GURU KASHI UNIVERSITY

Bachelor of Technology in Petroleum Engineering
(BPE)

Session: 2022-23

Department of Petroleum Engineering

PROGRAMME LEARNING OUTCOMES

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Programme Structure

Semester –I						
Course Code	**Course Title**	**Course Type**				
			L	**T**	**P**	**Credit**
BPE101	Basic Electrical Engineering	Core course	3	1	0	4
BPE102	Physics –I (Electromagnetism)	Core course	3	1	0	4
BPE103	Mathematics-1 (Calculus & Linear Algebra)	Core course	3	1	0	4
BPE104	Engineering Graphics & Drawing	Skill based	1	0	4	3
BPE105	Physics –I (Electromagnetism) Lab	Skill based	0	0	2	1
BPE106	Basic Electrical Engineering Lab	Skill based	0	0	2	1
BPE107	Computer Fundamentals and Its Applications Lab	Ability Enhancement	0	0	2	1
Discipline Elective-I (Any one of the following)						
BPE108	Energy Engineering	Discipline Elective	3	0	0	3
BPE109	Disaster Management					
BPE110	Basics of Management					
Total			**13**	**3**	**10**	**21**

Semester- II						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE201	Engineering Chemistry	Core course	3	1	0	4
BPE202	Mathematics–II (ODE & Complex Variables)	Core course	3	1	0	4
BPE203	Programming for Problem Solving	Skill based	3	0	0	3
BPE204	Communication Skills	Skill based	3	0	0	3
BPE205	Manufacturing Practices	Skill based	1	0	4	3
BPE206	Engineering Chemistry Lab	Skill based	0	0	2	1
BPE207	Programming for Problem Solving Lab	Skill based	0	0	2	1
BPE208	Communication Skills Lab	Skill based	0	0	2	1
Value added Course (Any one) For other disciplines also						
BPE209	Numerical Aptitude & Reasoning Ability	VAC	1	0	0	1
BPE210	Digital Marketing					
BPE211	Stress Management					
Discipline Elective-II (Any one of the following)						
BPE212	Fire, Safety and Hazard	Discipline Elective	3	0	0	3
BPE213	Non-Conventional Petroleum Resources					
BPE214	Wastewater Treatment and Recycling					
Total			**17**	**2**	**10**	**24**

Semester-III						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE301	Material and Energy Balance	Core course	3	1	0	4
BPE302	Fluid Flow	Core course	3	1	0	4
BPE303	Thermodynamics	Skill based	3	0	0	3
BPE304	Elements of Reservoir Engineering	Skill based	2	1	0	3
BPE305	Heat Transfer	Skill based	2	1	0	3
BPE306	Fluid Flow Lab	Skill based	0	0	2	1
BPE307	Heat Transfer Lab	Skill based	0	0	2	1
BPE308	Summer/Institutional Training	Skill based	NA	NA	NA	S/US
Discipline Elective-III (**Any one of the following)**						
BPE309	Petrochemical Technology	Discipline Elective	3	0	0	3
BPE310	Chemical Technology					
BPE311	Industrial Pollution Abatement					
BPE399		MOOC	-	-	-	-
Total			**16**	**4**	**4**	**22**

Note: Institutional Training will be imparted in the Institute at the end of 2nd Semester for 6-weeks duration. However this Subject is not applicable to LEET Students.
(S/US) Satisfactory/Unsatisfactory

Semester-IV						
Course Code	**Course Title**	**Course Type**				
			L	**T**	**P**	**Credit**
BPE401	Geology of Petroleum	Core course	4	0	0	4
BPE402	Drilling Technology	Core course	3	1	0	4
BPE403	Chemical Reaction Engineering	Skill based	2	1	0	3
BPE404	Petroleum Refining Engineering	Skill based	3	0	0	3
BPE405	Mechanical Operations	Skill based	3	0	0	3
BPE406	Chemical Reaction Engineering Lab	Skill based	0	0	2	1
BPE407	Petroleum Engineering Lab	Skill based	0	0	2	1
BPE408	Mechanical Operations Lab	Skill based	0	0	2	1
BCS415	Basics of Management	Value Added Course	2	0	0	2
Open Elective Course						
		OEC	2	0	0	2
Discipline Elective-IV(Any one of the following)						
BPE409	Petroleum Exploration Methods	Discipline Elective	3	0	0	3
BPE410	Polymer Technology					
BPE411	Plant Utilities					
Total			**20**	**2**	**6**	**27**
Open Elective-I(Any one of the following)						
BPE412	Web Designing and Development	IDC	2	0	0	2
BPE413	Total Quality Management					
BPE414	Refrigeration and air conditioning					

