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

DEPARTMENT OF PETROLEUM ENGINEERING

COURSE STRUCTURE AND SYLLABUS

For

B. TECH PETROLEUM ENGINEERING

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA - 533 003, Andhra Pradesh, India

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DEPARTMENT OF PETROLEUM ENGINEERING

COURSE STRUCTURE - R19

I Year – I SEMESTER

Sl. No	Course Code	Subjects	L	T	P	Credits
1	BS1101	Mathematics - I	3	0	0	3
2	BS1102	Mathematics – II	3	0	0	3
3	BS1110	Engineering Chemistry	3	0	0	3
4	ES1101	Programming for Problem Solving Using C	3	0	0	3
5	ES1103	Engineering Drawing	1	0	3	2.5
6	HS1102	English Lab	0	0	3	1.5
7	BS1111	Engineering Chemistry Lab	0	0	3	1.5
8	ES1102	Programming for Problem Solving Using C Lab	0	0	3	1.5
9	MC1104	Constitution of India	3	0	0	0
Total Credits			**16**	**0**	**12**	**19**

I Year – II SEMESTER

Sl. No	Course Code	Subjects	L	T	P	Credits
1	HS1201	English	3	0	0	3
2	BS1203	Mathematics – III	3	0	0	3
3	BS1208	Engineering Physics	3	0	0	3
4	ES1204	Engineering Mechanics	3	0	0	3
5	PT1201	Introduction to Petroleum Engineering	3	0	0	3
6	HS1203	Communication Skills Lab	0	0	3	1.5
7	BS1209	Engineering Physics Lab	0	0	3	1.5
8	ES1220	Engineering Workshop& IT Workshop	0	0	4	2
9	PR1201	Engineering Exploration Project	0	0	2	1
10	MC1201	Environmental Science	2	0	0	0
Total Credits			**17**	**0**	**12**	**21**

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II YEAR I SEMESTER

S. No.	Course Code	Course Title	L*	T	P	Credits
1	BS	Mathematics- IV	3	0	0	3
2	ES	Basic Electrical & Electronics Engineering	3	0	0	3
3	ES	Materials Science & Engineering	3	0	0	3
4	ES	Elements of Mechanical Engineering	3	0	0	3
5	PCC	Petroleum Geology	3	0	0	3
6	PCC	Chemical Process Principles	3	0	0	3
7	PCC	Basic Engineering (Mech. + Elec.) Laboratory	0	0	3	1.5
8	PCC	Petroleum Geology Laboratory	0	0	3	1.5
9	*MC	Essence of Indian Traditional Knowledge	2	0	0	0
10	*MC	Managerial and Organizational Behavior	0	0	2	0
					Total Credits	**21**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L*	T	P	Credits
1	PCC	Fluid Mechanics for Petroleum Engineers	3	0	0	3
2	PCC	Thermodynamics for Petroleum Engineers	3	0	0	3
3	PCC	Process Instrumentation	3	0	0	3
4	PCC	Petroleum Exploration	3	0	0	3
5	PCC	Petroleum Reservoir Engineering – I	3	0	0	3
6	PCC	Process Heat Transfer	3	0	0	3
7	PCC	Fluid Mechanics Laboratory	0	0	3	1.5
8	PCC	Process Heat Transfer Laboratory	0	0	3	1.5
9	*MC	Professional Ethics & Human Values	2	0	0	0
10	*MC	Physical Fitness Activities	0	0	2	0
					Total Credits	**21**

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III YEAR I SEMESTER

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

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

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

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III YEAR II SEMESTER

S. No.	Course Code	Course Title	L*	T	P	Credits
1	PCC	Petroleum Production Engineering	3	0	0	3
2	PCC	Petroleum Reservoir Engineering-II	3	0	0	3
3	PCC	Petroleum Refinery & Petrochemical Engineering	3	0	0	3
4	PEC	**PROFESSIONAL ELECTIVE – II** i. Offshore Engineering ii. Advanced Well Completion Engineering iii. Applied Mathematics in Reservoir Engineering	3	0	0	3
5	OEC	**OPEN ELECTIVE – II**(To be selected from open elective subjects offered by other branches)	3	0	0	3
6	PCC	Petroleum Analysis Laboratory	0	0	3	1.5
7	PCC	Petroleum Reservoir Engineering Laboratory	0	0	3	1.5
8	PCC	Drilling Simulation Laboratory	0	0	2	1
9		Summer Internship (4-6 weeks)	-	-	-	-
10	*MC	Mini Project(**Phase 2**)	-	-	-	-
11	*MC	Data Science (AICTE – NITTTR)	0	0	3	0
					Total Credits	**19**

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

i. Basic concepts in Petroleum Drilling and Completions
ii. Basic concepts in Petroleum Production Engineering
iii. Basic concepts in Petroleum Reservoir Engineering

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IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L*	T	P	Credits
1	PCC	Design of Surface Facilities	3	0	0	3
2	PCC	Enhanced Oil Recovery Techniques	3	0	0	3
3	PEC	**PROFESSIONAL ELECTIVE – III** i. HSE in Petroleum Industry ii. Petroleum Engineering Mathematics iii. Subsea Engineering	3	0	0	3
4	PEC	**PROFESSIONAL ELECTIVE – IV** i. Mathematics of Reservoir Simulation ii. Advances in Well Control iii. Pipeline Engineering	3	0	0	3
5	PEC	**PROFESSIONAL ELECTIVE –V** i. Statistics for Petroleum Engineers and Geoscientists ii. Advances in Seismic methods for Hydrocarbon Exploration	3	0	0	3
6	PCC	Petroleum Equipment Design & Simulation Laboratory	0	0	3	1.5
7	PCC	Petroleum Reservoir Simulation Laboratory	0	0	3	1.5
8	PR	Presentation Seminar (SIP Report)				1
9	PR	Project (Industrial/In-house) (**Phase 1**)				2
10	*MC	IPR & Patenting	2	0	0	0
11	*MC	Physical Fitness Activities	0	0	2	0
					Total Credits	**21**

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IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L*	T	P	Credits
1	PEC	**PROFESSIONAL ELECTIVE –VI** i. Production Optimization using Nodal Analysis ii. Deepwater Technology iii. Any other course subjective availability from NPTEL database (12 Weeks) other than regular offered courses	3	0	0	3
2	PEC	**PROFESSIONAL ELECTIVE –VII** i. Asset Management ii. Petroleum Economics, Policies and Regulations iii. Any other course subjective availability from NPTEL database (12 Weeks) other than regular offered courses	3	0	0	3
3	OEC	**OPEN ELECTIVE – III** (To be selected from open elective subjects offered by other branches)	3	0	0	3
4	PR	Project (Industrial/In-house) (**Phase 2**)	3	0	0	8
5	*MC	Physical Fitness Activities	0	0	2	0
					Total Credits	**17**

` **TOTAL CREDITS= 40 + 42 + 40 + 38 = 160**

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

i. Shale Gas Technology
ii. Basic concepts of Enhanced Oil Recovery Techniques

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I Year - I Semester		L	T	P	C
		3	0	0	3
Mathematics-I (BS1101) **(Common to all Branch's for I Year B. Tech)**					

Course Objectives:

- This course will illuminate the students in the concepts of calculus.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

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

- utilize mean value theorems to real life problems (L3)
- solve the differential equations related to various engineering fields (L3)
- familiarize with functions of several variables which is useful in optimization (L3)
- Apply double integration techniques in evaluating areas bounded by region (L3)
- students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional and 3-dimensional coordinate systems (L5)

UNIT I: Sequences, Series and Mean value theorems: (10 hrs)

Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series – Leibnitz's rule.

Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders.

UNIT II: Differential equations of first order and first degree: (10 hrs)

Linear differential equations – Bernoulli's equations – Exact equations and equations reducible to exact form.
Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal trajectories – Electrical circuits.

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UNIT III: Linear differential equations of higher order: (10 hrs)

Non-homogeneous equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, $e^{ax}V(x)$ and $x^nV(x)$ – Method of Variation of parameters.
Applications: LCR circuit, Simple Harmonic motion.

UNIT IV: Partial differentiation: (10 hrs)

Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mc Laurent's series expansion of functions of two variables.
Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT V: Multiple integrals: (8 hrs)

Double and Triple integrals – Change of order of integration – Change of variables.
Applications: Finding Areas and Volumes.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Joel Hass, Christopher Heil and Maurice D. Weir,** Thomas calculus, 14th Edition, Pearson.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press, 2013.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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I Year - I Semester		L	T	P	C
		3	0	0	3
MATHEMATICS - II (BS1102) **(Common to all Branch's for I Year B. Tech)**					

Course Objectives:

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

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

- develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
- solve system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel (L3)
- evaluate approximating the roots of polynomial and transcendental equations by different algorithms (L5)
- apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals (L3)
- apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations (L3)

Unit I: Solving systems of linear equations, Eigen values and Eigen vectors: (10 hrs)

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous equations linear equations – Gauss Elimination for solving system of equations – Eigen values and Eigen vectors and their properties.

Unit-II: Cayley-Hamilton theorem and Quadratic forms: (10 hrs)

Cayley-Hamilton theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton theorem – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation.

Singular values of a matrix, singular value decomposition (Ref. Book – 1).

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UNIT III: Iterative methods: (8 hrs)

Introduction – Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method (One variable and simultaneous Equations) – Jacobi and Gauss-Seidel methods for solving system of equations.

UNIT IV: Interpolation: (10 hrs)

Introduction – Errors in polynomial interpolation – Finite differences – Forward differences – Backward differences – Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula – Newton's divide difference formula.

UNIT V: Numerical integration and solution of ordinary differential equations: (10 hrs)

Trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule– Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Runge-Kutta method (second and fourth order).

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43^{rd} Edition, Khanna Publishers.
2. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **David Poole,** Linear Algebra- A modern introduction, 4^{th} Edition, Cengage.
2. **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science,Tata Mc. Graw Hill Education.
3. **M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
4. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

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I Year - I Semester		L	T	P	C
		3	0	0	3
ENGINEERING CHEMISTRY(BS1110)					

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:

- ***Importance*** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- ***Outline*** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
  Express the increase in demand as wide variety of advanced materials areintroduced; which have excellent engineering properties.
  Classifyand discuss the materials used in major industries like steel industry, metallurgical industries and construction industries and electrical equipment manufacturing industries. Lubrication is also ***summarized***.
- ***Relate*** the need of fuels as a source of energy to any industry, particularly industries like thermal power stations, steel industry, fertilizer industry etc., and hence introduced.
- ***Explain*** the importance and usage of water as basic material in almost all the industries; ***interpret***drawbacks of steam boilers and also howportable water is supplied for drinking purposes.

UNIT I: POLYMER TECHNOLOGY

Polymerisation:-Introduction-methods of polymerization (emulsion and suspension)-physical and mechanical properties.

Plastics: Compounding-fabrication (compression, injection, blown film, extrusion)- preparation, properties and applications of PVC, polycarbonatesand Bakelite-mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste.

Elastomers:- Natural rubber-drawbacks-vulcanization-preparation, properties and applications of synthetic rubbers (Buna S,thiokol and polyurethanes).

Composite materials: Fiber reinforced plastics-conducting polymers-biodegradable polymers-biopolymers-biomedical polymers.

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Learning Outcomes:*At the end of this unit, the students will be able to*

- ***Outline*** the properties of polymers and various additives added and different methods of forming plastic materials.
- ***Explain*** the preparation, properties and applications of some plastic materials.
- ***Interpret*** the mechanism of conduction in conducting polymers .
- ***Discuss***natural and synthetic rubbers and their applications.

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION

Single electrode potential-Electrochemical series and uses ofseries-standard hydrogen electrode, calomel electrode-concentration cell-construction of glass electrode-Batteries: Dry cell, Ni-Cd cells, Ni-Metal hydride cells, Li ion battery, zinc air cells–Fuel cells: H_2-O_2, CH_3OH-O_2, phosphoric acid, molten carbonate.

Corrosion:-Definition-theories of corrosion(chemical and electrochemical)-galvanic corrosion, differential aeration corrosion, stress corrosion, waterline corrosion-passivity of metals-galvanic series-factors influencing rate of corrosion-corrosion control (proper designing, cathodic protection)-Protective coatings: Surface preparation, cathodic and anodic coatings, electroplating, electroless plating (nickel). Paints (constituents, functions, special paints).

Learning Outcomes:*At the end of this unit, the students will be able to*

- ***Explain*** the theory of construction of battery and fuel cells.
- ***Categorize***the reasons for corrosion and study some methods of corrosion control.

UNIT III:CHEMISTRY OF MATERIALS

Part- A:

Nano materials:- Introduction-sol-gel method-characterization by BET, SEM and TEM methods-applications of graphene-carbon nanotubes andfullerenes:Types, preparation and applications

Thermal analysis techniques: Instrumentation and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC).

Part-B:

Refractories:- Definition,classification, properties (refractoriness, refractoriness under load, porosity and thermal spalling), failure of refractories.

Lubricants: - Definition, mechanism of lubricants and properties (definition and importance).

Cement:- Constituents, manufacturing,parameters to characterize the clinker formation: limesaturation factor (LSF), silica ratio (SR) and alumina ratio (AR),chemistry ofsettingand hardening, deterioration of cement.

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Learning Outcomes:*At the end of this unit, the students will be able to*

- ***Outline*** the awareness of materials like nanomaterials and fullerenes and their uses.
- ***Explain*** the techniques that detect and measure changes of state of reaction.
- ***Illustrate*** the commonly used industrial materials.

UNIT IV: FUELS

Introduction-calorific value-HCV and LCV-problems using Dulong's formula-proximate and ultimate analysis of coal sample-significance of these analyses-problems-Petroleum (refining-cracking)-Synthetic petrol (Fischer Tropsch and Bergius)-petrol knocking-diesel knocking-octane and cetane ratings-anti-knock agents-Introduction to alternative fuels (Bio-diesel,ethanol, methanol, Natural gas, LPG, CNG)-Flue gas analysis by Orsatapparatus-Rocket fuels.

Learning Outcomes:*At the end of this unit, the students will be able to*

- ***Differentiate*** petroleum, petrol, synthetic petrol and have knowledge how they are produced.
- ***Study*** alternate fuels.
- ***Analyse***flue gases.

UNIT V: WATER TECHNOLOGY

Hardness of water-determination of hardness by complexometric method-boiler troubles (priming and foaming, scale formation, boilercorrosion, caustic embrittlement)-internal treatments-softening of hard water (zeolite processs and related sums, ion exchange process)-treatment of industrial waste water

Portable water and its specifications-steps involved in purification of water-chlorination, break point chlorination-reverse osmosis and electro dialysis.

Learning Outcomes:*At the end of this unit, the students will be able to*

- ***Explain*** the impurities present in raw water, problems associated with them and how to avoid them are understood.

Standard Books:

1. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co. Latest edition
2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2019 edition.
3. A text book of engineering Chemistry by S. S. Dara; S. Chand & Co Ltd., Latest Edition
4. Engineering Chemistry by Shashi Chawla; Dhanpat Rai Publicating Co. Latest edition

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I Year - I Semester		L	T	P	C
		3	0	0	3
PROGRAMMING FOR PROBLEM SOLVING USING C (ES1101)					

COURSE OBJECTIVES:

The objectives of Programming for Problem Solving Using C are

1) To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
2) To gain knowledge of the operators, selection, control statements and repetition in C
3) To learn about the design concepts of arrays, strings, enumerated structure and union types. To learn about their usage.
4) To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
5) To assimilate about File I/O and significance of functions

UNIT I

Introduction to Computers: Creating and running Programs, Computer Numbering System, Storing Integers, Storing Real Numbers

Introduction to the C Language: Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples, Scope, Storage Classes and Type Qualifiers.

Structure of a C Program: Expressions Precedence and Associativity, Side Effects, Evaluating Expressions, Type Conversion Statements, Simple Programs, Command Line Arguments.

