellect and its considerable commercial value.
- scientific inventions having potential for industrial application are being protected for a limited duration to encourage the innovation).

Patents:

Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations.

(** The student is expected to be able to:

- understood the Patent law and its global instruments and spell out the novelty, non-obviousness and inventive step involved in obtaining a Patent besides assignment and licensing patterns.
- know the advantages of a patent andits benefit to the society and to the inventor).

Unit - IV

(* A Trade Mark is a statutory right which-

- provides protection to the owner of the mark by ensuring the exclusive right to use it, or to authorize another to use the same for consideration.
- can promote initiative and enterprise worldwide and hinders the efforts of unfair competitors).

Trademarks:

Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities – Trademarks Claims and Infringement – Remedies – Passing Off Action.

(** The student is expected to be able to:

- understand about the conceptual and legal framework and procedural requirements relating to Trade Marks and its infringement.
- It gives an insight how the Trademark is commercially advantageous to its owner).

Unit - V

(* Trade Secrets are significant business assets. Study of Trade Secrets-

- explains why this strategic assets are need to be protected.
- describe the human ingenuity that turns information into knowledge and how it confer competitive advantage).

Trade Secrets:

Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets - Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements – Breach of Contract – Unfair Competition – Trade Secret Litigation – Applying State Law.

(** The student is expected to be able to:

- understand the necessity of safeguarding the trade secrets.
- know that the trade secret is really kept a secret, the monopoly on such confidential information or product may never be an end. Once the information is leaked and goes into the public domain, it is lost forever).

Unit - VI

(* The study of Cyber Law provide-

- knowledge about the Information Technology Act and its various parameters can regulate the cyber technology.
- detailed insight about E-commerce, confidentiality, data security, digital signatures, cyber-crimes and punishments).

Cyber Law and Cyber Crime:

Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions - E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes and Punishment – Liability of Network Providers.

(** The student is expected to -

- know the importance of E-commerce, data security, online transactions and how the confidentiality and privacy can be safeguarded.
- understand the cybercrimes and how they can be dealt with under the law).

➢ Relevant Cases Shall be dealt where ever necessary.

Note: (* Learning Objectives)
(** Outcomes)

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Text Books:

1. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
2. Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.
3. PrabhuddhaGanguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
4. Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
5. Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).
6. Cyber Law - Texts & Cases, South-Western's Special Topics Collections.
7. R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.
8. M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

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IV Year - I Semester

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PETROLEUM EQUIPMENT DESIGN & SIMULATION LAB

Learning Objectives:
The students will be trained in the design and simulation of various equipment used in petroleum industry.

The following experiments have to be conducted using C/C++/Simulink using MATLAB/UNISIM for design and simulation:

1. Oil- Water separator.
2. Gas- Oil-Water separator.
3. Lean / rich amine heat exchanger.
4. Air cooled heat exchanger.
5. CO_2 and H_2S absorber unit using, MEA/DEA amine solution.
6. Stripping unit.
7. Single stage flash vaporization unit.
8. Three stage flash vaporization unit.
9. Liquid pumping system & simulation of water-hammer phenomena.
10. Gas Compressor unit.

Outcomes:
The students shall be able to carry-out the following tasks independently:

- Design and simulation of the two-phase and three phase separators.
- Design and simulation of compressors.
- Design and simulation of flash vaporization units.
- Design and simulation of absorber-stripper unit for removal of CO_2 and H_2S from natural gas.
- Size /rate the pipeline & pumping systems for liquid pumping & simulate water hammer conditions.
- Carryout detailed thermal sizing or rating of shell & tube exchangers as per TEMA specifications and API guidelines.
- Generate sized equipment data sheets as per the industry standards with required information for detailed design / manufacture.

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IV Year - I Semester

L	T	P	C
0	0	2	2

PETROLEUM RESERVOIR SIMULATION LAB

Learning Objectives:

- The main objective is to simulate the exploitation of a real reservoir without the costs of real life trial and error, e.g. to test different production scenarios to find an optimal one before the reservoir is actually put on production.
- To develop reservoir simulation models for new reservoirs to maximize recovery of oil and gas and to make investment decisions.
- To develop reservoir simulation models for existing reservoirs to study production decline and production forecasts.