Semester-V						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE501	Drilling Fluids & Cements	Core course	3	1	0	4
BPE502	Process Instrumentation & Control	Core course	3	1	0	4
BPE503	Strength of Materials	Skill based	2	1	0	3
BPE504	Mass Transfer	Skill based	2	1	0	3
BPE505	Environmental Studies	Ability Enhancement	2	0	0	2
BPE506	Process Instrumentation & Control Lab	Skill based	0	0	2	1
BPE507	Strength of Materials Lab	Skill based	0	0	2	1
BPE508	Mass Transfer Laboratory	Skill based	0	0	2	1
Discipline Elective-V(Any one of the following)						
BPE509	Natural Gas Engineering	Discipline Elective	3	0	0	3
BPE510	Materials Science & Engineering					
BPE511	Pipeline Engineering					
BPE599		MOOC	-	-	-	-
Total			**15**	**4**	**6**	**22**

Semester-VI						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE601	Offshore Drilling and Production Practices	Core course	3	1	0	4
BPE602	Numerical Methods	Core course	3	1	0	4
BPE603	Probability and Statistics	Skill based	3	0	0	3
BPE604	Basics of Research	Research based	2	0	0	2
BPE605	Numerical Methods Lab	Skill based	0	0	2	1
Open Elective Course						
		OEC	2	0	0	2
Discipline Elective-VI(Any one of the following)						
BPE606	Oil & Gas Transportation System	Discipline Elective	3	0	0	3
BPE607	Coal Bed Methane and Gas Hydrates					
BPE608	Oil & Gas Marketing & Resource Management					
Discipline Elective-VII(Any one of the following)						
BPE609	Enhanced Oil Recovery	Discipline Elective	3	0	0	3
BPE610	Directional Drilling					
BPE611	Process Economics and Management					
Total			**19**	**2**	**2**	**22**
Open Elective-II(Any one of the following)						
BPE612	Computer Aided Design	IDC	2	0	0	2
BPE613	Operation Research					
BPE614	Human Values and Ethics					

Semester- VII						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE701	Research Methodology	Research based	4	0	0	4
BPE702	Oil & Well Testing Techniques	Core course	4	0	0	4
BPE703	Well Logging	Core course	4	0	0	4
BPE704	Health, Safety and Environment Management in Petroleum Operations	Skill based	4	0	0	4
BPE705	Process Equipment Design	Skill based	0	0	4	2
BPE706	Project	Research based	0	0	4	2
BPE799		MOOC	-	-	-	-
Total			**16**	**0**	**8**	**20**

Semester-VIII						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE801	Internship	Research based	NA	NA	NA	20
Total			**0**	**0**	**0**	**20**
Grand Total			**116**	**17**	**46**	**178**

Evaluation Criteria for Theory Courses

A. Continuous Assessment
   Continuous Assessment-I: [10 Marks]
   Continuous Assessment-II: [10 Marks]
   Continuous Assessment-III: [5 Marks]
B. Attendance: (5 marks)
C. Mid Semester Test-1: [30 Marks]
D. MST-2: [20Marks]
E. End-Term Exam: [20 Marks]

SEMESTER-I

Course Title: Basic Electrical Engineering
Course Code: BPE101

L	T	P	Credits
3	1	0	4

Total hours 60

Course Outcomes: On successful completion of this course, students would be able to:

1. Discuss the DC and AC electrical circuit elements with RLC in detail.
2. Analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.
3. Analyze Single Phase AC Circuits and representation of alternating quantities and determining the power in these circuits.
4. Classify the different types of Electrical machines.
5. Understand the different type of electrical installation devices.