UNIT II

Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators.

Selection & Making Decisions: Logical Data and Operators, Two Way Selection, Multiway Selection, More Standard Functions

Repetition: Concept of Loop, Pretest and Post-test Loops, Initialization and Updating, Event and Counter Controlled Loops, Loops in C, Other Statements Related to Looping, Looping Applications, Programming Examples

UNIT III

Arrays: Concepts, Using Array in C, Array Application,Two Dimensional Arrays,Multidimensional Arrays, Programming Example – Calculate Averages

Strings: String Concepts, C String, String Input / Output Functions, Arrays of Strings, String Manipulation Functions String/ Data Conversion, A Programming Example – Morse Code

Enumerated, Structure, and Union: The Type Definition (Type def), Enumerated Types, Structure, Unions, and Programming Application

UNIT IV

Pointers: Introduction, Pointers to pointers, Compatibility, L value and R value

Pointer Applications: Arrays, and Pointers, Pointer Arithmetic and Arrays, Memory Allocation Function, Array of Pointers, Programming Application

Processor Commands: Processor Commands

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UNIT V

Functions: Designing, Structured Programs, Function in C, User Defined Functions, Inter-Function Communication, Standard Functions, Passing Array to Functions, Passing Pointers toFunctions, Recursion

Text Input / Output: Files, Streams, Standard Library Input / Output Functions, Formatting Input / Output Functions, Character Input / Output Functions

Binary Input / Output: Text versus Binary Streams, Standard Library, Functions for Files, Converting File Type.

TEXT BOOKS:

1. Programming for Problem Solving, Behrouz A. Forouzan, Richard F.Gilberg, CENGAGE
2. The C Programming Language, Brian W.Kernighan, Dennis M. Ritchie, 2e, Pearson

REFERENCES:

1. Computer Fundamentals and Programming, Sumithabha Das, Mc Graw Hill
2. Programming in C, Ashok N. Kamthane, AmitKamthane, Pearson
3. Computer Fundamentals and Programming in C, Pradip Dey, Manas Ghosh, OXFORD

COURSE OUTCOMES:

Upon the completion of the course the student will learn

1) To write algorithms and to draw flowcharts for solving problems
2) To convert flowcharts/algorithms to C Programs, compile and debug programs
3) To use different operators, data types and write programs that use two-way/ multi-way selection
4) To select the best loop construct for a given problem
5) To design and implement programs to analyze the different pointer applications
6) To decompose a problem into functions and to develop modular reusable code
7) To apply File I/O operations

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I Year - I Semester		L	T	P	C
		1	0	3	2.5
ENGINEERING DRAWING (ES1103)					

Course Objective:Engineering drawing being the principal 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 and special methods, cycloids, involutes, tangents &normals for the curves.
Scales: Plain scales, diagonal scales and vernier scales

Unit II
Objective: To introduce the students to use orthographic projections, projections of points & simple lines. To make the students draw the projections of the lines inclined to both the planes.
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.
Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

Unit III
Objective: The objective is to make the students draw the projections of the plane inclined toboth 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.

Unit IV
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 both the planes.

Unit V
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.

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Computer Aided Design, Drawing practice using Auto CAD, Creating 2D&3D drawings of objects using Auto CAD

Note: In the End Examination there will be no question from CAD.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

Course Outcome: The student will learn how to visualize 2D & 3D objects.

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KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF PETROLEUM ENGINEERING

I Year - I Semester		L	T	P	C
		0	0	3	1.5
ENGLISH LAB (HS1102)					

UNIT I:
Vowels, Consonants, Pronunciation, Phonetic Transcription

UNIT II:

Past tense markers, word stress-di-syllabic words, Poly-Syllabic words

UNIT III:

Rhythm & Intonation

UNIT IV:

Contrastive Stress (Homographs)

UNIT V:

Word Stress: Weak and Strong forms
Stress in compound words

References books:

1. Infotech English, Maruthi Publications (with Compact Disc).
2. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
3. English Pronunciation in use- Mark Hancock, Cambridge University Press.
4. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
5. English Pronunciation in use- Mark Hewings, Cambridge University Press.
6. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
7. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - I Semester		L	T	P	C
		0	0	3	1.5
ENGINEERING CHEMISTRY LAB (BS1111)					

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
3. Determination of Mn (II) using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of copper (II) using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of iron (III) by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of the concentration of strong acid vs strong base (by conductometric method).
10. Determination of strong acid vs strong base (by potentiometric method).
11. Determination of Mg^{+2} presentin an antacid.
12. Determination of $CaCO_3$ present in an egg shell.
13. Estimation of Vitamin C.
14. Determination of phosphoric content in soft drinks.
15. Adsorption of acetic acid by charcoal.
16. Preparation of nylon-6, 6 and Bakelite (demonstration only).

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

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.

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Course Objectives:

1) Apply the principles of C language in problem solving.
2) To design flowcharts, algorithms and knowing how to debug programs.
3) To design & develop of C programs using arrays, strings pointers & functions.
4) To review the file operations, preprocessor commands.

Exercise 1:

1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters.
2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.
3. Write a C program to display multiple variables.

Exercise 2:

1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

Exercise 3:

1. Write a C program to convert a string to a long integer.
2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
3. Write a C program to calculate the factorial of a given number.

Exercise 4:

1. Write a program in C to display the n terms of even natural number and their sum.
2. Write a program in C to display the n terms of harmonic series and their sum. 1 + 1/2 + 1/3 + 1/4 + 1/5 ... 1/n terms.
3. Write a C program to check whether a given number is an Armstrong number or not.

Exercise 5:

1. Write a program in C to print all unique elements in an array.
2. Write a program in C to separate odd and even integers in separate arrays.
3. Write a program in C to sort elements of array in ascending order.

Exercise 6:

1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix.

Exercise 7:

1. Write a program in C to search an element in a row wise and column wise sorted matrix.
2. Write a program in C to print individual characters of string in reverse order.

Exercise 8:

1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

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Exercise 9:

1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
2. Write a program in C to demonstrate how to handle the pointers in the program.

Exercise 10:

1. Write a program in C to demonstrate the use of & (address of) and *(value at address) operator.
2. Write a program in C to add two numbers using pointers.

Exercise 11:

1. Write a program in C to add numbers using call by reference.
2. Write a program in C to find the largest element using Dynamic Memory Allocation.

Exercise 12:

1. Write a program in C to swap elements using call by reference.
2. Write a program in C to count the number of vowels and consonants in a string using a pointer.

Exercise 13:

1. Write a program in C to show how a function returning pointer.
2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc( ) function.

Exercise 14:

1. 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
2. Write a program in C to convert decimal number to binary number using the function.

Exercise 15:

1. Write a program in C to check whether a number is a prime number or not using the function.
2. Write a program in C to get the largest element of an array using the function.

Exercise 16:

1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to remove a file from the disk.

Course Outcomes:

By the end of the Lab, the student

1) Gains Knowledge on various concepts of a C language.
2) Able to draw flowcharts and write algorithms.
3) Able design and development of C problem solving skills.
4) Able to design and develop modular programming skills.
5) Able to trace and debug a program

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - I Semester		L	T	P	C
		2	0	0	0
CONSTITUTION OF INDIA (MC1104)					

Course Objectives:

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
- To understand the central and state relation financial and administrative.

UNIT-I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Learning outcomes:

After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History, features of Indian constitution
- Evaluate Preamble Fundamental Rights and Duties

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions;
Learning outcomes:-After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government
- Explain the role of President and Prime Minister
- Know the Structure of supreme court and High court

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

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Learning outcomes:-After completion of this unit student will

- Understand the structure of state government
- Analyze the role Governor and Chief Minister
- Explain the role of state Secretariat
- Differentiate between structure and functions of state secretariat

UNIT-IV

A.Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

Learning outcomes:-After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration role and importance
- Analyze the role of Myer and elected representatives of Municipalities
- Evaluate Zillapanchayat block level organisation

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women

Learning outcomes:-After completion of this unit student will

- Know the role of Election Commission apply knowledge
- Contrast and compare the role of Chief Election commissioner and Commissiononerate
- Analyze role of state election commission
- Evaluate various commissions of viz SC/ST/OBC and women

References:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government andPolitics Hans
7. J. Raj IndianGovernment and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

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E-resources:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

Course Outcomes:

At the end of the semester/course, the student will be able to have a clear knowledge on the following:

- Understand historical background of the constitution making and its importance for building a democratic India.
- Understand the functioning of three wings of the government ie., executive, legislative and judiciary.
- Understand the value of the fundamental rights and duties for becoming good citizen of India.
- Analyze the decentralization of power between central, state and local self-government.
- Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.
    1. Know the sources, features and principles of Indian Constitution.
    2. Learn about Union Government, State government and its administration.
    3. Get acquainted with Local administration and Pachayati Raj.
    4. Be aware of basic concepts and developments of Human Rights.
    5. Gain knowledge on roles and functioning of Election Commission

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
ENGLISH (HS1201)					

Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

Course Objectives

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Learning Outcomes

At the end of the module, the learners will be able to

- understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ask and answer general questions on familiar topics and introduce oneself/others
- employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- form sentences using proper grammatical structures and correct word forms

Unit 1:

Lesson-1: A Drawer full of happiness from "**Infotech English**", Maruthi Publications
Lesson-2: Deliverance by Premchandfrom "**The Individual Society",** Pearson Publications.
(Non-detailed)
Listening: Listening to short audio texts and identifying the topic. Listening to short audio texts and identifying the context and specific pieces of information to answer a series of questions both in speaking and writing.

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Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self introductions and introducing others.

Reading: Skimming text to get the main idea. Scanning to look for specific pieces of information.

Reading for Writing: Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

Vocabulary: Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.

Grammar: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.
Pronunciation: Vowels, Consonants, Plural markers and their realizations

Unit 2:

Lesson-1: Nehru's letter to his daughter Indira on her birthday from "**Infotech English**", Maruthi Publications

Lesson-2: Bosom Friend by Hira Bansodefrom "**The Individual Society",** Pearson Publications. (Non-detailed)

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts, both in speaking and writing.

Speaking: Discussion in pairs/ small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)

Grammar: Use of articles and zero article; prepositions.

Pronunciation: Past tense markers, word stress-di-syllabic words

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Unit 3:

Lesson-1: Stephen Hawking-Positivity 'Benchmark' from "**Infotech English**", Maruthi Publications

Lesson-2: Shakespeare's Sister by Virginia Woolf from "**The Individual Society",** Pearson Publications. (Non-detailed**)**

Listening: Listening for global comprehension and summarizing what is listened to, both in speaking and writing.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed. Functional English: Complaining and Apologizing.

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical reading.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing. E-mail etiquette, Writing CV's.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words

Grammar: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

Pronunciation: word stress-poly-syllabic words

Unit 4:

Lesson-1: Liking a Tree, Unbowed: Wangari Maathai-biography from "**Infotech English**", Maruthi Publications

Lesson-2: Telephone Conversation-Wole Soyinka from "**The Individual Society",** Pearson Publications**.** (Non-detailed)

Listening: Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Functional English: Permissions, Requesting, Inviting.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

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Reading for Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. Writing SOP, writing for media.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.

Grammar: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

Pronunciation: Contrastive Stress

Unit 5:

Lesson-1: Stay Hungry-Stay foolish from "**Infotech English**", Maruthi Publications

Lesson-2: Still I Rise by Maya Angelou from "**The Individual Society",** Pearson Publications. (Non-detailed)

Listening: Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.

Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides. Functional English: Suggesting/Opinion giving.

Reading: Reading for comprehension. RAP Strategy Intensive reading and Extensive reading techniques.

Reading for Writing: Writing academic proposals- writing research articles: format and style.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.

Grammar: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Pronunciation: Stress in compound words

Prescribed text books for theory for Semester-I:

1. "**Infotech English**", Maruthi Publications. (Detailed)
2. "**The Individual Society",** Pearson Publications. (Non-detailed)

Reference books:

1. Infotech English, Maruthi Publications. (with Compact Disc)
2. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
3. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
4. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
5. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
MATHEMATICS - III (BS1203) **(Common to all Branch's for I Year B. Tech)**					

Course Objectives:

- To familiarize the techniques in partial differential equations.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

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

- Interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- Estimate the work done against a field, circulation and flux using vector calculus (L5)
- Apply the Laplace transform for solving differential equations (L3).
- Find or compute the Fourier series of periodic signals (L3)
- Know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)
- Identify solution methods for partial differential equations that model physical processes (L3)

UNIT I: Vector calculus: (10 hrs)

Vector Differentiation: Gradient — Directional derivative — Divergence — Curl — Scalar Potential. Vector Integration: Line integral — Work done — Area — Surface and volume integrals — Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof).

UNIT II:Laplace Transforms: (10 hrs)

Laplace transforms of standard functions — Shifting theorems — Transforms of derivatives and integrals —
Unit step function — Dirac's delta function — Inverse Laplace transforms — Convolution theorem (without proof).
Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

UNIT III: Fourier series and Fourier Transforms: (10 hrs)

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.

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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UNIT IV:PDE of first order: (8 hrs)

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.

UNIT V: Second order PDE and Applications: (10 hrs)

Second order PDE: Solutions of linear partial differential equations with constant coefficients — RHS term of the type $e^{ax + by}$,sin(ax + by), cos(ax + by), $x^m y^n$
Applications of PDE: Method of separation of Variables — Solution of One dimensional Wave, Heat and two-dimensional Laplace equation.

Text Books:

1. **B.S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **B. V. Ramana**, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10thEdition, Wiley-India.
2. **Dean. G. Duffy**, Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.
3. **Peter O' Neil**, Advanced Engineering Mathematics, Cengage.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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I Year - II Semester		L	T	P	C
		3	0	0	3
ENIGINEERING PHYSICS (BS1208)					

Course Objectives:

Physics curriculum which is re-oriented to the needs of non-circuital branches of graduate engineering courses offered by JNTUniversity:kakinada that serves as a transit to understand the branch specific advanced topics. The course is designed to:

- Impart concepts of mechanics required to identify forces and moments in mechanical systems by vector representation-extend Newton's second law for inertial and non-inertial frames of reference- study different types of harmonic oscillatory motions.
- Tap the Simple harmonic motion and its adaptability for improved acoustic quality of concert halls- impart concepts of flaw detection techniques using ultrasonics.
- Study the structure- property relationship exhibited by solid materials within the elastic limit.
- Impart knowledge in basic concepts of LASERs along with its Engineering applications-Familiarize types of sensors for various engineering applications
- Explore the knowledge of magnetic and dielectric materials and their utility in appliances.

UNIT-I **(10hrs)**

MECHANICS: Basic laws of vectors and scalars, rotational frames-conservative and non – conservative forces , F = - grad V, Newton's laws in inertial and linear accelerating non-inertial frames of reference, rotating frame of reference with constant angular velocity, Harmonic oscillator ; damped harmonic motion ; Forced oscillations and resonance.

Outcome:

The students will be able to

- Identifyforces and moments in mechanical systems using scalar and vector techniques
- extend Newton's second law for inertial and non-inertial frame of reference
- explain simple harmonic motion and damped harmonic motions

UNIT-II (10hrs)

ACOUSTICS & ULTRASONICS: Introduction – Reverberation - Reverberation time - Sabine's formula (Derivation using growth and decay method)–absorption coefficient and its determination-factors affecting acoustics of buildings and their remedies.

Production of ultrasonics by Magnetostriction and piezoelectric methods – Detection of ultrasonics - acoustic grating - Non-Destructive Testing- pulse echo system through transmission and reflection modes - Applications.

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Outcome:
The students will be able to

- explain how sound is propagated in buildings
- analyze acoustic properties of typically used materials in buildings
- recognize sound level disruptors and their use in architectural acoustics
- Use of ultrasonics in flaw detection using NDT technique

UNIT-III **(9hrs)**

ELASTICITY:, stress, strain, Hooke's law, stress-strain curve, generalized Hooke's law with and without thermal strains for isotropic materials, different types of moduli and their relations, bending of beams – Bending moment of a beam – Depression of cantilever.