Reservoir Simulation Experiments:

The students will be trained in the software Package ECLIPSE, or any other equivalent software to model and solve reservoir engineering problems.

1. File organization and structure
2. Selection of suitable by grid sensitivity studies.
3. Fluid properties
4. Rock properties
5. Wells
6. Aquifer modeling
7. 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
8. Prediction of properties permeability, relative permeability, saturation etc.

Outcomes:

After the laboratory course, the students will be able to:

- Explain reservoir simulation fundamentals- the underlying equations and the numerical techniques used to solve them.
- Design a reservoir simulation model, construct the data set, execute the simulator, and view simulation results visually using post-processing software.
- Plan and conduct the calibration of a reservoir simulation model.
- Apply reservoir simulation technology to solve production and reservoir engineering problems in individual wells or patterns.
- Apply reservoir simulation technology to solve production and reservoir engineering problems in entire fields or reservoirs.
- Present results of an engineering study effectively in a written report.

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IV Year - II Semester

L	T	P	C
4	0	0	3

ENHANCED OIL RECOVERY (EOR) TECHNIQUES

Learning Objectives:

- Understanding of secondary / tertiary recovery of crude oils of specific reservoirs.
- Following the selection criteria to which reservoir suits for specific EOR techniques.
- Post project monitoring.
- Knowledge of maintenance of injection wells / Production wells.
- Knowledge of ignition of injection wells in case of thermal EORs.
- Knowledge of handling of chemicals like CO_2, Surfactants, Polymers etc.
- Handling of injection wells in case of any leakage or blowout situations.

UNIT-I:

Introduction: Secondary oil recovery processes, Selection of lift mechanism for wells, Gas lift methods continuous & intermittent gas lift valve designs, Sucker rod pumping units - parts of pumping unit, design, operation and maintenance - Electrical submersible pumps design, operation and maintenance.

UNIT-II:

Gas injection: Introduction, Predictive performance, Gas injection in carbonate reservoirs, Inert gas injection, Candidates for gas injection.

Miscible flooding: Introduction, Sweep efficiency - High pressure gas injection, Enriched gas drive, LPG slug drive; Predictive technique, Field applications.

Carbon dioxide flooding: Process description, Field projects, CO_2 sources- problem areas, designing a CO_2 flood, Guidelines for selection of miscible CO_2 projects, Immiscible CO_2 flooding conclusions.

UNIT-III:

Polymer flooding: Introduction, Polymer products and theory of use, Planning polymer flood projects.

Polyacrylamides: Introduction, Polyacrylamides chemistry, Application of PAM/AA in enhanced oil recovery, Factors affecting flow in porous media, Field considerations- Site factors, Field operation.

UNIT-IV:

Alkaline flooding: Introduction, Types of caustic used, Entrapment of residue oil, Displacement mechanisms in alkaline flooding, Crude oil properties, Alkali consumption, pH of injected

caustic, Effect of sodium ions and sodium chloride, Effect of divalent ions, Reservoir selection-Documented alkaline flooding - field tests.

S**urfactants flooding:** Introduction, Classification of EOR surfactants, Mechanism of oil displacement by surfactant flooding, Ultra low interfacial tension in relation to oil displacement by surfactant flooding, Factors influencing oil recovery, Surfactant gas flooding for oil recovery, Interfacial phenomena in surfactant gas flooding, Mechanism of surfactant loss in porous media, Present status of the use of surfactants in oil recovery.

UNIT-V:

Steam flooding for enhanced oil recovery: Introduction, Theory- Screening criteria for steam flood prospects, Reservoir rock and fluid properties, heat losses and formation heating, Oil recovery calculations, An overview of steam flood modeling, Parametric studies in steam flooding, Economics of the steam flooding process.

In-situ combustion technology: Introduction, Reservoir characteristics, Ignition-Ignition methods, Process In-situ Combustion, Use of In-situ Combustion, Conclusions, Current status of In-situ Combustion.

UNIT-VI:

Microbial enhanced oil recovery: Microorganisms, Historical development of microbial enhancement of oil recovery, Laboratory experiments - potential of microbial enhancement oil recovery, Field application of microbial enhancement of oil recovery, Microbes associated with oilfield problems, Microbial interactions with produced oil, Potential of microbial enhancement of oil recovery, Injection of cells and spores.

other EOR techniques

Environmental factors associated with oil recovery: Introduction, Primary and secondary production, Chemical flooding, Micellar-polymer processes, Thermal processes, Gas flooding-Research.