Course Content

UNIT I **10 Hours**

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT II **18 Hours**

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Transformers: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT III **16 Hours**

Electrical Machines: Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT IV **16 Hours**

Power Converters: DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of

Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Suggested Readings

1. Kothari, D. P. and Nagrath, I. J. (2010). *Basic Electrical Engineering*. Tata McGraw Hill.
2. Kulshreshtha, D. C. (2009). *Basic Electrical Engineering*. McGraw Hill.
3. Bobrow, L. S. (2011). *Fundamentals of Electrical Engineering*. Oxford University Press.
4. Hughes, E. (2010). *Electrical and Electronics Technology.* Pearson

SEMESTER-I

Course Title: PHYSICS (ELECTROMAGNETISM
Course Code: BPE102

L	T	P	Credits
3	1	0	4

Total hours 56

Course Outcomes: On successful completion of this course, students would be able to:

1. Apply knowledge of electricity and magnetism to explain natural physical processes and related technological advances
2. Use the knowledge regarding calculus along with physical principles to effectively solve problems encountered in everyday life, further study in science, and in the professional world
3. Design experiments and acquire data in order to explore physical principles, effectively communicate results, and critically evaluate related scientific studies.
4. Assess the contributions of physics to our evolving understanding of global change and sustainability while placing the development of physics in its historical and cultural context
5. Acknowledge the concepts of induction and self-induction, to solve problems using Faraday's and Lenz's laws and analyze and solve RL circuits

Course Content

UNIT I **10 Hours**

Electrostatics in vacuum: Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

UNIT II **18 Hours**

Electrostatics in a linear dielectric medium: Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre

of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Magnetostatics: Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

UNIT III **10 Hours**

Magnetostatics in a linear magnetic medium: Magnetization and associated bound currents; auxiliary magnetic field; Boundary conditions on and solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Faraday's law: Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

UNIT IV **18 Hours**

Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations: Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time- dependent electric field; calculating magnetic field due to changing electric fields in quasi- static approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Electromagnetic waves: The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Suggested Readings

1. David J Griffths. (1999). *Introduction to Electrodynamics*. PrenticeHall.
2. Walker, Jearl, David Halliday, and Robert Resnick. (2011). *Fundamentals of Physics*. Hoboken, N.J: Wiley.
3. Saslow, W. (2008). *Electricity, magnetism and light*. e-book.

SEMESTER-I

Course Title MATHEMATICS –I (CALCULUS AND LINEAR ALGEBRA)
Course Code: BPE103

L	T	P	Credits
3	1	0	4

Total hours 58

Course Outcomes: The objective of this course is to familiarize the prospective engineers with techniques in calculus and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. On successful completion of this course, students would be able to:

1. To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
2. The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
3. The tool of power series and Fourier series for learning advanced Engineering Mathematics.
4. To deal with functions of several variables that is essential in most branches of engineering.
5. The essential tool of matrices and linear algebra in a comprehensive manner.

Course Content

UNIT I **30 Hours**

a. Calculus:

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

b. Advanced Calculus

Differentiation: Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Integration: Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable
densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple
applications involving cubes, sphere and rectangular parallelepipeds.

c. Trigonometry

Hyperbolic and circular functions, logarithms of complex number resolving real and imaginary parts of a complex quantity, De Moivre's Theorem.
Theory of equations:Relation between roots and coefficients, reciprocal Equations, transformation of equations and diminishing the roots.

UNIT II **8 Hours**

Matrices

Matrices: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Eigen values & vectors.

UNIT III **10 Hours**

Sequences and series

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

UNIT IV **10 Hours**

Algebra

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank- nullity theorem, composition of linear maps, Matrix associated with a linear map.
Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

Suggested Text/Reference Books

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

6. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
7. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
8. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
11. 2. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.
12. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
13. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
14. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
15. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

SEMESTER-I

Course Title: ENGINEERING GRAPHICS & DRAWING

Course Code: BPE104

L	T	P	Credits
1	0	4	3

Total hours 60

Course Outcomes: On successful completion of this course, the students would be able to:

1. Understand about engineering drawing applications and its importance in society.
2. Learn about the visual aspects of engineering design
3. Understand the engineering graphics standards.
4. Understand the concept of solid modeling techniques.
5. Apply the computer-aided geometric design in engineering

Course Content

UNIT I **15 Hours**

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Orthographic Projections covering, Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

UNIT II **15 Hours**

Projections of Regular Solids covering, those inclined to both the Planes-Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT III **15 Hours**

Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple

and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Customization & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

UNIT IV **15 Hours**

Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerance techniques; dimensioning and scale multi views of dwelling;

Demonstration of a simple team design project that illustrates Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerance; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modeling (BIM).