Outcome:
The students will be able to

- Understand the elasticity and plasticity concepts
- Study different types of moduli and their relation
- Analyze the concepts of shearing force and moment of inertia

UNIT-IV (9hrs)

LASERS & SENSORS: Characteristics–Spontaneous and Stimulated emission of radiation – population inversion - Einstein's coefficients & Relation between them and their significance - Pumping Mechanisms - Ruby laser – Helium Neon laser – Applications.
SENSORS (qualitative description only): Different types of sensors and applications; Strain and Pressure sensors- Piezoelectric, magnetostrictive sensors, Temperature sensor - bimetallic strip, pyroelectric detectors.

Outcome:
The students will be able to

- **Understand** the basic concepts of LASER light Sources
- Study Differenttypes of laser systems
- Identify different types of sensors and their working principles

UNIT-V (10hrs)

MAGNETISM & DIELECTRICS: Introduction – Magnetic dipole moment – Magnetization-Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Bohr Magneton - Classification of magnetic materials (Dia, Para and Ferro) – Domain concept of Ferromagnetism - Hysteresis – soft and hard magnetic materials – Applications of Ferromagnetic materials.
Introduction - Dielectric polarization **–** Dielectric polarizability, Susceptibility and Dielectric constant-types of polarizations: Electronic and Ionic (Quantitative), Orientational polarizations (qualitative)-Lorentz internal field – Claussius_Mossoti equation- Frequency dependence of polarization - Applications of dielectrics.

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Outcome:
The students will be able to

- **explain** the concept of dielectric constant and polarization in dielectric materials.
- **summarize** various types of polarization of dielectrics .
- **interpret** Lorentz field and Claussius_Mosotti relation in dielectrics.
- **classify** the magnetic materials based on susceptibility and their temperature dependence.
- **explain** the applications of dielectric and magnetic materials .
- **Apply** the concept of magnetism to magnetic devices.

Text Books:

1. "Engineering Mechanics" by Manoj K Harbola, Cengage Publications 2nd Eds.
2. "A text book of Engineering Physics" by P G Kshirsagar& M N Avadhanulu, S Chand & Company Ltd.
3. "Engineering Physics" by R K Gaur and S L Gupta, Dhanpat Rai Publications.
4. "Sensor and Transducers" by Ian R Sinclair, Elsevier (Newnes) 3rd Eds.

Reference Books:

1. "Engineering Physics" by M R Srinivasan, New Age International Publishers.
2. "Lectures on Physics" by Richard P Feynman, Pearson Publishers, New Millennium Eds.
3. "Lasers and Non-linear Optics" by B B Laud, New Age International Publishers (3rd Eds.).

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
ENIGINEERING MECHANICS (BS1204)					

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'sTheorm, 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. The students are to be exposed to concepts of moment of inertia and polar moment of inertia including transfer methods and their applications.
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.
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.

UNIT – IV
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.
Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics- Work Energy method and applications to particle motion- Impulse momentum method.

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UNIT – V
Objectives: The students are to be exposed to rigid motion kinematics and kinetics
Rigid body Motion: Kinematics and kineticsof translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse momentum method.

TEXT BOOK:

1. Engg. Mechanics - S.Timoshenko&D.H.Young., 4thEdn - , 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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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - II Semester		L	T	P	C
		3	0	0	3
INTRODUCTION TO PETROLEUM ENGINEERING (PT1201)					

Learning Objectives:

- To introduce the concepts that will enable the transition from petroleum science to petroleum engineering.
- To explain the role of petroleum engineers in upstream, midstream and downstream sectors.
- To learn the fundamental concepts of upstream, midstream and downstream sectors.

UNIT-I

Introduction:

What is Petroleum Engineering & Significance? Introduction Petroleum Industry- Upstream Sector – Midstream Processing-Downstream Processing-Indian and World Scenario of Petroleum and Natural Gas- Petroleum Trade- Geopolitics.

UNIT II

Upstream Sector-1

Exploration & Production –Indian and World Scenario of Petroleum and Natural Gas Resources-
The Reservoir –Reservoir fluids- Hydrocarbon Phase diagrams- Onshore and Offshore Reservoirs – Reservoir Drives.

UNIT III

Upstream Sector-2

Exploration and Drilling Rigs- Rig Components-Drill and drill bits- Drilling fluids-Well Completions Production System: Sketches of Well - Well head- Christmas tree and Casing and various other parts-Cementing-Safety Systems- **Subsea Wells**: Drilling & Completion and Production

Artificial Lift: Principles and operation of Rod Pumps – Downhole Pumps – Gas Lift – Plunger Lift-Electrical submersible pumps.
Well Workover and Intervention- Well Stimulation: Matrix Acidizing and Hydro-fracturing.

UNIT IV

Gathering of Oil & Gas and Storage:

Well Tubing- Separaion of Reservoir Fluids- Manifolds and Gathering – Production Separators – Gas Treatment and Compression - Oil & Gas Storage, Metering and Export.
Midstream processing: Transportation of Crude Oil & its Products and Natural Gas- - World and Indian pipeline scenario- Design of Oil and Gas pipelines - Safety aspects of pipelines-Environmental issues.

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UNIT V

Downstream Processing

Crude Oil Refining: Classification and Composition – Constituents - Products and their specifications– Pre-treatment of crude oil- Refinery distillation- Safety in refinery operations.

Text Books:

1. HavardDevold, Oil and Gas Production Handbook: An Introduction to Oil & Gas Production, ABB ATPA Oil and Gas, 2006.
2. John R. Fanchi and Christiansen, R.L., Introduction to Petroleum Engineering, John Wiley & Sons, 2017.

Outcomes:

- The students will be able to understand the role of petroleum engineers in various facets of petroleum exploration, production, transportation, refining and processing.
- Students get motivated to work for the energy security after knowing the present scenario of petroleum and natural gas.

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - II Semester		L	T	P	C
		0	0	3	1.5
COMMUNICATION SKILLS LAB (HS1203)					

UNIT I:
Oral Activity: JAM, Hypothetical Situations, Self/Peer Profile
Common Errors in Pronunciation, Neutralising Accent

UNIT II:
Oral Activity: Telephonic Etiquette, Role Plays
Poster Presentations

UNIT III:
Oral Activity: Oral Presentation skills, Public speaking
Data Interpretation

UNIT IV:
Oral Activity: Group Discussions: Do's and Don'ts- Types, Modalities

UNIT V:
Oral Activity: Interview Skills: Preparatory Techniques, Frequently asked questions, Mock Interviews.
Pronunciation: Connected speech (Pausing, Tempo, Tone, Fluency etc.,)

References:

1. Infotech English, Maruthi Publications (with Compact Disc).
2. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
3. English Pronunciation in use- Mark Hancock, Cambridge University Press.
4. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
5. English Pronunciation in use- Mark Hewings, Cambridge University Press.
6. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
7. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.
8. Technical Communication- Meenakshi Raman, Sangeeta Sharma, Oxford University Press.
9. Technical Communication- Gajendrea Singh Chauhan, SmitaKashiramka, Cengage Publications.

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - II Semester		L	T	P	C
		0	0	3	1.5
ENGINEERING PHYSICS LAB (BS1209)					

(Any 10 of the following listed 15 experiments)

LIST OF EXPERIMENTS:

1. Determination of Rigidity modulus of a material- Torsional Pendulum.
2. Determination of Young's modulus by method of single cantilever oscillations.
3. Determination of Acceleration due to Gravity and Radius of Gyration - Compound Pendulum.
4. Verification of laws of vibrations in stretched strings – Sonometer.
5. Determination of spring constant of springs using coupled oscillators.
6. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus
7. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
8. Measurement of magnetic susceptibility by Gouy's method.
9. Determination of ultrasonic velocity in liquid (Acoustic Grating)
10. Determination of dielectric constant by charging and discharging method
11. Determination of wavelength of Laser by diffraction grating
12. Determination of particle size using Laser.
13. Determeination of Pressure variation using strain Gauge sensor.
14. Determination of Moment of Inertia of a Fly Wheel.
15. Determination of Velocity of sound –Volume Resoantor.

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - II Semester		L	T	P	C
		0	0	4	2
ENGINEERING WORKSHOP & IT WORKSHOP					

Engg Workshop

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

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

Trade:

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

IT Workshop

COURSE OBJECTIVES:

The objective of IT Workshop is to

1. Explain the internal parts of a computer, peripherals, I/O ports, connecting cables
2. Demonstrate basic command line interface commands on Linux
3. Teach the usage of Internet for productivity and self paced lifelong learning
4. Describe about Compression, Multimedia and Antivirus tools
5. Demonstrate Office Tools such as Word processors, Spreadsheets and Presentation tools

Computer Hardware:

Experiment 1: Identification of peripherals of a PC, Laptop, Server and Smart Phones: Prepare a report containing the block diagram along with the configuration of each component and its functionality, Input/ Output devices, I/O ports and interfaces, main memory, cache memory and secondary storage technologies, digital storage basics, networking components and speeds.

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Operating Systems:

Experiment 2: Internet Services:

- Web Browser usage and advanced settings like LAN, proxy, content, privacy, security, cookies, extensions/ plugins
- Antivirus installation, configuring a firewall, blocking pop-ups
- Email creation and usage, Creating a Digital Profile on LinkedIn
- Source control on Github, Hackerrank, Codechef, HackerEarth, etc
- Google hangout/ Skype/ gotomeeting video conferencing
- archive.org for accessing archived resources on the web

Productivity Tools:

Experiment 3: Demonstration and Practice on archival and compression tools

- scanning and image editing tools
- OCR and text extraction
- audio players, recording using Mic, editing, podcast preparation
- video players, recording using webcam/camcorder, editing
- podcast, screencast, vodcast, webcasting

Office Tools:

Experiment 4: Demonstration and Practice on Text Editors like Notepad++, Sublime Text, Atom, Brackets, Visual code, etc
Experiment 5: Demonstration and practice on Microsoft Word, Power Point
Experiment 6: Demonstration and practice on Microsoft Excel.
Experiment 7: Demonstration and practice on LaTeX and produce professional pdf documents.
Experiment 8:Cloud based productivity enhancement and collaboration tools:

- Store, sync, and share files with ease in the cloud using Google Drive
- Document creation and editing text documents in your web browser using Google docs
- Handle task lists, create project plans, analyze data with charts and filters using Google Sheets
- Create pitch decks, project presentations, training modules using Google Slides
- Manage event registrations, create quizzes, analyze responses using Google Forms
- Build public sites, internal project hubs using Google Sites
- Online collaboration through cross-platform support using Jamboard
- Keep track of important events, sharing one's schedule, and create multiple calendars using Google Calendar

TEXT BOOKS:

1. Computer Fundamentals, Anita Goel, Pearson Education, 2017
2. PC Hardware Trouble Shooting Made Easy, TMH

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REFERENCES:

1. Essential Computer and IT Fundamentals for Engineering and Science Students, Dr.N.B.Vekateswarlu, S.Chand

WEB RESOURCES:

1. https://explorersposts.grc.nasa.gov/post631/2006-2007/computer_basics/ComputerPorts.doc
2. https://explorersposts.grc.nasa.gov/post631/2006-2007/bitsnbyte/Digital_Storage_Basics.doc
3. https://www.thegeekstuff.com/2009/07/linux-ls-command-examples
4. https://www.pcsuggest.com/basic-linux-commands/
5. https://www.vmware.com/pdf/VMwarePlayerManual10.pdf
6. https://geek-university.com/vmware-player/manually-install-a-guest-operating-system/
7. https://gsuite.google.com/learning-center/products/#!/

COURSE OUTCOMES:

Students should be able to:

1. Assemble and disassemble components of a PC
2. Construct a fully functional virtual machine, Summarize various Linux operating system commands,
3. Secure a computer from cyber threats, Learn and practice programming skill in Github, Hackerrank, Codechef, HackerEarth etc.
4. Recognize characters & extract text from scanned images, Create audio files and podcasts
5. Create video tutorials and publishing, Use office tools for documentation, Build interactive presentations, Build websites, Create quizzes & analyze responses.

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - II Semester		L	T	P	C
		0	0	2	1
ENGINEERING EXPLORATION PROJECT(PR1201)					

COURSE OBJECTIVES:

- Build mindsets & foundations essential for designers
- Learn about the Human-Centered Design methodology and understand their real-world applications
- Use Design Thinking for problem solving methodology for investigating illdefined problems.
- Undergo several design challenges and work towards the final design challenge

Apply Design Thinking on the following Streams to

- Project Stream 1: Electronics, Robotics, IOT and Sensors
- Project Stream 2: Computer Science and IT Applications
- Project Stream 3: Mechanical and Electrical tools
- Project Stream4: Eco-friendly solutions for waste management, infrastructure, safety, alternative energy sources, Agriculture, Environmental science and other fields of engineering.

HOW TO PURSUE THE PROJECT WORK?

- The first part will be learning-based-masking students to embrace the methodology by exploring all the phases of design thinking through the wallet/ bag challenge and podcasts.
- The second part will be more discussion-based and will focus on building some necessary skills as designers and learning about complementary material for human- centered design.
- The class will then divide into teams and they will be working with one another for about 2 – 3 weeks. These teams and design challenges will be the basis for the final project and final presentation to be presented.
- The teams start with **Design Challenge** and go through all the phases more in depth from coming up with the right question to empathizing to ideating to prototyping and to testing.
- Outside of class, students will also be gathering the requirements, identifying the challenges, usability, importance etc
- At the end, Students are required to submit the final reports, and will be evaluated by the faculty.

TASKS TO BE DONE:

Task 1: Everyone is a Designer

- Understand class objectives & harness the designer mindset

Task 2: The Wallet/Bag Challenge and Podcast

- Gain a quick introduction to the design thinking methodology
- Go through all stages of the methodology through a simple design challenge
- Podcast: Observe, Listen and Engage with the surrounding environment and identify a design challenge.

Task 3: Teams & Problems

- Start Design Challenge and learn about teams & problems through this
- Foster team collaboration, find inspiration from the environment and learn how to identify problems

Task 4: Empathizing

- Continue Design Challenge and learn empathy
- Learn techniques on how to empathize with users
- Go to the field and interview people in their environments
- Submit Activity Card

Task 5: Ideating

- Continue Design Challenge and learn how to brainstorm effectively
- Encourage exploration and foster spaces for brainstorming
- Submit Activity Card

Task 6: Prototyping

- Continue Design Challenge and learn how to create effective prototypes
- Build tangible models and use them as communication tools
- Start giving constructive feedback to classmates and teammates
- Submit Activity Card

Task 7: Testing

- Finish Design Challenge and iterate prototypes and ideas through user feedback
- Evolve ideas and prototypes through user feedback and constructive criticism
- Get peer feedback on individual and group performance
- Submit Activity Card

Task 8:

- Final Report Submission and Presentation

Note: The colleges may arrange for Guest Speakers from Various Design Fields: Graphic Design, Industrial Design, Architecture, Product Design, Organizational Design, etc to enrich the students with Design Thinking Concept.

REFERENCES:

1. Tom Kelly, *The Art of Innovation: Lessons in Creativity From IDEO, America's Leading Design Firm* (Profile Books, 2002)
2. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation (HarperBusiness, 2009)
3. Jeanne Liedtka, Randy Salzman, and Daisy Azer, Design Thinking for the Greater Good: Innovation in the Social Sector (Columbia Business School Publishing, 2017)

OTHER USEFUL DESIGN THINKING FRAMEWORKS AND METHODOLOGIES:

- Human-Centered Design Toolkit (IDEO); https://www.ideo.com/post/design-kit
- Design Thinking Boot Camp Bootleg (Stanford D-School); https://dschool.stanford.edu/resources/the-bootcamp-bootleg
- Collective Action Toolkit (frogdesign); https://www.frogdesign.com/wpcontent/
  - uploads/2016/03/CAT_2.0_English.pdf
- Design Thinking for Educators (IDEO); https://designthinkingforeducators.com/

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DEPARTMENT OF PETROLEUM ENGINEERING

I Year - II Semester		L	T	P	C
		2	0	0	0
ENVIRONMENTAL SCIENCE(MC1201)					

Learning Objectives:
The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

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-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

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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. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

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.

Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.

The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:

1. Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
3. Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

Reference:

1. Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
MATHEMATICS-IV					

Course Objectives:

- To familiarize the complex variables.
- To familiarize the students with the foundations of probability and statistical methods.
- To equip the students to solve application problems in their disciplines.

Course Outcomes: At the end of the course students will be able to

- apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
- find the differentiation and integration of complex functions used in engineering problems (L5)
- make use of the Cauchy residue theorem to evaluate certain integrals (L3)
- apply discrete and continuous probability distributions (L3)
- design the components of a classical hypothesis test (L6)
- infer the statistical inferential methods based on small and large sampling tests (L4)

UNIT – I: Functions of a complex variable and Complex integration:

Introduction – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.
Complex integration: Line integral – Cauchy's integral theorem – Cauchy's integral formula – Generalized integral formula (all without proofs).

UNIT – II: Series expansions and Residue Theorem:

Radius of convergence – Expansion in Taylor's series, Maclaurin's series and Laurent series.
Types of Singularities: Isolated – pole of order m – Essential – Residues – Residue theorem (Without proof) – Evaluation of real integral of the type $\int_{-\infty}^{\infty} f(x)dx$

UNIT – III: Probability and Distributions:
Review of probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

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UNIT – IV: Sampling Theory:
Introduction – Population and samples – Sampling distribution of Means and Variance (definition only) – Central limit theorem (without proof) – Introduction to t, χ^2 and F-distributions – Point and Interval estimations – Maximum error of estimate.

UNIT – V: 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 two means (Large and Small samples) – Tests on proportions.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **Miller and Freund's,** Probability and Statistics for Engineers, 7/e, Pearson, 2008.

Reference Books:

1. **S. C. Gupta and V. K. Kapoor**, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.
2. **Jay l. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
3. **Shron L. Myers, Keying Ye, Ronald E Walpole,** Probability and Statistics Engineers and the Scientists, 8th Edition, Pearson 2007.
4. **Sheldon, M. Ross**, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation, 2011

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
BASIC ELECTRICAL AND ELECTRONICS ENGINEERING					

Preamble:
This course covers the topics related to analysis of various electrical circuits, operation of various electrical machines and electronic components to perform well in their respective fields.

Learning Objectives:
- To learn the basic principles of electrical circuital law's and analysis of networks.
- To understand principle of operation and construction details of DC machines.
- To understand principle of operation and construction details of transformers, alternator and 3-Phase induction motor.
- To study operation of PN junction diode, half wave, full wave rectifiers and
- OP-AMPs.
- To learn 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 – star-delta and delta-star transformations.-Numerical Problems.

Unit – II:
DC Machines
Principle of operation of DC generator – EMF equation – types of DC machines – torque equation characteristics of DC motors – applications – three point starter – speed control methods of DC motor – Swinburne's Test-Brake test on DC shunt motor-Numerical problems.

Unit – III:
AC Machines:
Transformers
Principle of operation and construction of single phase transformers – EMF equation – Losses – OC & SC tests – efficiency and regulation-Numerical Problems.

AC Rotating Machines
Principle of operation and construction of alternators – types of alternators Regulation of alternator by synchronous impedance method – principle of operation of synchronous motor – principle of operation of 3-Phase induction motor – slip-torque characteristics – efficiency – applications-Numerical Problems.

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Unit IV:

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)-Numerical Problems.

Unit V

Transistors

PNP and NPN junction transistor, transistor as an amplifier– frequency response of CE amplifier – Basic concepts of feedback amplifier-Numerical problems.

Learning Outcomes:

After the completion of the course the student should be able to:

- analyse various electrical networks.
- understand operation of DC generators,3-point starter and DC machine testing by Swinburne's Test and Brake test.
- analyse performance of single-phase transformer and acquire proper knowledge and working of 3-phase alternator and 3-phase induction motors.
- analyse operation of half wave, full wave bridge rectifiers and OP-AMPs.
- understanding operations of CE amplifier and basic concept of feedback amplifier.

Text Books:

1. Electrical Technology by Surinder Pal Bali, Pearson Publications.
2. Electronic Devices and Circuits by R.L. Boylestad and Louis Nashelsky, 9th edition, PEI/PHI 2006.

Reference Books:

1. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group
2. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
3. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications,2nd edition
4. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications,2nd edition
5. Industrial Electronics by G.K. Mittal, PHI.

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - I Semester		L	T	P	C
		3	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.
- 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
Introduction: Engineering Materials – Classification – levels of structure.
Crystal Geometry and Structure Determination: Space lattice and Unit cell. Bravais lattices, crystal systems with examples. Lattice coordinates, Miller indices, Bravais indices for directions and places: crystalline and non-crystalline solids; ionic, covalent and metallic solids; packing efficiency, coordination number; structure determination by Bragg's X-ray diffraction and powder methods.

UNIT -II
Crystal Imperfection: Point defects, line defects-edge and screw dislocation, Berger's circuit and Berger's vectors, dislocation reaction, dislocation motion, multiplication of dislocations during deformation.

Role of dislocation on crystal properties; surface defects, dislocation density and stress required to move dislocations.

UNIT -III
Basic thermodynamic functions: phase diagrams and phase transformation: Primary and binary systems-general types with examples; tie line& lever rule, non-equilibrium cooling: phase diagrams of Fe-Fe_3-C, Pb-Sn, Cu-Ni systems.
Phase transformations in Fe-Fe_3-C steels, Time-Temperature-Transformation (TTT) curves for eutectoid steels and plain carbon steels; effect of alloying elements on properties of steels; types of steels, alloys and other metals used in chemical industry.

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UNIT -IV

Elastic, Inelastic and plastic deformations in solid materials: rubber like elasticity, visco elastic behavior (models); shear strength of real and perfect crystals, work hardening mechanisms, cold working, hot working; dynamic recovery, recrystallization, grain growth, grain size and yield stress, Brief description of heat treatment in steels.

Magnetic materials: Terminology and classification, magnetic moments due to electron spin, ferro-magnetism and related phenomena, domain structure, hysteresis loop, soft and hard magnetic materials.

UNIT- V

Fracture in ductile and brittle materials, creep: 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.

Oxidation and Corrosion: Mechanisms of oxidation, oxidation resistant materials, principles and types of corrosion, protection against corrosion.

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 JavedHashemi, 4th Edition, Tata-McGraw Hill, 2008.

Reference Books:

1. Elements of Materials Science, L.R. Van Vlack,
2. Science of Engineering Materials, vols. 1&2, ManasChanda, McMillan Company of India Ltd.
3. Materials Science and Engineering, BalaSubramaniam, R., Callister's, Wiley, 2010

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DEPARTMENT OF PETROLEUM ENGINEERING

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

ELEMENTS OF MECHANICAL ENGINEERING
(Only for Petroleum Engineering & Chemical 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.

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: Classification of boilers, essentialities of boilers, selection of different types of boilers, study of boilers, boiler mountings and accessories.

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-V:

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.

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

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
PETROLEUM GEOLOGY					

Learning Objectives:

- This basic course in 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 to oil and gas accumulation.
- It exposes the students to different geological environments relates to petroleum industry.
- 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

Origin of the Earth- envelops of the Earth- Crust, mantle, core. Internal dynamic process- Plate tectonics- Continental drift, External dynamic process- Weathering, erosion and deposition.

Identification of different structural features encountered in oil exploration viz: Joints, faults, folds, unconformities. Origin of igneous, sedimentary and metamorphic rocks. Structures and textures- Petrographic character of conglomerate, sandstone, shale, limestone and dolomite.

UNIT- II

Introduction to sedimentary basins and deltaic systems. Source rocks: Definition of source rocks. Organic source rocks, nature and types of source rocks.

The process of diagenesis, catagenesis and metagenesis in the formation of source rock, kerogen-types, thermal maturation, subsurface pressure temperature conditions for the generation of oil and gas from the source sediments.

UNIT- III

Characteristics of reservoir rocks: Classification and nomenclature, Clastic reservoir rocks, Carbonate reservoir rocks. Unconventional, fractured and miscellaneous reservoir rocks. Marine and non-marine reservoir rocks.

Reservoir properties and cap rocks: Reservoir porosity – primary and secondary porosity, effective porosity, permeability, effective and relative permeability, relationship between porosity and permeability,saturation. Cap rocks: Definition and characteristics of cap rocks.

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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 and accumulation of hydrocarbons: Classification and types of traps, Structural, stratigraphic and combination type of traps. Traps associated with salt domes. 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, Cambay basin, Assam Arakan basin and Mumbai off- shore.

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.
- 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 .
- 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.

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Text Books:

1. Geology of Petroleum, A.I. Levorsen, 2nd Edition. CBS, Publishers, 2006.
2. Engineering Geology, Bell, F.G., 2nd Edition, ButterworthHeimann,2007.
3. Text book of Geology, Mukherjee, P.K., The World Press Pvt. Ltd., 2005.

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

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
CHEMICAL PROCESS PRINCIPLES					

Learning Objectives:

The subject of chemical process calculations is intended to make the students understand mainly the calculations involved in material and energy balances across 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 in chemical processes.
- 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, Units and inter conversions

Behavior of Ideal gases: Kinetic theory of gases, Application of ideal gas law, Gaseous mixtures, Gases in chemical reactions.

UNIT-II

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

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

UNIT-III

Material balances: Tie components, Yield, Conversion, Processes involving chemical reactions. Material balance calculations in simple drying, dissolution and crystallization processes.

Processes involving recycles, bypass, purge and other complexities.

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UNIT-IV

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 nonpolar 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-V

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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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - I Semester		L	T	P	C
		0	0	3	1.5
BASIC ENGINEERING LAB (Electrical + Mechanical					

Learning Objectives:

- To predetermine the efficiency of dc shunt machine using Swinburne's test.
- To predetermine the efficiency and regulation of 1-phase transformer with O.C and S.C tests.
- To obtain performance characteristics of DC shunt motor &3-phase induction motor.
- To find out regulation of an alternator with synchronous impedance method.
- To control speed of dc shunt motor using Armature voltage and Field flux control methods.
-

Section A: Electrical Engineering:

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.

Section B: Mechanical Engineering:

Collect the Concerned Syllabus from ME Dept. BoS

Learning Outcomes:

After the completion of the course the student should be able to:

- Compute the efficiency of DC shunt machine without actual loading of the machine.
- Estimate the efficiency and regulation at different load conditions and power factors for single phase transformer with OC and SC tests.
- Analyse the performance characteristics and to determine efficiency of DC shunt motor &3-Phase induction motor.
- Pre-determine the regulation of an alternator by synchronous impedance method.
- Control the speed of dc shunt motor using Armature voltage and Field flux control methods.

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - I Semester		L	T	P	C
		0	0	3	1.5
PETROLEUM GEOLOGY LABORATORY					

Learning Objectives:

Objective of the petroleum geology lab is to import fundamental understanding on sedimentary reservoirs associated with oil and gas reservoirs also to impart a sound understanding on distinction between source rocks and the reservoir rocks that includes both conventional and unconventional hydrocarbon reservoirs.

List of Experiments:

1. Identifying the distinction between sedimentary and carbonate reservoir rocks.
2. Identifying primary and secondary porosities associated with sedimentary& carbonate reservoirs.
3. Recognizing various hydrocarbon traps
4. Contour lines/ Isolines, Different maps – (Basin map, structure map)
5. Well correlation (SP and ϒ- ray) (Used for transforming known stratigraphic position in a (key) well to other wells in similar geological setting.
6. Gamma ray measurement.
7. Well correlation – Field size, Well correlation – Basin size
8. Petroleum system – Source rock, migration path, reservoir path, cap rock
9. Reservoir engineering – Pyrolysis
10. Identifying source rock parameters – HI, PI, SPI.

Outcomes:

- Understand the basics of sedimentary and carbonate reservoir rocks.
- Plotting lithostratigraphic column and geological cross-section.
- Understand the basics of well correlation used SP and Gamma ray mapping.
- Students can be in a position to plot contour lines and lithostratigraphic columns etc.
- Identifying and understanding source of parameters.

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - I Semester		L	T	P	C
		2	0	0	0
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE					

Course Objectives:
To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system

- The course aim of the importing basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledge system
- To understand the legal framework and traditional knowledge and biological diversity act 2002 and geographical indication act 2003
- The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection
- To know the student traditional knowledge in different sector

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

- Understand the concept of Traditional knowledge and its importance
- Know the need and importance of protecting traditional knowledge
- Know the various enactments related to the protection of traditional knowledge
- Understand the concepts of Intellectual property to protect the traditional knowledge

UNIT I
Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge
Learning Outcomes:
At the end of the unit, the student will able to:

- Understand the traditional knowledge.
- Contrast and compare characteristics importance kinds of traditional knowledge.
- Analyze physical and social contexts of traditional knowledge.
- Evaluate social change on traditional knowledge.

UNIT II
Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.
Learning Outcomes:
At the end of the unit, the student will able to:

- Know the need of protecting traditional knowledge.
- Apply significance of tk protection.
- Analyze the value of tk in global economy.
- Evaluate role of government

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UNIT III

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.

Learning Outcomes:

At the end of the unit the student will able to:

- Understand legal framework of TK.
- Contrast and compare the ST and other traditional forest dwellers
- Analyze plant variant protections
- Evaluate farmers right act

UNIT IV

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

Learning Outcomes:

At the end of the unit, the student will able to:

- Understand TK and IPR
- Apply systems of TK protection.
- Analyze legal concepts for the protection of TK.
- Evaluate strategies to increase the protection of TK.

UNIT V

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Learning Outcomes:

At the end of the unit, the student will able to:

- Know TK in different sectors.
- Apply TK in engineering.
- Analyze TK in various sectors.
- Evaluate food security and protection of TK in the country.

Reference Books:

1) Traditional Knowledge System in India, by Amit Jha, 2009.
2) Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, PratibhaPrakashan 2012.
3) Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
4) "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

e-Resources:

1) https://www.youtube.com/watch?v=LZP1StpYEPM
2) http://nptel.ac.in/courses/121106003/

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - I Semester		L	T	P	C
		3	0	0	3
MANAGEMENT AND ORGANISATIONAL BEHAVIOUR					

Course Objectives:

- To familiarize with the process of management, principles, leadership styles and basic concepts on Organisation.
- To provide conceptual knowledge on functional management that is on Human resource management and Marketing management.
- To provide basic insight into select contemporary management practices and Strategic Management.
- To learn theories of motivation and also deals with individual behavior, their personality and perception of individuals.
- To understand about organizations groups that affect the climate of an entire organizations which helps employees in stress management.

Unit I

Introduction: Management and organizational concepts of management and organization- Nature and Importance of Management, Functions of Management, System approach to Management - Taylor's Scientific Management Theory, Fayol's Principles of Management, Leadership Styles, Social responsibilities of Management.Designing Organizational Structures: Basic concepts related to Organization - Departmentation and Decentralization, MBO, Process and concepts.

Unit II

Functional Management: Human Resource Management (HRM) Concepts of HRM, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating. - Marketing Management: Concepts of Marketing, Marketing mix elementsand marketing strategies.

Unit III

Strategic Management: Strategic Management and Contemporary Strategic Issues: Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and implementation, Generic Strategy alternatives. Bench Marking and Balanced Score Card as Contemporary Business Strategies.