Outcomes: The students can

- Have the knowledge of that specific reservoir before designing of any EOR project.
- Understand operation and maintenance of EOR techniques.
- Be aware of safety precautions while handling of various types of chemicals used in EOR.
- Know monitoring the reservoir after post project activities.
- Handle the wells during work over operations.

Text Books:

1. Applied Enhanced Oil Recovery, Aurel Carcoana, Prentice Hall, 1992.
2. Enhanced Oil Recovery, Larry W. Lake, Prentice Hall, 1998.

Reference Books:

1. Enhanced Oil Recovery Processes and Operations, E.C. Donaldson, G. V. Chillingarian, T.F. Yew, Elsevier, 1998.
2. Basic Concepts in Enhanced Oil Recovery Processes, Marc Baviere, SCI, 1991.
3. Enhanced Oil Recovery: Proceedings of the Third European Symposium on Enhanced Oil Recovery, F. John Fayers, Elsevier, 1981.
4. Fundamentals of Enhanced Oil Recovery, H. R. Van Pollew and Associates, PennWell, 1980.
5. Enhanced Recovery of Residual and Heavy Oil, M. M. Schumacher, Noyes Data Corp., 1980.
6. Recent Advances in Enhanced Oil and Gas Recovery, IstvanLaktos, Academy Kiado, 2001.
7. Enhanced Oil Recovery, Don W. Greew, G. Paul Willfite, Society of Petroleum Engineers, 1998.
8. Enhanced Oil Recovery: Field Planning and Development Strategies, Vladmir Alvarado, Eduardo Marriglee, Gulf Professional Publishing, 2010.

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IV Year - II Semester

L	T	P	C
4	0	0	3

HEALTH SAFETY AND ENVIRONMENT & FIRE ENGINEERING(HSE&FE) IN PETROLEUM INDUSTRY

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.

Drilling and production operations: Drilling- Production- 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.

Environmental transport of petroleum wastes: Surface paths- Subsurface paths- Atmospheric paths, Planning for environmental protection.

Waste treatment methods: Treatment of water- Treatment of solids- Treatment of air emissions-Waste water disposal: surface disposal.

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- Machinery, plants and equipment- General safety provisions- Miscellaneous-Remediation of contaminated sites- Site assessment-Remediation process.

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.

Guidelines on internal safety audits (procedures and checklist) - Inspection & Safe practices during electrical installations- Safety instrumentation for process system in hydrocarbon industry- Safety aspects in functional training -Work permit systems.

UNIT-VI:

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- Suppression of hydrocarbons fires.

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.

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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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IV Year - II Semester

L	T	P	C
4	0	0	3

PETROLEUM ECONOMICS, POLICIES&REGULATIONS

Leaning Objectives:

- Understand the importance of petroleum sector in the world economy, both the macro and micro-economic environment and as applicable to India.
- Understand the commercial aspect and capital budgeting and capital efficiency related to the oil and gas industry value chain from exploration to consumers.
- Carry out a project risk evaluation, breakeven and sensitivity analysis and develop a model to know which petroleum projects is viable and relative priority.
- Understand geopolitical risks and opportunities and hedging strategies to mitigate market and price risks.
- Understand the regulations regarding refining, processing, storage, transportation distribution, marketing& sale of petroleum products.
- To have an overview of the regulatory frame related to exploration as per NELP.

UNIT-I:

Macro-Economic Approach of Petroleum Industry: Political environment related to petroleum industry and issues related to government and corporate interests, Need for understanding petroleum economics required to make investment decisions; Introduction, Role and value of Oil & Gas, Evolution of national oil companies, Organization of petroleum exporting countries.

UNIT-II:

Principles, Methods and Techniques of Petroleum Engineering Economics: Introduction, outline and key terminologies and generic issues of micro-economic analysis applicable to all sectors of the oil and gas supply chain, Capital budgeting and capital efficiency, Sources of revenue and cost and profitability analysis, Operating expenditures (OPEX) and their fixed, variable and marginal components, Economic indicators and yardsticks used to rank asset values (NPV, IRR, etc.)