Suggested Text/Reference Books

1. Gill, P.S.(2001).*Engineering Drawing*. S.K; Kataria and Sons, Ludhiana.

2. Bhatt, N.D.(2012). *Engineering Drawing*. Charotar Book Stall, TulsiSadan, Anand.
3. French, T.E. and Vierck. C.J.(1993).*Graphic Science*. McGraw-Hill, New York.
4. Zozzora, F.(1958). *Engineering Drawing*. McGraw Hill, NewYork.
(Corresponding set of) CAD Software Theory and User Manuals

SEMESTER-I

Course Title : PHYSICS(ELECTROMAGNETISM) LAB
Course Code: BPE105

L	T	P	Credits
0	0	2	1

Total hours 15

Course Outcomes On successful completion of this course, the students would be able to:
1. Apply knowledge Experiments on electromagnetic induction and electromagnetic breaking.
2. Predict use LC circuit and LCR circuit.
3. Design Resonance phenomena in LCR circuits
4. Assess Magnetic field from Helmholtz coil.
5. Understand Measurement of Lorentz force in a vacuum tube

Course Content
List of experiments **15 Hours**

- Experiments on electromagnetic induction and electromagnetic breaking;
- LC circuit and LCR circuit;
- Resonance phenomena in LCR circuits;
- Magnetic field from Helmholtz coil;
- Measurement of Lorentz force in a vacuum tube.

SEMESTER-I

Course Title : BASIC ELECTRICAL ENGINEERING LAB
Course Code: BPE106

L	T	P	Credits
0	0	2	1

Total hours 15

Course Content

List of experiments **15 Hours**

- Basic safety precautions. Introduction voltage. Resonance in R-L-C circuits.
- Transformers: Observation of the no-load current waveform on an oscilloscope (non- sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.
- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super- synchronous speed.
- Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
- Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

SEMESTER-I

Course Title : COMPUTER FUNDAMENTALS AND ITS APPLICATIONS LAB
Course Code: BPE107

L	T	P	Credits
0	0	2	1

Total hours 15

Course Outcomes: On successful completion of this course, students would be able to:

1. Familiarizing with Open Office (Word processing, Spreadsheets and Presentation).
2. To acquire knowledge on editor, spread sheet and presentation software.
3. The students will be able to perform documentation and accounting operations.
4. Students can learn how to perform presentation skills.

Course Content

List of Experiments **Hours: 15**

1. Search, generate, and manipulate data using MS office / Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

SEMESTER-I

Course Title : ENERGY ENGINEERING
Course Code: BPE108

L	T	P	Credits
3	0	0	3

Total hours 45

Course outcomes: On completion of this course, the successful students should be able to

1. Know about the various conventional solid fossil fuels energy resources and their effective utilization.
2. Study naturally occurring petroleum and its products upon refining and their commercial applications.
3. Acquire knowledge about various naturally occurring and synthesized gaseous fuels and efficient utilization.
4. Know about various types of liquid and gaseous fuel burners and applying combustion principles for solution of problems based upon combustion.
5. Study the energy demand, energy crisis and identify available nonconventional (renewable) energy resources and techniques to utilize them effectively.

Course Content

UNIT I **2 Hours**

Introduction

Energy crisis in the world and position in India

UNIT II **18 Hours**

Conventional Sources of Energy

Solid Fuels

Principal solid fuel-coal, origin, composition and classification of coal, origin, composition and classification of coals, analysis and properties of coal, characteristics and distribution of Indian coals, coal preparation, Storage of coal, coal carbonization, briquetting, gasification and liquefaction of solid fuels.

Liquid Fuels

Petroleum and Related Products:

Introduction: Origin, occurrence and reserves, reserves, Production and consumption, classification and characteristics of Petroleum properties and characteristics, petroleum refining in India.