Unit IV

Individual Behavior: Perception-Perceptual process- Impression management- Personality development – Socialization – Attitude- Process- Formation- Positive attitude- Change – Learning – Learning organizations- Reinforcement Motivation – Process- Motives – Theories of Motivation: Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation,

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Unit V

Group Dynamics: Types of Groups, Stages of Group Development, Group Behaviour and Group Performance Factors, Organizational conflicts: Reasons for Conflicts, Consequences of Conflicts in Organization, Types of Conflicts, Strategies for Managing Conflicts, Organizational Climate and Culture, Stress, Causes and effects, coping strategies of stress.

Course Outcomes:

- After completion of the Course the student will acquire the knowledge on management functions, global leadership and organizational structure.
- Will familiarize with the concepts of functional management that is HRM and Marketing of new product developments.
- The learner is able to think in strategically through contemporary management practices.
- The learner can develop positive attitude through personality development and can equip with motivational theories.
- The student can attain the group performance and grievance handling in managing the organizational culture.

TEXT BOOKS

Subba Rao P., *Organizational Behaviour*, Himalaya Publishing House. Mumbai
L.M. Prasad, Principles and Practice of Management.

Reference Books:

1. Subba Rao P., *Organizational Behaviour*, Himalaya Publishing House. Mumbai.
2. Fred Luthans *Organizational Behaviour*, TMH, New Delhi.
3. Robins, Stephen P., *Fundamentals of Management*, Pearson, India.
4. Kotler Philip & Keller Kevin Lane: Marketing Mangement 12/e, PHI, 2007
5. Koontz &Weihrich: *Essentials of Management*, 6/e, TMH, 2007
6. Kanishka Bedi, *Production and Operations Management*, Oxford University Press, 2007.

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
FLUID MECHANICS FOR PETROLEUM ENGINEERS					

Learning Objectives:

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

- Understand basic concepts associated with fluid flow such as viscosity, shear, Newtonian and non-Newtonian fluids.
- Learn and apply Continuity and Navier Stokes equations as fundamental equations for the analysis of oil and gasrecovery 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 flow metering including 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 in pipelines such as fittings and valves and their relevance towards variation in pressure drop correlations in pipes
- Understand the knowledge related to various fluid flow measuring devices (Venturi, Orifice, Rotameter, hot wire anemometer and Pitot Tube).
- Momentum transfer processes applied to oil and gas reservoirs

UNIT-I

Units and Dimensions, 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.

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UNIT-II

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

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-III

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-IV

Transportation and Metering of fluids- Pipes, fittings and valves, Pumps: positive displacement and centrifugal pumps.

Measurement of flowing fluids: Full bore meters, insertion meters; Venturi meter, Rotameter, Orifice meter, Hot wire anemometer, Pitot tube, and Other flow metering devices.

UNIT-V

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

Compressors, fans, blowers, steam – ejectorsand jets.

Outcomes:

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

- Analyze fluid flow in circular conduits.
- Do calculations associated 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 with compressible fluid flow in circular and rectangular ducts.
- Estimate pressure drop in packed and fluidized beds.
- Rigorously carry out various calculations associated with fluid flow in various types of pumps, fans and blowers.
- Calculate, analyze and calibrate various flow measuring devices.

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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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - II Semester		L	T	P	C
		3	0	0	3
THERMODYNAMICS FOR PETROLEUM ENGINEERS					

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

- Understand zeroth, first, second and third 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 Petroleum 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 characterization, thermodynamic behavior of Oil and Natural Gas, its handling, storage and transport.

UNIT-I:
Introduction: The scope of thermodynamics, defined quantities; temperature, volume, pressure, work, energy, heat, The Zeroth Law andJoules 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. Calculation of ideal work and lost work, Examples on thermodynamic behavior of Oil and Natural Gas under Reservoir conditions.

UNIT-IV:
Thermodynamic properties of fluids: Property relations for homogeneous phases, Residual properties, two phase systems, thermodynamic diagrams, tables of thermodynamic properties, generalized property correlations for gases.

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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.

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.

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 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.

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
		3	0	0	3
PROCESS INSTRUMENTATION					

Learning Objectives:

- To learn the basic elements of an instrument and its static and dynamiccharacteristics
- To study various types of industrialthermometers
- 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 digitalinstrumentation.

UNIT I

Fundamentals: Elements of instruments, static and dynamic characteristics of instruments.

Industrial Thermometers**:** Mercury in glass thermometer - Bimetallic thermometer - Pressure spring thermometer,Thermo-electricity –types of thermocouples – Thermocouple lead wires.Resistance-thermometers: RTD and bridge circuits (2 wire, 3 wire and 4 wire - method) -Radiation receiving elements- pyrometers.

UNIT II

Pressure measurement: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 III

Head, density and specific gravity, 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, Viscosity measurement.

Composition analysis, spectroscopic analysis by absorption, emission, mass and color measurement spectrometers, gas analysis by thermal conductivity, analysis of moisture, gas chromatography, refractometer.

UNIT IV

Open channel meters, viscosity meters, quantity meters, flow of dry materials, Recording instruments, indicating and signaling instruments, transmission of instrument readings, control center, instrumentation diagram.

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UNIT V
Distributed control system (DCS) working and architecture of DCS- elements of DCS, human measuring interface, engineering work station, communication media and protocol.

Outcomes:
The students will be able to:

- Understand the basic elements of an instrument and itscharacteristics
- 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 instrumentreadings
- Get an understanding of instrumentation diagrams, control center, process analysis and digitalinstrumentation

Text Books:

1. Industrial Instrumentation, Donald P. Eckman, Wiley eastern, 1950.
2. Modern Distributed Control Systems, DrMoustafaElshafei, Create space independent publishing platform, 1st ed. 2016.

Reference Books:

1. Principles of Industrial Instrumentation, Patranabis, 2nd Edition, Tata McGraw-Hill, 1996.
2. Instruments for measurements and control by Holbrock W.C. Van Nostrand East West.
3. Hand book Instrumentation, Considine, McGraw Hill.

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II Year - II Semester		L	T	P	C
		3	0	0	3

PETROLEUM EXPLORATION

Learning Objectives:

- The syllabus for petroleum exploration should be 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.
- At the same time sedimentology and biostratigraphy are also important to understand the sedimentary sequences holding hydrocarbons as the knowledge of these will help them in Oil and Gas Exploration

UNIT-I

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

UNIT-II

Sedimentological methods in hydrocarbon exploration
Biostratigraphic methods 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 & stacking- 2D, 3D, & 4D seismic surveys.

Field procedures & principles- Time corrections applied to seismic data- Data processing - Introduction to 2D & 3D data acquisition & interpretation of reflection data for identification of drillable structures. Calculation of reserves based on identified structures.

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 IIndyear course. The knowledge of these methods will go a long way along with the other subjects i.e, like well completion, reservoir engineering so that they can opt for upstream industry jobs.

Text Books:

1. Introduction to Geophysical Prospecting, Milton B. Dobrin, and Carl H. Savit, 4thEdition, 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 AsgerEriksen, 4thEdition, 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
		3	0	0	3
PETROLEUM RESERVOIR ENGINEERING-I					

Learning Objectives:

- The students will be imparted knowledge in the basic concepts in reservoir engineering including PVT analysis for oil & gas reservoirs, Material balance applied to oil & gas reservoirs, Darcy's law and its applications and 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

Radial Diffusivity Equation: 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 slightly compressible fluids.

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.

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Outcomes:

The students will be able to:

- Perform basic PVT analysis of the specific reservoir of various sands.
- Carry out the calculations in material balance and 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.
- Compute the flow rates of oil and gas from stabilized inflow equations.

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, 3rdEdition, 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.

5. Practical Reservoir Engineering and Characterization, Baker, R – Harvey W. Y and Jensen, J. L. Elsevier, GPP, 2015

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II Year - II Semester		L	T	P	C
		3	0	0	3
PROCESS HEAT TRANSFER					

Learning Objectives:

- This course is designed to introduce 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.
- Further the students will be trained to acquire skills to carry out the detailed process design of shell and tube heat exchangers such as number tubes, selection of shell and tube material, estimate number of baffles and also provide necessary information regarding TEMA classification. Design of double pipe heat exchangers, both counter current and co-current.
- Heat transfer processes applied to oil and gas reservoirs

UNIT-I:

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

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 in 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 and turbulent flow, the transfer of heat by turbulent eddies.

Analogy between the momentum and heat transfer, heat transfer to liquid metals, heating and cooling of fluids in forced convection outside tubes.

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

UNIT-IV:

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

Radiation: Properties and definitions, black body radiation, real surfaces, and the grey body. Absorption of radiation by opaque solids, radiation between surfaces, radiation and shielding, combined heat transfers by conduction, convection and radiation.

UNIT-V:

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).

Evaporators: Types of Evaporators, performance of tubular evaporator. Capacity and economy, methods of feeding, multiple effect evaporators, vapor recompression.

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		L	T	P	C
		0	0	3	1.5
FLUID MECHANICS LABORATORY					

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
2. Measurement of point velocities
3. Verification of Bernoulli's equation
4. Variation of Orifice coefficient with Reynolds Number
5. Determination of Venturi coefficient
6. Friction losses in Fluid flow in pipes
7. Pressure drop in a packed bed for different fluid velocities
8. Pressure drop and void fraction in a fluidized bed
9. Studying the coefficient of contraction for a given open orifice
10. Studying the coefficient of discharge in notches
11. Studying the Characteristics of a centrifugal pump
12. Viscosity determination using Stoke's law
13. Viscosity determination using Canon-Fenske viscometer

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		L	T	P	C
		0	0	3	1.5
PROCESS HEAT TRANSFER LABORATORY					

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.
11. Studies on single effect evaporator.

Outcomes:

Upon successful completion of this lab course, the student 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
PROFESSIONAL ETHICS & HUMAN VALUES					

Course Objectives:

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty
- To appreciate the rights of others
- To create awareness on assessment of safety and risk

Course outcomes:

Students will be able to:

- Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field
- Identify the multiple ethical interests at stake in a real-world situation or practice
- Articulate what makes a particular course of action ethically defensible
- Assess their own ethical values and the social context of problems
- Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
- Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work
- Integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research.

UNIT I

Human Values: Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others –Living Peacefully –Caring –Sharing –Honesty -Courage-Cooperation– Commitment – Empathy –Self Confidence Character –Spirituality.

Learning outcomes:

1. Learn about morals, values & work ethics.
2. Learn to respect others and develop civic virtue.
3. Develop commitment
4. Learn how to live peacefully

UNIT II

Engineering Ethics:Senses of 'Engineering Ethics-Variety of moral issued –Types of inquiry –Moral dilemmas –Moral autonomy –Kohlberg's theory-Gilligan's theory-Consensus and controversy –Models of professional roles-Theories about right action-Self-interest -Customs and religion –Uses of Ethical theories –Valuing time –Cooperation –Commitment.

Learning outcomes:

1. Learn about the ethical responsibilities of the engineers.
2. Create awareness about the customs and religions.
3. Learn time management
4. Learn about the different professional roles.

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UNIT III

Engineering as Social Experimentation**:** Engineering As Social Experimentation –Framing the problem –Determining the facts –Codes of Ethics –Clarifying Concepts –Application issues – Common Ground -General Principles –Utilitarian thinking respect for persons.

Learning outcomes:

1. Demonstrate knowledge to become a social experimenter.
2. Provide depth knowledge on framing of the problem and determining the facts.
3. Provide depth knowledge on codes of ethics.
4. Develop utilitarian thinking

UNIT IV

Engineers Responsibility for Safety and Risk: Safety and risk –Assessment of safety and risk –Risk benefit analysis and reducing risk-Safety and the Engineer-Designing for the safety-Intellectual Property rights (IPR).

Learning outcomes:

1. Create awareness about safety, risk & risk benefit analysis.
2. Engineer's design practices for providing safety.
3. Provide knowledge on intellectual property rights.

UINIT V

Global Issues: Globalization –Cross-culture issues-Environmental Ethics –Computer Ethics – Computers as the instrument of Unethical behavior –Computers as the object of Unethical acts – Autonomous Computers-Computer codes of Ethics –Weapons Development -Ethics and Research – Analyzing Ethical Problems in research.

Learning outcomes:

1. Develop knowledge about global issues.
2. Create awareness on computer and environmental ethics
3. Analyze ethical problems in research.
4. Give a picture on weapons development.

Text Books:

1) "Engineering Ethics includes Human Values" by M.Govindarajan, S.Natarajan and, V.S.Senthil Kumar-PHI Learning Pvt. Ltd-2009
2) "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.
3) "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger –Tata McGraw-Hill–2003.
4) "Professional Ethics and Morals" by Prof.A.R.Aryasri, DharanikotaSuyodhana-Maruthi Publications.
5) "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran-LaxmiPublications.
6) "Professional Ethics and Human Values" by Prof.D.R.Kiran-
7) "Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication.

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DEPARTMENT OF PETROLEUM ENGINEERING

II Year - II Semester		L	T	P	C
		0	0	2	0
PHYSICAL FITNESS ACTIVITIES					

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DEPARTMENT OF PETROLEUM ENGINEERING

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

Course Objectives:

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

Unit-I

Introduction to Managerial Economics and demand Analysis:

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

Unit – II:

Theories of Production and Cost Analyses:

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

Unit – III:

Introduction to Markets, Theories of the Firm & Pricing Policies:

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

Unit – IV:

Introduction to Accounting & Financing Analysis:

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

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Unit – V:

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

Course Outcomes:

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

TEXT BOOKS:

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

REFERENCES:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

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

Learning objectives:

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

UNIT-I

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

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

Controller tuning and Process identification; Control valves.

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

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

Text Books:

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

Reference Books:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3
WELL LOGGING & FORMATION EVALUATION					

Learning objectives:

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

UNIT-I

Direct Methods: Mud logging- coring – conventional and sidewall coring - Core analysis.

Concepts of well logging: What is well logging? - Logging terminology - Borehole environment - Borehole temperature and pressure - Log header and depth scale-Major components of well logging unit and logging setup- Classification of well logging methods-Log presentation- Log quality control.

UNIT-II

Open hole logging: SP Logging- Origin of SP, uses of SP log-Calculation of salinity of formation water- Shaliness - Factors influence SP log.

Resistivity log: Single point resistance log (SPR)- Conventional resistivity logs- Response of potential and gradient logs over thin and thick conductive and resistive formations - Limitations of conventional resistivity tools. Focused resistivity log- Advantages of focused resistivity tools over conventional resistivity tools.

Micro resistivity log: Conventional and focused micro resistivity logs and their application.

Induction log: Principle of induction tool and the advantages, Criteria for selection of induction and lateral logging tool, Determination of true resistivity (Rt) of the formation - Resistivity index - Archie's equation.

UNIT-III

Gamma ray log: principle of radioactivity - Uses of gamma ray log- Determination of Shaliness of formation-API counts- Calibration of Gamma ray tool - Statistical fluctuation- Time constant.

Natural Spectral Gamma ray log: Principle and application.

Caliper log: Principle and application of caliper tool.

Density log: Principle of density tool- Environmental corrections - Porosity determination - Tool calibration, Litho density log.

Neutron log: Principle and application of neutron tool, Porosity determination.

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

UNIT-IV

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

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

UNIT-V

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

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

Outcomes:

From the well logs the students:

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

Text Books:

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

Reference Books:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - I Semester		L	T	P	C
		3	0	0	3
DRILLING AND WELL COMPLETIONS					

Learning Objectives:

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

UNIT-I

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

UNIT-II

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

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

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

UNIT III

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

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

Packers: Function – Application.