UNIT-III:

Managing and Mitigating Uncertainty and Risk: Risk, uncertainty and decision analysis, Analysis of alternative selections and replacements**,** Managing and Mitigating uncertainty and Risk -Breakeven and sensitivity analysis, Optimization Techniques, Geopolitical risks and opportunities and hedging strategies to mitigate market and price risks, Asset valuation process: fair market value, probability and risk.

UNIT-IV:

Application and Project Evaluation: Project lifecycles, optimum economic life and multi-year cash flows, Oil fields exploration and drilling operations, estimation of oil reserves and evaluation of an oil property, Project financial analysis, Project development and Joint development - utilization oil fields - production operations - Oil transportation - Crude oil processing.

UNIT-V:

Valuing Petroleum Assets, Portfolios and Companies: Asset valuation process: fair market value, probability and risk, Risk adjustments when valuing petroleum reserve categories, The portfolio approach to asset and corporate management, Portfolio characterization, balance and diversification.

Demand and Marketing of Petroleum Products: Crude oil fundamentals, Price of crude, Crude oil prices in transactions, Internal Markets and Prices, Marketing and sale of Motor, Aviation, Lubricant, Asphalt and Propane Transportation: Fundamentals of transportation, Pipelines, Oil tankers, Downstream transportations, Distribution of petroleum products.

UNIT-VI:

Petroleum or Oil & Gas Policies and Regulations: Petroleum and Oil & Gas rules and regulations in India, The Oil fields regulations and development Act, New Exploration Licensing Policy (NELP), Functions of directorate general of hydrocarbons, Petroleum and Natural Gas Regulatory Board.

Outcomes:

On completion of the course the students should be able to**:**

- Explain the inter-relations between Oil industry petroleum sector and its impact on national and global economy.
- Evaluate a strategic policy framework of a firm and comment on its relative position within the industry.
- Develop the capability to analyze the global oil and gas industry, focusing on its strategic, economic and fiscal position.
- Demonstrate decision making skills in analyzing basic financial results related to petroleum industry.

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- Capable of analyzing the petroleum industry involving pricing, risk profiling, optimization and profitability choosing appropriate techniques.
- Develop generic marketing plans for petroleum products downstream.
- Understand and apply the regulatory framework and related to petroleum industry in the area of licensing and exploration.

Text Books:

1. Petroleum Economics and Engineering, Third Edition, Hussein K. Abdel-Aal, Mohammed A. Alsahlawi, CRC Press, 2013. (ISBN: ISBN; 1466506660, 9781466506664)
2. The Global Oil & Gas Industry: Management, Strategy and Finance, Andrew Inkpen & Michael H. Moffett, 2011. (ISBN-10: 1593702396, ISBN-13: 978-1593702397)

Reference books:

1. Petroleum Economics, Jean Masseron, Technip; 4threvised Edition, 2000. (ISBN-10: 2710805979; ISBN-13: 978-2710805977)
   (The instructor can download information required from internet to teach the topics in UNIT VI).

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IV Year - II Semester

L	T	P	C
4	0	0	3

SHALE GAS RESERVOIR ENGINEERING
(ELECTIVE-III)

Leaning Objectives:

- To understand the global significance and distribution of shale gas reservoirs
- To gain knowledge in petro-physical properties, pore pressure prediction, performance analysis, production and testing of shale gas reservoirs.
- To study gas shale asset life cycle and environmental issues and challenges.

UNIT-I:

Gas Shale – Global significance, Distribution – Organic matter – Rich shale depositional environments – Geochemical assessment of unconventional shale gas resource system.

UNIT-II:

Sequence stratigraphy of unconventional resource shales – Pore Geometry in gas shale reservoirs.

Petro-physical evaluation of gas shale reservoirs.

UNIT-III:

Pore pressure prediction of shale formations using well log data: Overpressure generating mechanisms – Overpressure estimation methods – Role of tectonic activity on shale pore pressure – Geo-mechanics of gas shales.

UNIT-IV:

Performance analysis of unconventional shale reservoirs: Shale reservoir production – Flow rate decline analysis – Flow rate and pressure transient analysis – Reservoir modeling and simulation – Specialty short term tests – Enhanced oil recovery.