Refining Unit Processes: Cracking, thermal cracking, catalytic cracking, hydrocraking, reforming thermal and catalytic reforming, alkylation, and polymerization, Isomerization.

Petroleum Products - Naphtha, motor gasoline, aviation gasoline, kerosene, diesel oil, gas oils, fuel oils, lubricants, petroleum waxes, Petroleum coke.

Gaseous Fuels (6 hours)

Types, natural gas, methane from coal mines, producer, water carburettor, water, coal, blast furnace and refinery gases, gases from biomass, LPG, gasification of coal and oil, purification of gaseous fuels.

UNIT III **15 Hours**

Combustion Process and Appliances

Nature and types of combustion processes, mechanism of combustion reaction, spontaneous ignition temperature, gas and oil burners, coal burning equipments, fluidized bed combustion.

Furnaces

General classification and description of different types of furnaces with special reference to furnaces used in ceramic, petroleum and pharmaceutical industries.

UNIT IV **10 Hours**

Nuclear energy: - Nuclear reactions, fuel materials, moderators and structural materials, reactors Energy by bio-processes-bio-gas Solar Energy - Photovoltaic cells, solar collectors, wind, tidal and geothermal energy, biofuels.

Suggested Readings:

1. Sarkar Samir, Fuels and Combustion, 2nd Ed., Orient Longman, 2003.
2. Gupta O.P., Elements of Fuels, Furnaces and Refractories, Khanna Publications, 1997.
3. Wilson, P.J., Wells, G.H., Coal, Coke and Coal Chemicals, McGraw Hill, 1950.
4. Griswold, J. Fuels, Combustion and Furnaces, McGraw Hill, 2006.
5. Francis, W., Peters M.C., Fuels and Fuel Technology: a Summarized Manual, 2nd Ed., Pergarmon Press, 1980.

SEMESTER-I

Course Title : DISASTER MANAGEMENT
Course Code: BPE109

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Identify various types of disasters, their causes, effects & mitigation measures.
2. Demonstrate the understanding of various phases of disaster management cycle and create vulnerability and risk maps.
3. Understand the use of emergency management system to tackle the problems.
4. Discuss the role of media, various agencies and organizations for effective disaster management.
5. Design early warning system and understand the utilization of advanced technologies in disaster management.

Course Content:

UNIT I **10 Hours**

Introduction to Disaster Management

Define and describe disaster, hazard, vulnerability, risk-severity, frequency and details, capacity, impact, prevention, mitigation.

Disasters

Identify and describe the types of natural and manmade disasters, hazard and vulnerability profile of India, mountain and coastal areas, Factors affecting vulnerability such as impact of development projects and environment modifications (including dams, land-use changes, urbanization etc.), Disaster impacts (environmental, physical, social, ecological, economic etc.); health, psycho-social issues; demographic aspects (gender, age, special needs), Lessons and experiences from important disasters with specific reference to civil engineering.

UNIT II **15 Hours**

Disaster Mitigation and Preparedness (7 hours)

Disaster Management Cycle-its phases; prevention, mitigation, preparedness, relief and recovery; structural and non structural measures; Preparedness for natural disasters in urban areas.

Risk Assessment

Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems; Use of Remote Sensing Systems (RSS) and GIS in disaster Management, early warning systems.

UNIT III **10 Hours**

Post disaster response

Emergency medical and public health services; Environmental post disaster response (water, sanitation, food safety, waste management, disease control, security, communications); reconstruction and rehabilitation; Roles and responsibilities of government, community, local institutions, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines.

UNIT IV **10 Hours**

Integration of public policy

Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management.

Suggested Readings:

1. www.http//ndma.gov.in
2. http://www.ndmindia.nic.in
3. Iyengar. (2006). *Natural Hazards in the Urban Habitat.* C.B.R.I., Tata McGraw Hill.
4. Natural Disaster management, Jon Ingleton (Ed), Published by Tudor Rose, Leicester92.
5. Singh, B.K. (2008). *Handbook of disaster management: Techniques &Guidelines.* Rajat Publications.
6. Singh, R.B. (2006). *Disaster Management.* Rawat Publications.
7. ESCAP: Asian and the Pacific Report on Natural Hazards and Natural Disaster Reduction.