UNIT IV

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

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UNIT-V

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

Outcomes:

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

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

Text Books:

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

Reference Books:

1. Drilling Engineering, J.J. Azar and G. Robello Samuel, Pennwell Books, 2007.
2. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.
3. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie Charrier Pennwell, 1985.
4. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.
5. Formulas and Calculation for Drilling, Production and Workover, Norton J. Lapeyrouse, 2nd Edition, Gulf Publishing, 2002.
6. Applied Drilling Engineering, Adam T. Bourgoyne Jr., Keith K. Millheim, Martine E. Chenevert and F. S. Young Jr., Society of Petroleum Engineers, 1991.
7. Well Engineering and Construction, Hussain Rabia, Entrac Consulting, 2002.
8. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011.
9 Well Completion Design, Jonathan Bellarby, Elsevier, 2009.
10. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.
11. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.
12 Well Testing, John Lee, Society of Petroleum Engineers, 1982.

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DEPARTMENT OF PETROLEUM ENGINEERING

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

Learning Objectives:

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

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

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

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

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

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

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

UNIT-V

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

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

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

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

Text Book:

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

Reference Books:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

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

Learning Objectives:

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

This course makes the students to:

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

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

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

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

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

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

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

Outcomes:

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

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

Text Books:

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

Reference Books:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

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

SAFETY IN PETROLEUM OPERATIONS

(offeredfor other Branches (except Petroleum Engineering))

Learning Objectives:

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

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

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

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Outcomes:
The students will be able to:

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

Text Books:

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

Reference Books:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

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

CORROSIONCONTROL IN PETROLEUM INDUSTRY

(offeredfor other Branches (except Petroleum Engineering))

Learning Objectives:

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

UNIT-I

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

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

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

UNIT-II

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

UNIT-III

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

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UNIT-IV

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

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

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

UNIT-V

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

Outcomes:

The student will be able to:

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

Text Books:

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

Reference Books:

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

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

UNCONVENTIONAL HYDROCARBON RESOURCES

(offeredfor other Branches (except Petroleum Engineering))

Learning Objectives:

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

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

UNIT-IV

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

UNIT V

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

Outcomes:

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

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

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

Text Books:

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

Reference Books:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

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

Learning Objectives:

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

Experiments:

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

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

Outcomes:

The student will be able to:

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

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

Learning Objective:

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

List of Experiments:

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

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

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

Outcomes:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

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

Learning Objective:

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

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

Outcomes:

The students will be able to:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - I Semester		L	T	P	C
MINI PROJECT					

Learning Objectives:

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

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

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

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

Outcomes:

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

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

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

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - II Semester		L	T	P	C
		3	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.

UNIT-I
Petroleum production system over all view, Production from various types of reservoir based on drive mechanisms, field development method, Safety control system.
Properties of oil and natural gas: Solution Gas-oil ratio, density of oil and gas, viscosity of oil and gas, formation volume factor of oil and gas, oil and gas compressibility, specific gravity of gas and gas pseudo critical pressure and temperature.

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.

UNIT-III
Choke performance – sonic & subsonic flow, single & multiphase flow in oil & gas wells; Well deliverability - nodal analysis, Well decline analysis.

UNIT-IV
Artificial lift methods: Sucker rod pumping system- Selection of unit and types of unit, Load & power requirements, Performance analysis; electrical submersible pumps: principle, design & operation;

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.

UNIT-V
Production Stimulation: Well problem identification; 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.

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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.

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:

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

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - II Semester		L	T	P	C
		3	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, Gas and water coning, natural water influx, and immiscible displacement.

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 Craw-ford 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

Gas and water coning: Basic Concepts in Coning, Coning in vertical and Horizontal wells, Critical rate and Breakthrough time calculations from various correlations-After breakthrough time calculations.

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.

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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, accordingly proper stimulation jobs can be recommended.
- 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 (17thImpression 1998).
2. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing, 2006.
3. B. C. Craft – M. Hawkins, Ronald E. Terry & J. Brandon Rogers, 3rd revised Edition, Prentice Hall, New York, 2014.

Reference Books:

1. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham &Trotman Inc. 1986.
2. Basic Reservoir Engineering, Rene Cosse, Editions Technip, 1993.
3. 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
		3	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 – 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.
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.

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- 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.

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
		3	0	0	3
OFFSHORE ENGINEERING					

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- Functions of offshore structures- Offshore structure configurations- Bottom-Supported fixed structures- Compliant structures- Floating structures- Deepwater challenges - 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.

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.

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UNIT-V

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

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.

Reference Books:

1. Offshore Operation facilities, Huacan Fang, MenglanDuan, 1st Edition, Gulf professional Publishing.
2. Handbook of Offshore Oil and Gas Operations, James Speight, 1st Edition, Gulf professional Publishing.

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III Year - II Semester		L	T	P	C
		3	0	0	3
ADVANCED WELL COMPLETION ENGINEERING					

Learning Objectives:

- Introduction of basics of reservoir engineering and well completion operations
- Concept of sand controls preventions and techniques
- Introduction factors affecting well completion and design selection
- Detailed design basis of well completion equipment
- Fundamental of well completion techniques and installation system

UNIT-I

Basics of well reservoir engineering in well completion: IPR, perforation, well stimulation techniques including fracturing. Sand controls- introduction- rock strength analysis- sand control prediction and mitigation techniques including installation of screens, gavel pack job-sand consolidation methods

UNIT-II

Well completion life: Introduction- types of well completion- factors affecting well completion- TPR- flow through tubing, well completion fluid properties and production and injection tubing sizing analysis.

UNIT-III

Material selection and stress analysis: Selection of control lines for Injection of corrosion inhibitors, scale inhibitors and use of other seals. Load and stress analysis of tubing including burst pressure, collapse, axial load calculation and some design factors.

UNIT-IV

Well completion equipment: Introduction- types of completion equipment- surface and subsurface equipment. Rating of SSSV, packer, landing nipple locks and sling sleeve and side pocket mandrel selection. Selection of control lines and subsea isolation valve.

UNIT-V

Well completion installation system: Introduction-onshore and subsea well completion installation system. Well bore cleanup operations-well fluid displacement. Filtration prior to well flow

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Outcomes:

The student will be able to:

- Understand the basic idea about reservoir engineering and well completion.
- Different types of well completion.
- Use of completion equipment.
- Types of installation in onshore and offshore areas.

Text Books:

1. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.
2. Well Completion Design, Jonathan Bellarby, Elsevier, 2009.

Reference 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.
3. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.

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DEPARTMENT OF PETROLEUM ENGINEERING

III Year - II Semester		L	T	P	C
		3	0	0	3
APPLIED MATHEMATICS IN RESERVOIR ENGINEERING					

Learning Objectives:

The subject aims to provide the student with:

- Mathematics fundamental necessary to formulate, solve and analyze engineering problems.
- An understanding of Fourier series and Laplace Transform to solve real world problems.
- An understanding of complex integration.
- An understanding of partial differential equations that can be solved using analytical means with application to reservoir engineering.

UNIT-I

Diffusion equation: Derivation of one-dimensional non-linear diffusivity equation with quadratic pressure-gradient term; Dimensionless form; Derivation of transient diffusivity equation in radial coordinates in non-dimensional form; Superposition in space and time; Well boundary conditions using bottom hole pressure and specified flow rate.

UNIT-II

Laplace transform: Linearity of the Laplace Transform operator; Existence conditions; Laplace transform of a time derivative, periodic functions and Dirac-Delta function; First and second Shift theorems; Convolution; Application of Laplace transforms in solving linear differential equations with initial conditions and system of linear simultaneous differential equations.

UNIT-III

Petroleum engineering applications of Laplace Transforms: Line source solution; Bessel and modified Bessel equations; Finite well radius solution; Constant pressure inner boundary condition; Incorporating storage, skin and dual-porosity; Numerical inversion of Laplace Transforms.

UNIT-IV

Fourier transforms: Fourier transform theorem: Linearity, Fourier series of periodic functions; Trigonometric series; Euler's formulae; Half range series; Shift theorem, Similarity theorem, convolution theorem, Parseval's theorem and derivatives; Fourier Sine and Cosine transforms; One-dimensional pressure diffusion; Heat equation; Elliptic problem; Radial problems; Inverting Fourier Transforms numerically: Discrete Fourier transforms and Fast Fourier transforms.

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UNIT-V

Complex Integration, Cauchy‘s Integral theorem and its application; Integral formula for simply and multiply connected domains and its applications; Taylors and Laurents’ series and their application; Singular points; Liouvilles theorem with applications; Residue theorem and applications; Contour Integration; Boundary value problems.

Outcomes:

- Analyze and solve reservoir engineering problems using Laplace Series.
- Analyze and solve reservoir engineering problems using Fourier series.
- Understand analytic function of a complex variable and able to apply Cauchy integral theorem and residue theorem to solve contour integrations.
- Be competent in solving linear PDEs using classical analytical solution methods.

Text Books:

1. A text book of Engineering Mathematics (Vol-I and II), P.N.Wartikar and J.N.Wartikar, 07th edition, Pune VidhyarthiGrihaPrakashan, Pune, 2013.
2. A text book of Engineering Mathematics, by N.P.Bali& Manish Goyal, 09th edition, LaxmiPrakashan, 2014.
3. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, Willey Eastern Ltd. Mumbai, 2013.
4. Higher Engineering Mathematics by B. S. Grewal, 33rd edition, Khanna Publication, New Delhi, 1996.
5. Advanced Engineering Mathematics by H. K. Dass, 12th edition, S. Chand Publication, New Delhi, 2003
6. Higher Engineering Mathematics by B. V. Ramana, 12th edition, Tata McGraw Hill, Delhi, 2011.

Reference Books:

1. B.S. Grewal; Higher Engineering Mathematics; Khanna Publishers.
2. ErusingKreyszig; Advanced Engineering Mathematics; New International Ltd.
3. J. Brown and R. Churchill; Complex Variables and Its applications; McGraw-Hill Higher Education.
4. Frank Ayres; Theory and Problems of Matrices; Schaum Outline Series.
5. K.P. Gupta; Special Functions; Krishna Prakashan Media.
6. H.S. Kasana; Complex Variables (Theory and Applications); - PHI.
7. Srimanta Pal, Subodh C. Bhunia; Engineering Mathematics; Oxford University Press.

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DEPARTMENT OF PETROLEUM ENGINEERING

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

BASIC CONCEPTS IN PETROLEUM DRILLING AND COMPLETIONS

(offeredfor other Branches (except Petroleum Engineering))

Learning Objectives:

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

UNIT-I

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

UNIT-II

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

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

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

UNIT III

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

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(b) Well completion: Types of wells- Types of completion. Perforation methods.
Packers: Function – Application.

UNIT IV

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

UNIT-V

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

Outcomes:

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

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

Text Books:

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

Reference Books:

1. Drilling Engineering, J.J. Azar and G. Robello Samuel, Pennwell Books, 2007.
2. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.
3. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie Charrier Pennwell, 1985.

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4. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.
5. Formulas and Calculation for Drilling, Production and Workover, Norton J. Lapeyrouse, 2nd Edition, Gulf Publishing, 2002.
6. Applied Drilling Engineering, Adam T. Bourgoyne Jr., Keith K. Millheim, Martine E. Chenevert and F. S. Young Jr., Society of Petroleum Engineers, 1991.
7. Well Engineering and Construction, Hussain Rabia, Entrac Consulting, 2002.
8. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, Society of Petroleum Engineers, 2011.
9 Well Completion Design, Jonathan Bellarby, Elsevier, 2009.
10. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.
11. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.
12 Well Testing, John Lee, Society of Petroleum Engineers, 1982.

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DEPARTMENT OF PETROLEUM ENGINEERING

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

BASIC CONCEPTS OF PETROLEUM PRODUCTION ENGINEERING

(offeredfor other Branches (except Petroleum 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.

UNIT-I

Petroleum production system over all view, Production from various types of reservoir based on drive mechanisms, field development method, Safety control system.

Properties of oil and natural gas: Solution Gas-oil ratio, density of oil and gas, viscosity of oil and gas, formation volume factor of oil and gas, oil and gas compressibility, specific gravity of gas and gas pseudo critical pressure and temperature.

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-basic concepts.

UNIT-III

Separation systems: Working and operating principles of vertical and horizontal separators

transportation systems: Working and operating principles of pumps, compressors, pipelines-series, parallel and loop.

UNIT-IV

Basic concepts on artificial lift methods: Sucker rod pumping system, electrical submersible pumps, hydraulic piston pumping, progressive cavity pumping, plunger lift, hydraulic jet pumping, and Gas lift system.

UNIT-V

Production Stimulation: Well problem identification, Matrix acidizing, Fundamentals of Hydraulic fracturing.

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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.

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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DEPARTMENT OF PETROLEUM ENGINEERING

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

BASIC CONCEPTS IN PETROLEUM RESERVOIR ENGINEERING

(offeredfor other Branches (except Petroleum Engineering))

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 behaviour, Basic concepts in PVT analysis.

UNIT-II

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-III

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

UNIT-IV

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 slightly and constant compressibility.

UNIT-V

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:

- Understand the basic concepts in petroleum reservoir engineering.
- Acquire the knowledge on drive mechanisms and how to apply the material balance to oil reservoirs.
- Applying of Darcy's law in field potential.
- Estimate the reserves of various sands of the reservoir from well data.
- Learn the differential equation for radial flow in a porous medium.

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- Calculate the formation damage and can recommend suitable stimulation operations to reverse the wells.
- Learn the well inflow estimation for stabilized flow conditions.

Text Books:

1. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17thImpression 1998).
2. 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, 3rdEdition, 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
		0	0	3	1.5
PETROLEUM ANALYSIS LABORATORY					

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.

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III Year - II Semester		L	T	P	C
		0	0	3	1.5
PETROLEUM RESERVOIR ENGINEERNG LABORATORY					

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.

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III Year - II Semester		L	T	P	C
		0	0	2	1
DRILLING SIMULATION LABORATORY					

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, remote panel.
3. **Familiarization and line-up of operational components – III:** Choke manifold.
4. **Operation of major components – I:** Mud pumps, operating slow circulation rate, operating the rotary table,
5. **Operation of major components – II:** Pulling weight on bit running in and pulling out of hole, remote choke panel operating.
6. **Kick identifications:** Setting flow alarms (deviation mud volume), setting flow alarms for return mud volume, identifying kick warning signs.
7. **Well shut in procedures:**Utilizing shut in procedures to kill well, well control computations.
8. Studies on the effect of weight on drill bit and rotary speed on the rate of penetration and wear of the bit.
9. Studies on the effect of mud density on the penetration and wear of the bit.
10. Studies on the effect of 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.

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III Year - II Semester		L	T	P	C
SUMMER INTERNSHIP					

Students shall 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.

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III Year - II Semester		L	T	P	C
MINI PROJECT					

Learning Objectives:

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

Based on the studies carried out during the mini project (phase 1) the same team carryout the mini project (**Phase 2**)which involves process and mechanical design calculations of an equipment / process/system and constructing a working model based on the above calculations. The report to 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.

Outcomes:

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

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

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III Year - II Semester		L	T	P	C
		0	0	3	0
DATA SCIENCES					

Course Objectives:

From the course the student will learn

- Provide you with the knowledge and expertise to become a proficient datascientist
- Demonstrate an understanding of statistics and machine learning concepts that are vital for datascience
- Learn to statistically analyze adataset
- Explain the significance of exploratory data analysis (EDA) in data science
- Critically evaluate data visualizations based on their design and use for communicating stories fromdata

Course Outcomes:

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

- Describe what Data Science is and the skill sets needed to be a data scientist
- Illustrate in basic terms what Statistical Inference means. Identify probability distributions commonly used as foundations for statistical modelling, Fit a model to data

- Use R to carry out basic statistical modeling and analysis
- Apply basic tools (plots, graphs, summary statistics) to carry out EDA
- Describe the Data Science Process and how its components interact
- Use APIs and other tools to scrap the Web and collect data
- Apply EDA and the Data Science process in a case study

UNIT I

Introduction, The Ascendance of Data, Motivating Hypothetical: Data Sciencester, Finding Key Connectors, The Zen of Python, Getting Python, Virtual Environments, Whitespace Formatting, Modules, Functions, Strings, Exceptions, Lists, Tuples, Dictionaries defaultdict, Counters, Sets, Control Flow, Truthiness, Sorting, List Comprehensions, Automated Testing and assert, Object-Oriented Programming, Iterables and Generators, Randomness, Regular Expressions, Functional Programming, zip and Argument Unpacking, args and kwargs, Type Annotations, How to Write Type Annotations.