Resource estimation for shale gas reservoirs – Introduction – Methodology – Reservoir evaluation of shale gas plays.

UNIT-V:

Wettability of gas shale reservoirs: Wettability – Imbibition in gas shales – Factors influencing water imbibition in shales – Quantitative interpretation of imbibition at the field scale – initial water saturation in gas shales.

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UNIT-VI:

Gas shale challenges over the asset life cycle: Asset life cycle – Exploration phase – Appraisal phase – Development phase – Production phase – Rejuvenation phase.

Gas shale environmental issues and challenges: Overview – water use – the disposal and reuse of fracking waste water – Ground water contamination – Methane incisions – Other air emissions – social impacts on shale gas communities – Waste water injection – Earth quakes – Regulatory developments.

Outcomes:

- With the knowledge gained on the different aspects of shale gas reservoirs such as organic geo-chemistry, mineralogy, petrophysical properties, geomechaniscs, reservoir engineering, the students will be able to evaluate and map shale gas pockets in sedimentary basins. Further, they will be able to devise the production mechanisms to extract shale gas.
- Knowing the shale gas environmental issues and challenges such as high water demands and ground water contamination risks posed by hydro-fracturing fluids and waste, the students will be able to address these problems during the exploration of shale gas reservoirs.

Text Book:

1. Fundamentals of Gas Shale Reservoirs, Reza Rezace, John Wiley & Sons, 2015.

Reference Book:

1. Shale Oil and Gas Handbook: Theory, Technologies and Challenges, Sohrab Zendeh boudi & A. Bahadori, Elsevier Science, 2016.

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IV Year - II Semester

L	T	P	C
4	0	0	3

SUBSEA ENGINEERING
(ELECTIVE-III)

Learning Objectives:

- To understand the subsea development operations.
- To learn the hydraulic / equipment / system design considerations.
- To learn the process control and power supply consideration.
- To understand the reliability issues& design challenges involving subsea systems.

UNIT-I:

Overall View of Subsea Engineering: Introduction – Subsea production systems – Flow Assurance & System engineering – Subsea structures & Equipment – Subsea pipelines.

Subsea Field Development: Subsea field development overview – Deepwater or Shallow-Water development – Wet Tree & Drain tree systems – Subsea Tie-back development – Stand-Alone development – Artificial lift methods and Constraints – Subsea processing – Template, Clustered Well Systems & Daisy chain –Subsea field development assessment.

UNIT-II:

Subsea Distribution System: Introduction – Design Parameters – SDS component design requirements.

Installation & Vessels: Introduction – Typical installation vessels – Vessel requirements & selection – Installation - positioning & Analysis.

UNIT-III:

Subsea Control: Introduction – Types of control systems – Topside equipment – SCMMB – SCM – Subsea transducers & Sensors – HIPPS – SPCS – IWOCS.

Subsea Power Supply: Introduction – Electrical power system – Hydraulic power system.

UNIT-IV:

Subsea System Engineering: Introduction – Typical flow assurance process - System design & Operability.

Hydraulics: Introduction – Composition & Properties of hydrocarbon – Emulsion – Phase behaviour – Hydrocarbon flow – Slugging & Liquid handling – Slug catcher design – Pressure surge – Line sizing.

UNIT-V:

Heat Transfer & Thermal Insulation: Introduction – Heat transfer fundamentals – U value – Steady state heat transfer – Transient heat transfer – Thermal management strategy & Insulation.

Hydrates: Introduction – Physics & Phase behaviour – Hydrate prevention – Hydrate remediation – Hydrate control design philosophies – Recovery of thermodynamic hydrate inhibitors.

UNIT-VI:

Wax & Asphaltenes: Introduction - Wax - Wax management – Wax remediation – Asphaltenes – Asphaltenes control design philosophies.

Subsea Corrosion & Scale: Introduction – Pipeline internal corrosion – Pipeline external corrosion – Scales – Overview of Erosion & Sand management.

Outcomes: The students will be able to:

- Do flow assurance calculations and size the piping & distribution system.
- Deliver the equipment & system design required for a given subsea project requirement.
- Anticipate reliability issues such as hydrate, wax formation, corrosion etc. during design.