SEMESTER-I

Course Title : BASICS OF MANAGEMENT
Course Code: BPE110

L	T	P	Credits
3	0	0	3

Total hours 60

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

1. Understand the concepts related to Business.
2. Demonstrate the roles, skills and functions of management.
3. Able to diagnose and solve organizational problems and develop optimal managerial decisions.
4. Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.

Course Content

UNIT I **15 Hours**

Introduction

Definition and concept of Management, functions of management viz. planning, organizing, staffing, coordinating, controlling; Various areas of management: Human Resource Management (HRM): recruitment, training, retraining and compensation policies; Financial Management: payback period, Net Present Value (NPV), Internal Rate of Return (IRR), profitability ratio, cost benefit analysis; Materials Management: economic order quantity, re-order point, safety stock, Just-in-Time Technique of Materials Management; Marketing Management: necessity, advertisement, print media, electronic media, sales promotion.

Structure of Industrial Organization

Concept and structure of an organization, hierarchical management structure (top, middle and lower level management) and functional management structure.

UNIT II **15 Hours**

Leadership

Concept, importance, types and qualities of a good leader.

Motivation

Concept and importance of motivation - drives and incentives, intrinsic and extrinsic motivation, brief about theories of motivation.

Ethics and Values

Introduction, importance of attitude, values and ethical behaviour. Professional ethics – its need and development.

UNIT III **20 Hours**

Customer Relationship Management (CRM)

Need, various types of customers, customer satisfaction, life- long customer, Customer Satisfaction Index (CSI) and its significance. Legal Aspects of Business, Elementary knowledge of Income Tax, Sales Tax, Excise Duty, Provident Fund, Employees State Insurance Act., Labour welfare schemes, systems of wage payment, incentives, Salient features of Factory Act 1948 with special reference to health, safety and welfare measures, working hours, annual leave with wages, Payment of Wages Act 1936, Minimum Wages Act 1948, Intellectual Property Rights (IPR), concept, definitions, infringements related to patents, copyright, trademark.

Total Quality Management

Introduction to Total Quality Management (TQM) and steps to achieve this, MIS: Concept, importance and steps for its development.

UNIT IV **10 Hours**

Knowing Drug Abuse

Type of Drugs used and their ill effects, Consequences of drug abuse, Symptoms and Prevention, Rehabilitation.

Traffic Laws

Importance of knowing traffic laws and safe driving ,Traffic rules Controlling road rage among young drivers, Law regarding traffic, Social responsibility towards injured in case of road accidents.

Suggested Readings:

1. Philip Kotler. Principles of Management.TEE Publication
2. ShyamalBannerjee. Principles and Practice of Management. Oxford and IBM Publishing Co, New Delhi.
3. MY Khan and PK Jain. Financial Management. Tata McGraw Hill Publishing Co., New Delhi.
4. SL Goel. Modern Management Techniques.Deep and Deep Publications Pvt Limited, New Delhi.
5. James AF Stoner, R Edward Freeman and Daniel R Gilbert Jr. Management. Prentice Hall of India Pvt Ltd, New Delhi.
6. H Koontz, C O' Daniel. Essentials of Management. McGraw Hill Book Company, New Delhi.
7. Philip Kotler. Marketing Management. Prentice Hall of India, New Delhi
8. DD Sharma. Total Quality Management. Sultan Chand and Sons, New Delhi.
9. Dr. GB Reddy. Intellectual Property Rights and the Law.
10. Service Quality Standards, Sales & Marketing Department, MarutiUdyog Ltd.

11. Mohamed &Sagadevan Customer Relationship Management: A step-by-step approach. Oscar Publication, Delhi.
12. Sugandhi RK. Customer Relation Management. Oscar Publication, Delhi.