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UNIT II

Visualizing Data: matplotlib, Bar Charts, Line Charts, Scatterplots. Linear Algebra: Vectors, Matrices, Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Some Other Correlational Caveats, Correlation and Causation.

Gradient Descent: The Idea Behind Gradient Descent, Estimating the Gradient, Using the Gradient, Choosing the Right Step Size, Using Gradient Descent to Fit Models, Minibatch and Stochastic Gradient Descent.

UNIT III

Getting Data: stdin and stdout, Reading Files, Scraping the Web, Using APIs,

Working with Data: Exploring Your DataUsingNamedTuples, Dataclasses, Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction.

Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem

UNIT IV

Machine Learning: Modeling, Overfitting and Underfitting, Correctness, The Bias-Variance Tradeoff, Feature Extraction and Selection, k-Nearest Neighbors, Naive Bayes, Simple Linear Regression, Multiple Regression, Digression, Logistic Regression

UNIT V

Clustering: The Idea, The Model, Choosing k, Bottom-Up Hierarchical Clustering.

Recommender Systems: Manual Curation, Recommending What's Popular, User-Based Collaborative Filtering, Item-Based Collaborative Filtering, Matrix Factorization

Data Ethics, Building Bad Data Products, Trading Off Accuracy and Fairness, Collaboration, Interpretability, Recommendations, Biased Data, Data Protection

IPython, Mathematics, NumPy, pandas, scikit-learn, Visualization, R

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Textbooks:

1) Joel Grus, "Data Science From Scratch", OReilly.
2) Allen B.Downey, "Think Stats", OReilly.

Reference Books:

1) Doing Data Science: Straight Talk From The Frontline, 1st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013
2) Mining of Massive Datasets, 2nd Edition, Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, v2.1, Cambridge University Press, 2014
3) "The Art of Data Science", 1st Edition, Roger D. Peng and Elizabeth matsui, Lean Publications, 2015
4) "Algorithms for Data Science",1st Edition, **Steele**, Brian, **Chandler**, John, **Reddy**, Swarna, springers Publications, 2016

e-Resources:

1) https://github.com/joelgrus/data-science-from-scratch
2) https://github.com/donnemartin/data-science-ipython-notebooks
3) https://github.com/academic/awesome-datascience

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DEPARTMENT OF PETROLEUM ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
DESIGN OF SURFACE FACILITIES					

Learning Objectives:

- To understand the different components of petroleum production system.
- To understand and analyses the flow pattern used in petroleum production system
- To enable students to understand the surface equipment used for separation in petroleum production system.
- To enable students to understand the surface storage system, transportation facilities used in petroleum production system.
- To enable students to understand the treatment process used in petroleum production system.

UNIT-I
Processing of oil and gas: Oil and gas properties, stage separation, separator function and design

UNIT-II
Demulsification, desalting of crude oils and heater treaters: Types of emulsions, destabilization of emulsion, heater treaters, desalters, function and design.

UNIT-III
Artificial lift techniques: Need for artificial lift and their methods.
Design of gas-lift production system for continuous and intermittent gas-lift systems.

UNIT-IV
sucker-rod pumping: Classification, components of the sucker rod system. Design of sucker rod pumps.

UNIT-V
Design of electrical submersible pumps and other artificial lift equipment.

Outcomes:
On completion of this course, the students will be able to:

- Recognize and understand the different components of petroleum production system.
- Analyze the different flow pattern used in petroleum production system
- Understand and compare the different surface equipment used for separation in petroleum production system.
- Compare and relate the different treatment processes used in petroleum production system.
- Interpret the storage system patterns and transportation facilities used in petroleum production system.

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Text Books:

1. Hill, A. D., Economides, C. E., Zhu, D., Economides, M. J., (2012) Petroleum Production Systems, Prentice Hall, ISBN: 9780137033812
2. Kumar, S., (1987) Gas Production Engineering, Gulf Publishing Company, Texas. ISBN: 0872015777.

Reference Books:

1. Campbell, J. M., (1998) Gas Conditioning and Processing (Vol I, II, III), Campbell & Co., USA. ISBN: 9996395420
2. Arnold, K. and Stewart, M., (1989) Surface Production Operations-2, Gulf Publishing Company, Houston. ISBN: 0884158225.
3. Ikoku, Chi U., (1984) Natural Gas Production Engineering, John Wiley & Sons Inc. ISBN: 0894646397.

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DEPARTMENT OF PETROLEUM ENGINEERING

IV Year - I Semester		L	T	P	C
		3	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: Different Secondary and tertiary oil recovery techniques. Methods to improve the recovery factor at pore scale and macro scale, Displacement and sweep efficiency.

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.
Surfactants 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.

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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.

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.

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, AurelCarcoana, 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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DEPARTMENT OF PETROLEUM ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
HSE 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-Air emissions.
Drilling and production operations: Drilling- Production.

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-Additives during acidizing, sand control and fracturing.

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UNIT-V

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

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

IV Year - I Semester		L	T	P	C
		3	0	0	3
PETROLEUM ENGINEERING MATHEMATICS					

Learning Objectives:

- To develop logical understanding of the subject.
- To develop mathematical skill so that students are able to apply mathematical methods & principals in solving problem from Petroleum Engineering field.
- To make aware students about the importance and symbiosis between Mathematics and Engineering.
- To challenge students to further develop and extend their critical thinking skills by applying strategies which will help them interpret, analyze, evaluate, infer, and synthesize concepts studied in this course and develop greater knowledge and understanding of mathematics and to attain the skills necessary for success in the of higher mathematics including GATE examination.

UNIT-I

Linear algebra: Matrix algebra, Systems of linear equations, Row reduction; Matrix operations; Determinants and their properties; Cramer's rule; Eigen values and eigen-vectors; Diagonalization of a matrix; Symmetric matrices; Linear transformations.

UNIT-II

Calculus: Functions of single variable, Limit, continuity and differentiability, Taylor series, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

UNIT-III

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation**.**

UNIT-IV

Probability and statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions, Linear regression analysis.

UNIT-V

Numerical methods: Numerical solutions of linear and non-linear algebraic equations. Integration by trapezoidal and Simpson's rule. Single and multi-step methods for numerical solution of differential equations.

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Outcomes:

- Analyze finite and infinite dimensional vector spaces and subspaces over a field and their properties, including the basis structure of vector spaces.
- Define and illustrate the concepts of sample space, events and compute the probability and conditional probability of events
- Derive numerical methods for approximating the solution of problems of continuous mathematics
- Able to convert complex partial differential equations into a simpler set of algebraic equations.
- Able to show the understanding of impact of Engineering Mathematics on Petroleum Reservoir Applications.
- Able to demonstrate their understanding of mathematical ideas from multiple perspectives, such as by
  i. using the internal connections between geometry, algebra, and numerical computation,
  ii. applying the connections between theory and applications, or
  iii. distinguishing between a formal proof and a less formal arguments and understanding the different roles these play in mathematics.

Text Books:

1. Dennis G. Zill, Warren S. Wright: Advanced Engineering Mathematics, 4th edition,Jones and Bartlett Publishers, 2010
2. E. Kreyszig : Advanced Engineering Mathematics, 8th Edition John Wiley and sons 1999.
3. Higher Engineering Mathematics by B.S. Grewal, Khanna publishers, 39th edition.
4. Advanced Engineering Mathematics by Erwin Kreyszig, 8th edition, John willy 2000.

Reference Books:

1. T. M. Apostol : Calculus Vols I and II, 2nd Edition, John Wiley and sons, 1967 and1969.M. D. Weir, J. Hass and F. R. Giordano: Thomas' Calculus, 11th edition, PearsonEducations, 2008
2. Numerical Methods for Scientific and Engineering Computation, M.K.Jain, New Age Publication.
3. Numerical Methods, GermundDahlquist, Ake Bjorck, Dover Publication.
4. Engineering Mathematics by M.K. Venkataraman
5. Engineering Mathematics by P. Kandaswamy, et al.

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DEPARTMENT OF PETROLEUM ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
SUBSEA ENGINEERING					

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.

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-III

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

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-IV

Wax &Asphaltenes: Introduction - Wax - Wax management – Wax remediation – Asphaltenes – Asphaltenes control design philosophies.

Hydrates: Introduction – Physics & Phase behaviour – Hydrate prevention – Hydrate remediation – Hydrate control design philosophies – Recovery of thermodynamic hydrate inhibitors.

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UNIT-V

Heat Transfer & Thermal Insulation: Introduction – Heat transfer fundamentals – U value – Steady state heat transfer – Transient heat transfer – Thermal management strategy & Insulation.

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 - I Semester		L	T	P	C
		3	0	0	3

MATHEMATICS OF RESERVOIR SIMULATION

Learning Objectives:

- To develop oil and gas reservoir simulators using numerical tools so that the reservoir engineering principles can be applied widely in the petroleum industry.
- To initiate a rigorous mathematical study of the both parabolic dominant as well as hyperbolic dominant single-phase fluid flow equations (the fundamental governing equations) that describe fluid flow through a petroleum reservoir.
- To learn the finite difference approximation for solving the non-linear diffusivity equation that includes the heterogeneous and anisotropic petroleum reservoirs.

UNIT-I

Differential equations for flow in reservoirs: Single-phase flow (Differential operators, general equation for single-phase flow, boundary conditions); Types of second-order differential equations (Parabolic, hyperbolic and elliptic equations); Differential equations for two-phase flow (pressure and saturation equations).

UNIT-II

Introduction to finite difference technique: Taylor series expansion; First-difference quotients; Second-difference quotients; Truncation error; Grid systems (Block-centered grid, Point-centered grid, variable grid); Round-off error; Numerical stability (consistency, convergence and stability).

UNIT-III

Numerical solution of parabolic problems in one dependent variable (using diffusivity equation of a petroleum reservoir): The forward difference equation, von Neumann stability criteria by harmonic analysis; Implicit difference equations (Backward difference equation, tri-diagonal algorithm and Crank-Nicolson difference equation); Explicit difference equations (Time-centered explicit equation, Dufort-Frankel approximation); Alternate-direction methods (Peaceman-Rachford method, Douglas-Rachford method, Brian and Douglas method).

UNIT-IV

Numerical solution of first-order hyperbolic problems in one dependent variable (using Buckley-Leverett equation of a petroleum reservoir): Difference equations (Distance-weighting, Time-weighting, General form of difference equation, Linearization of difference equation); Stability; Truncation error analysis (Local truncation error, numerical dispersion, superposition of numerical and physical dispersion); Unstable solutions.

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UNIT-V

Numerical solution of elliptic problems in one dependent variable (using steady state fluid flow equation of a petroleum reservoir): Elliptic difference equations; Direct solution method; Iterative methods; Point and line relaxation methods; Alternate-Direction Iteration method; Strongly implicit procedure.

Outcomes:

- Be familiar with the modeling assumptions and derivations that lead to PDEs.
- Recognize the major classification of PDEs and the qualitative differences between the classes of equations
- Reservoir simulation being the necessary tool for the petroleum engineers helps to understand the recovery of petroleum hydrocarbons in an efficient manner.
- With the advances in computing capabilities and the used numerical method, the complex petroleum reservoir rock-fluid interaction can be tracked and visualized using the scientific computations.
- Insights from this course are expected to help in managing the reservoir assets and making reliable predictions about production rates.

Text Books:

1. Peaceman D W. (1977). Fundamentals of Numerical Reservoir Simulation, Elsevier Scientific Publishing Company, New York, 1977, 191 pages.
2. Ewing R E. (1983). The Mathematics of Reservoir Simulation, SIAM Philadelphia, 197 pages.
3. Guy C and J Jaffre. (1986). Mathematical Models and Finite Elements for Reservoir Simulation: Single phase, Multi-phase and Multi-component Flows through Porous Media, Elsevier Science Publishers (ISBN: 0 444 70099 4), Netherlands, 389 pages.
4. Aziz K and A Settari. (1979). Petroleum Reservoir Simulation, Applied Science Publishers, London, 1979.

Reference Books:

1. Bear J., and Y Bachmat. (1991). Introduction to Modeling of Transport Phenomena in Porous Media, Kluwer Academic Publishers, Dordrecht, The Netherlands.
2. Bear J. (1972). Dynamics of Fluids in Porous Media, New York, 1972.
3. Collins R E. (1961). Flow of Fluids through Porous Materials, Van Nostrand-Reinhold, New York, 1961.
4. Thomas J W. (1995). Numerical Partial Differential Equations, Finite Difference Methods, Springer-Verlag, New York.

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IV Year - I Semester		L	T	P	C
		3	0	0	3
ADVANCES IN WELL CONTROL					

Learning Objectives:

- Introduction to basics of Well control and Pressure Control theory.
- Concept of Kick and Well Control techniques.
- Detailed description of Well Control Equipment.
- Well Control during Workover operations.
- Detailed Description on Subsea Well control and Intervention Operations.

UNIT-I

Basics of formation: Pore pressure – Overburden and Effective Stress Concepts- Conventional Pressure-Prediction Concepts-Pressure Control theory - Swab and Surge Pressure, Abnormal Pressure-Formation Integrity tests – Fracture gradient determination -ECD -MAASP

UNIT-II

Kick Detection and Well Control Methods: Causes of Kick- Detection and Containment-Shut in pressure analysis –Increasing mud Density, Primary, Secondary and tertiary well control - Barriers, Well killing procedures - Drillers method – Wait and weight method – Volumetric method – Bull heading – Kill sheet calculations.

UNIT-III

Well Control Equipment: Safety valves –SSSV - FOSV-IBOP, Surface BOPEquipment- Low Pressure and High pressure equipment, Special kick problems.

Fishing operations: Requirement for fishing and procedures for various fishing problems,Procedures to free the pipes.

UNIT-IV

Well Control During Completion and Work Over Operations: Completion and workover Fluids characteristics –Well control Surface Equipment – Well Control barriers and Integrity Envelopes, Well control during Work over - Coil Tubing – Slick-line / wire line - Stimulation Operations.

UNIT-V

Subsea Well Control System: Subsea BOP – LMRP, Risers, Well Control in deep water drilling and Completion, Subsea test tree, Subsea Tree, Subsea Intervention – Riserless Operations.

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Outcomes:
The student will be able to:

- Understand the basic well Control concept during drilling.
- Different methods of well control.
- Importance of Well Control equipment and maintenance.
- Barriers and Use of Well Control Equipment during Workover Operations.
- Understand the Subsea Control system and Subsea Intervention.

Text Books:

1. Well Engineering and construction, Hussain Rabia, Entrac Petroleum, 2001.
2. Advanced Well control,David Watson, Terry Brittenham and Preston L Mooore, SPE Text Book Series, 2003
3. Well Control for completions and Interventions, Howard Crompton, Gulf Professional Publishing, First Edition, 2018.

Reference Books:

1. Drilling Enginering, Heriott –Watt University.

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		3	0	0	3
PIPELINE ENGINEERING					

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.

Pipeline construction: Construction – Commissioning.

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.

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UNIT-IV

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

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

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.

Materials selection: Elements of design – Materials designation standards.

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.

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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DEPARTMENT OF PETROLEUM ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
STATISTICS FOR PETROLEUM ENGINEERING AND GEOSCIENTISTS					

Learning Objectives:

- To help the students to understand the fundamental concepts probability and statistics.
- To understand various hypothesis testing for sampling analysis.
- To help students in modelling of reservoir characteristics.

UNIT-I

Fundamentals Of Statistics And Probability: Events, Randomness, Sample, Conditional Probability and Independence, Bayes Theorem, discrete and Continuous Probability Distributions, Joint Probability, Conditional Probability.