Text Books:

1. Subsea Engineering Handbook, Yong Bai & Qiang Bai, Gulf Professional Publishing, New York, 2012.
2. Offshore Drilling and Completions Training Manual, Drill – Quip, Inc.
3. Manual on Subsea Technology, IOGPT, ONGC.

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IV Year - II Semester

L	T	P	C
4	0	0	3

RESERVOIR MODELING & SIMULATION
(ELECTIVE-III)

Learning Objectives:

- Theoretical and working knowledge of reservoir simulation models of varying complexities:
    i. Single-phase fluid equations in multiple dimensions
    ii. Volume finite difference approaches
    iii. Block centered grids
    iv. Point distributed grids
    v. Well representation
- Applicable numerical methods for the solution of simple and complex reservoir simulation models. Emphasis shall be towards the general approaches such as direct solution and iterative solution methods.
- Parametric analysis of reservoir simulation models.

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.

UNIT-IV:

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-V:

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-VI:

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.

Outcomes:

For a given reservoir characterization and assumed geometry, the students with good knowledge of this course shall be able to carry the following tasks:

- Develop a simple mathematical model to represent the reservoir production capabilities using mathematics and fundamentals of fluid flow.
- Enhance the complexity of mathematical model to represent realistic reservoir conditions
- Working knowledge of model solution approaches using mathematical rules such as linearization.
- Parametric case studies and remedies to bypass numerical instabilities and stiff formulations.

Text Book:

1. Petroleum Reservoir Simulation: A Basic Approach, Jamal H. Abou – Kaseem, 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.

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IV Year - II Semester

L	T	P	C
0	0	0	2

SEMINAR
(SIP REPORT PRESENTATION)

Learning Objectives:

- To give a clear, organized and accurate oral presentation of Summer Training Report.
- To provide verbally/ through power point presentation of condensed large amounts of technical information into concise, condensed analysis.
- Sharing the practical knowledge obtained during training with fellow students.

The presentation and evaluation of the summer training report for 50 marks should be conducted by a committee constituted by the University.

Outcomes:

The students will extend their abilities to:

- Get themselves good clarity in the technical topics being presented.
- Develop good communication skills.
- Practice the behaviors of effective speakers.
- Assess strengths in speaking and set goals for future growth.

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IV Year - II Semester

L	T	P	C
0	0	0	10

PROJECT WORK

Learning Objectives:
The students are guided to learn the following aspects:

- Understanding &evaluating the design / operation / environmental aspects of a petroleum equipment/ process.
- Understanding & evaluating the technology aspects of various alternatives available, called "Best Available Technologies (BAT)", through literature & references and select a suitable equipment/ process with optimum capacity.
- Carrying-out the basic design of the process using steady state simulation.
- Preparation of equipment layout & plot plan drawing.
- Preliminary cost estimation of CAPEX and OPEX.
- Presentation &project management skills.

The project work may consist of any one of the following:

a) The project work should consist of a comprehensive design project of any one of the petroleum upstream processes concerned with reservoir, drilling, production, surface production operations, stimulation, enhanced oil recovery in the form of a report.

b) Modeling & Simulation of any petroleum upstream unit concerned with reservoir, drilling, production, surface production operations, stimulation, enhanced oil recovery.

c) Any experimental work with physical interpretations.

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Outcomes:

The student shall be able to carry out independently the following tasks:

- Preparation of project feasibility reports for petroleum processes/plants.
- Gather & use various sources such as market data, literature, customer feed-backs etc. to evaluate the Best Available Technologies in the market and select suitable process meeting the site conditions, environmental regulations, product quality etc.
- Simulation of overall plant including estimation of utility consumptions.
- Generation of equipment diagrams and MSD (Material Selection Diagrams).
- Sizing of all plant equipment and preliminary cost estimation using cost indexes, charts& literature.
- Preliminary cost estimation of piping, instrumentation, electrical equipment, civil works & construction as % of equipment cost, to determine Installation cost of the equipment/ plant.
- Preliminary utility & chemical consumption estimation and using this data estimating the operating cost.
- Manage a comprehensive project in a planned manner, within specified time and present the salient features of the result to the audience with confidence and clarity.

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