UNIT-II

Statistical Test And Distribution Techniques: Binomial, Poisson, Gamma, Exponential, Hypergeometric, Multinomial, Chi- Square, t, F tests, Hypothesis Testing Involving one and univariate population.

UNIT-III

Statistical Modeling: Point and Interval Estimation, Linear Models, Regression Analysis and parametric Estimation Multivariate Techniques, Factor Analysis, Linear Discriminant Analysis.

UNIT-IV

GeostatisticalApplications: Expectations, Moment Generating and Characteristic Functions, Semi-variogram, Auto correlation, Linear Estimation, Kriging &cokriging Equations.

UNIT-V

Nonlinear estimation, Semi- variogram and Normalized Data, Non parametric Estimation, Conditional Simulation, Multivariate Simulation.

Outcomes:

The student will be able to:

- Estimate probability of occurrence.
- Test number of hypothesis for uncertainty analysis
- Modeling of deterministic variables.
- Develop a stochastic model for subsurface resource mapping.
- Creating continuous surface for discrete measurements

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Text Books:

1. Statistics and data analysis in Geology, John C Davis, Wiley Student Edition, 621pp.

Reference Books:

1. Probability & Statistics, Spiegel M.R, Schiller J, srinivasan R. A. Schaum's Outlines Series, McGraw Hill, 408pp.
2. JimbaOluwafemi Solomon, Basic Geostatistics.

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DEPARTMENT OF PETROLEUM ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
ADVANCES IN SEISMIC EXPLORATION METHODS FOR HYDROCARBON EXPLORATION					

Learning Objectives:
The syllabus for seismic exploration is aimed at the student to have a clear knowledge of seismic exploration in India. The student should know in detail about the seismic which are used in Petroleum exploration which are the back bone of the whole gamut of Oil exploration including acquisition, processing an interpretation

UNIT – I
Introduction: Seismic DataAcquisition,Land Data Acquisition, Marine DataAcquisition, Fundamentals of Seismic Prospecting Seismic WaveFundamentals:Compressional Waves(P-waves), Shear Waves(S-waves),AirWave, RayleighWaves, LoveWaves, Direct and HeadWaves, GroundWaves Characteristics of SeismicEvents, Reflections, CriticalReflection, Refractions, Diffractions. Introduction to OBC, and3 Component seismic surveys

UNIT –II
Seismic refraction surveys- Geometry of refracted path, Methodology of refraction profiling- Recording instruments & energy sources- Corrections applied to refraction data Interpretation of refraction data- Seismic Reflection Surveys:Geometry of reflected ray path: Single horizontal reflector- Common depth point (CDP) profiling & stacking- 2D, 3D, & 4D seismic surveys- Field procedures & principles. Time corrections applied to seismic data(static correctios)

UNIT – III
Seismic DataProcessing: Objective of Seismic data processing, Basic Data ProcessingSequence,Preprocessing: Geometry,De-Multiplexing, Reformatting, Re-sampling, Geometry Merging, Static corrections, Amplitude Recovery,Geometric Spreading Correction, sorting, De-convolution, Velocity Analysis, NMO, DMO and Residual StaticCorrections, Common depth point (CDP) profiling & stacking, Migration Both prestack and post stack migration, Prestack Depth Migration

UNIT – IV
Interpretation – Structural Interpretation of reflection data, 2D and 3D interpretation Correlation of seismic processed data with the well data with the help of synthetic seismogram, Identification of different geological boundaries, Marking and correlation of faults, preparation of time and depth structures maps. Identification of different structures from interpreted seismic data. Reserves calculations of identified structures. Stratigraphic interpretation of seismic data: Identification of pinchouts, unconformity traps, Reef traps etc.

UNIT – V
Virtual Reality centres, Introduction to seismic visualizationcentres. Virtual reality and their use in better interpretation of seismic data. Introduction to 2D-3C and 3D-3C and OBC methods and their acquisition and interpretation and processing. 4D seismic.

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Outcomes:
The outcome of Elective this should enable the student to have a clear understanding of the seismic exploration, viz its acquisition methods, processing and interpretation, People opting this elective should become totally conversant in all aspects of seismic exploration

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 AsgerEriksen, 4th Edition, John Wiley, 2011.

Reference Book:

1. Elements of Geology: Oil and Gas Exploration Techniques, J. Guillemot, Technip 1991

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IV Year - I Semester		L	T	P	C
		0	0	3	1.5
PETROLEUM EQUIPMENT DESIGN & SIMULATION LABORATORY					

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

The following numerical experiments have to be simulated 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	3	1.5
PETROLEUM RESERVOIR SIMULATION LABORATORY					

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. Screening Criteria
   i. Fluid properties
   ii. Rock properties
4. Well Pattern and Boundary Conditions
5. Aquifer modeling (single and multiphase fluid flow: Oil-Water/Oil-Water-Gas)
6. History matching consisting of adjusting the parameters of the model such as permeability and porosity until the computed results for the historical period are close to historical data
7. 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 - I Semester		L	T	P	C
		0	0	0	1
PRESENTATION SEMINAR (SIP REPORT)					

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 College/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 - I Semester		L	T	P	C
		0	0	0	2
PROJECT (INDUSTRIAL/IN-HOUSE)					

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 shall 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.

Each student will carry out the project (**Phase 1**)under the guidance of an instructor / faculty, he/she is given a project at the beginning of I Semester of IV year B. Tech. Program.Project (**Phase 1**)should consists of the followingitems:

1. Project topic
2. Introduction
3. Literature review
4. Gaps
5. Objective and scopes
6. Expected outcome

The project shall be presented for the mid-term review. A report shall be submitted in a standard format. The report will be assessed by the internal committee for the completion of project (**phase 1**).

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IV Year - I Semester		L	T	P	C
		2	0	0	0
IPR & PATENTS					

Course Objectives:

- To know the importance of Intellectual property rights, which plays a vital role in advanced Technical and Scientific disciplines
- Imparting IPR protections and regulations for further advancement, so that the students can familiarize with the latest developments

Course Outcomes:

- IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents
- Studentget an insight on Copyrights, Patents and Software patents which are instrumental for further advancements

UNIT I

Introduction to Intellectual Property Rights (IPR): Concept of Property - Introduction to IPR – International Instruments and IPR - 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 - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

UNIT II

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 Remedy – Case Law - Semiconductor Chip Protection Act.

UNIT III

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

UNIT IV

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 Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

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UNIT V

Trade Secrets & Cyber Law and Cyber Crime: 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 –Law of Unfair Competition – Trade Secret Litigation – Applying State Law.
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 - Prevention and Punishment – Liability of Network Providers.

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.

References:

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

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).
- 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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IV Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**2**	**0**
Physical Fitness Activities					

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IV Year - II Semester		L	T	P	C
		3	0	0	3
PRODUCTION OPTIMIZATION USING NODAL ANALYSIS					

Learning Objectives:

- To analyze oil and gas well problems using nodal systems analysis for both flowing and artificial lift wells.
- To understand the various pressure losses including the flow in pipes and restrictions associated with the oil and gas well plants and to assess their performance.
- To improve the performance of the oil and gas wells by calculating the pressure drop that will occur in all the systems using the nodal analysis approach.
- To understand and assess the performance of an artificial lift system used to efficient produce oil and gas.

UNIT-I:

Production systems analysis: Introduction, Pressure losses in complete system, Node locations, Systems analysis approach, Determination of flow capacity, Effect of flow-line size and tubing size, Well restricted by inflow and piping system, Finding optimum tubing size, Effect of gas rate on outflow and effect of perforating density on inflow.

UNIT-II:

Reservoir performance: Introduction; Well performance equations (Factors affecting productivity index and inflow performance, Drawdown, Effect of depletion and IPR behavior of gas wells); Predicting present time IPRs for oil wells (Vogel method, Fetkovich method, Jones, Blount and Glaze method, Constructing IPRs when no stabilized tests are available, IPR construction for special cases); Predicting future IPRs for oil wells (Standing method, Fetkovich method and Combining Vogel and Fetkovich); Predicting present time IPRs for gas wells (Use of back pressure equation, Jones-Blount-Glaze method, and Predicting future IPRs for gas wells); Well completion effects (Open hole completions, perforated completions and Gravel-packed completions).

UNIT-III

Flow in pipes and restrictions: Introduction, Basic equations and concepts (Single-phase, two-phase flow variables, modification of the pressure gradient equation for two-phase flow); Fluid property calculations (density, velocity, viscosity, isothermal compressibility, interfacial tension, formation volume factor; predicting flowing temperatures in wells and pipelines); Well-flow correlations (Poettmann and carpenter method, Hagedorn and brown method, Duns and Ros method, Orkiszewski method, Flow in annuli, Flow in directional wells, Pipeline flow correlations); Pressure drop through restrictions (Surface chokes, subsurface safety valves, and pipe fittings).

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UNIT-IV

Total system analysis: Introduction, Tubing size selection, Flow-line size effect, Effect of stimulation, Systems analysis for wells with restrictions (surface chokes and subsurface safety valves), Evaluating completion effects, Nodal analysis of injection wells, Effect of depletion, Relating performance to time, Analyzing multi-well systems.

UNIT-V:

Artificial lift design: Introduction; Continuous flow gas lift, Well performance, Valve spacing, Gas lift valve performance and Otis design procedure; Submersible pump selection, Sucker rod or beam pumping; Hydraulic pumping.

Outcomes:

The course will aid the students in get into the following field applications with ease.

- Selecting tubing size.
- Selecting flow-line size.
- Gravel pack design.
- Surface choke sizing.
- Subsurface safety valve sizing.
- Analyzing an existing system for abnormal flow restrictions.
- Artificial lift design.
- Well stimulation evaluation.
- Determining the effect of compression on gas well performance.
- Analyzing effects of perforating density.
- Predicting the effect of depletion on producing capacity.
- Allocating injection gas among gas life wells.
- Analyzing a multiwall producing system.
- Relating field performance to time.

Text Books:

1. Dale Beggs H. (2003). Production Optimization Using Nodal Analysis. OGCI and Petroskills Publications (ISBN: 0-930972-14-7), Tulsa, Oklahoma.
2. BoyunGuo. (2007). Petroleum Production Engineering, A Computer-Assisted Approach (Gulf Professional Publishing, ebook ISBN: 9780080479958), 312 pages. DOI: https://doi.org/10.1016/B978-0-7506-8270-1.X5000-2

Reference Books:

1. Gilbert W E. (1954). Flowing and Gas-Lift Well Performance. API Drill. Prod. Practice.
2. Nind T E W. (1964). Principles of Oil Well Production. McGraw-Hill.
3. Brown K E., and H D Beggs. (1978). The Technology of Artificial Lift Methods, vol 1, Penn Well Publ. Co., Tulsa, Oklahoma.

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IV Year - II Semester		L	T	P	C
		3	0	0	3
DEEP WATER TECHNOLOGY					

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

Introduction: Definition, Global deep water reserves & development activity. Technological advances.

Dynamics of Offshore Structure: Analysis of Waves and fluid induced forces on offshore structures, Current and wind forces, soil mechanics of seabed & structures.

UNIT – II

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

Deep water Production System: Fixed Structures, Compliant Towers, Subsea systems, Floating Production Systems like FPSOs, FPSSs, TLPs, Spar Platform and FSOs.

UNIT – III

Deep water applications of Subsea Technology: Subsea completion, X-mas tree, control systems, Manifolds, Templates, ROVs, deep-water installation vessels with DP system.

UNIT – IV

Deep water Pipelines & umbilical: Issues in deep water Pipeline Design, Rigid and Flexible flow lines, Pipe-in-pipe, deep-water Risers and their configurations, Pipeline installation methods, Umbilical – functions, configurations and installation, Flow assurance strategies.

UNIT – V

Emerging deep water Technologies: Autonomous Underwater Vehicles (AUVs) Seismic-while-drilling, Dual-activity-drilling, Innovative Floating Production Concepts, Subsea processing, subsea separation (VASPS, SUBSIS, Twister),Deep water complications.

Out comes:

The Students will be able to:

- Understand induced forces on/Off-shore Structures and soil mechanics of Sea bed.
- Deliver the equipment and design required for deep water drilling and production operations.
- Applications of deep water production technology.
- Understand and utilize the deep water control and flow system.
- Apply subsea processing and separation concepts.

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Text Books:

4. Subsea Engineering Handbook, Yong Bai &Qiang Bai, Gulf Professional Publishing, New York, 2012.
5. Offshore Drilling and Completions Training Manual, Drill – Quip, Inc.
6. Manual on Subsea Technology, IOGPT, ONGC

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IV Year - II Semester		L	T	P	C
		3	0	0	3
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.

Reservoir performance analysis and forecast – Reservoir management economics – Reservoir management case studies.

UNIT-IV

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-V

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.

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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, AbdusSatter 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;

Reference Book:

1. Handling Risk and Uncertainty in Petroleum Exploration and Asset Management, American Association of Petroleum Geologists, 2015.

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IV Year - II Semester		L	T	P	C
		3	0	0	3
PETROLEUM ECONOMICS, POLICIES AND 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.)

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-III

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 - utilization oil fields - production operations - Oil transportation - Crude oil processing.

UNIT-IV

Valuing Petroleum Assets, Portfolios and Companies: Asset valuation process: fair market value, probability and risk, Risk adjustments when valuing petroleum reserve categories, Theportfolio 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,

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Asphalt and Propane Transportation: Fundamentals of transportation, Pipelines, Oil tankers, Downstream transportations, Distribution of petroleum products.

UNIT-V

Oil & Gas Policies and Regulations: Petroleum, 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.
- 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
		3	0	0	3

SHALE GAS TECHNOLOGY
(offeredfor other Branches (except Petroleum Engineering))

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

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.

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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, SohrabZendehboudi& A. Bahadori, Elsevier Science, 2016.

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IV Year - II Semester		L	T	P	C
		3	0	0	3

BASIC CONCEPTS OF ENHANCED OIL RECOVERY (EOR) TECHNIQUES
(offeredfor other Branches (except Petroleum Engineering))

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: Different Secondary and tertiary oil recovery techniques. Methods to improve the recovery factor at pore scale and macro scale, Displacement and sweep efficiency.

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.
Surfactants 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.

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KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF PETROLEUM ENGINEERING

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.

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.

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, AurelCarcoana, Prentice Hall, 1992.
3. 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.
9. Basic Concepts in Enhanced Oil Recovery Processes, Marc Baviere, SCI, 1991.
10. Enhanced Oil Recovery: Proceedings of the Third European Symposium on Enhanced Oil Recovery, F. John Fayers, Elsevier, 1981.
11. Fundamentals of Enhanced Oil Recovery, H. R. Van Pollew and Associates, PennWell, 1980.
12. Enhanced Recovery of Residual and Heavy Oil, M. M. Schumacher, Noyes Data Corp., 1980.
13. Recent Advances in Enhanced Oil and Gas Recovery, IstvanLaktos, Academy Kiado, 2001.
14. Enhanced Oil Recovery, Don W. Greew, G. Paul Willfite, Society of Petroleum Engineers, 1998.
15. 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
		3	0	0	8
PROJECT(INDUSTRIAL/IN-HOUSE)					

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.

The project work shall consist of any one of the following:

d) 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.
e) Modeling & Simulation of any petroleum upstream unit concerned with reservoir, drilling, production, surface production operations, stimulation, enhanced oil recovery.
f) Any experimental work with physical interpretations.

Each student will continue the project of phase 1 under the guidance of an instructor / faculty.
Project (**Phase 2**)should consists of the following items:

1. Experimental design/procedure/methodology
2. Conceptual/Mathematical/Numerical model
3. Results and Discussion
4. Future scope for development/improvement
5. References

The project shall be presented for the mid-term review. A report shall be submitted in a standard format. The report will be assessed by the external examiner for the completion of project (phase 2).

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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IV Year - II Semester		L	T	P	C
		0	0	2	0
Physical Fitness Activities					