SEMESTER-II

Course Title : ENGINEERING CHEMISTRY
Course Code: BPE201

L	T	P	Credits
3	1	0	3

Total hours 56

Course Outcomes: On successful completion of this course, the students would be able to:

1. Demonstrate Schrodinger equation, Particle in a box solution and their applications
2. Conjugated molecules and Nanoparticles,
3. Evaluate band structure of solids and the role of doping on band structures.
4. Distinguish the ranges of Vibrational and rotational spectroscopy of diatomic molecules,
5. Applications, Nuclear magnetic resonance and magnetic resonance imaging
5. Rationalize periodic properties such as ionization potential, electro-negativity, Oxidation states and electro-negativity.
6. List the Thermodynamic functions: energy, entropy and free energy and also Estimations of entropy and free energies.

Course Content

UNIT I **14 Hours**

Atomic and molecular structure

Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and Nanoparticles, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations, Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

UNIT II **14 Hours**

Spectroscopic techniques and applications

Principles of spectroscopy and selection rules, Electronic spectroscopy, Fluorescence and its applications in medicine, Vibrational and rotational spectroscopy of diatomic molecules, Applications, Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques, Diffraction and scattering.

Intermolecular forces and potential energy surfaces

Ionic, Dipolar and Vander Waals interactions, Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

UNIT III **14 Hours**

Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria, Water chemistry, Corrosion,Use of free energy considerations in metallurgy through Ellingham diagrams.

Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

UNIT IV **14 Hours**

Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Suggested Readings:

1. Mahan, B. H. (1987). University chemistry.
2. Sienko, M. J. & Plane, R. A. *Chemistry. (1979): Principles and* Applications. New York: McGraw-Hill.
3. Banwell, C. N. (1966). *Fundamentals of Molecular Spectroscop.* New York, McGraw-Hill.
4. Tembe, B. L., Kamaluddin& Krishnan, (2008). M. S. *Engineering Chemistry (NPTEL Web-book).*

SEMESTER-II

Course Title : MATHEMATICS –II (ODE & COMPLEX VARIABLES)
Course Code: BPE202

L	T	P	Credits
3	1	0	4

Total hours 54

Course Outcomes: On successful completion of this course, the students would be able to:

1. Demonstrate the methods of forming and solving Ordinary differential equations and Solve linear differential equations with constant and variable coefficients
2. Explain the concept of differential equation and classifies the differential equations with respect to their order and linearity.
3. Solve first-order ordinary and exact differential equations and converts separable and homogeneous equations to exact differential equations by integrating factors.
4. Apply the method of undetermined coefficients to solve the non-homogeneous linear differential equations with constant coefficients.
5. Compare the Methods of Cauchy's Riemann Integral and Analytical methods.

Course Content

UNIT I **14 Hours**

Multivariable Calculus (Integration)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

UNIT II **12 Hours**

First order ordinary differential equations

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT III **16 Hours**

Ordinary differential equations of higher orders

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Complex Variable – Differentiation

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

UNIT IV **12 Hours**

Complex Variable – Integration

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula(without proof), Liouville's theorem and Maximum-Modulus theorem (without proof);Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, CauchyResidue theorem (without proof), Evaluation of definite integral involving sine and cosine,Evaluation of certain improper integrals using the Bromwich contour.

Suggested Text/Reference Books

1. Thomes, G.B.and Finney, R.L.(2010)*Calculus and Analytic Geometry*; Ninth Edition; Pearson Education
2. Kreyszig, E. (1998) *Advanced Engineering Mathematics*; Eighth Edition, John wiley and sons.
3. Grewal, B.S. (1965) *Higher Engineering Mathematics*; Khanna Publishers, New Delhi.
4. BabuRam(2009) *Advance Engineering Mathematics*; First Edition; Pearson Education.
5. Richard Courant and Fritz John (2012).*Introduction to Calculus and Analysis, Volume II***,** Springer Publication.
6. Harold M. Edwards (2013) *Advanced Calculus: A Differential Forms Approach*, Birkhauser.

SEMESTER-II

Course Title : PROGRAMMING FOR PROBLEM SOLVING
Course Code: BPE203

L	T	P	Credits
3	1	0	3

Total hours 45

Course Outcomes: On successful completion of this course, the students would able to:

1. Design the algorithms to write a programs.
2. Apply arrays, pointers and structures to formulate algorithms and programs
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration
4. To implement conditional branching, iteration and recursion
5. Test and execute the programs and correct syntax and logical errors

Course Content

UNIT I **8 Hours**

Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems.Representation of Algorithm: Flowchart/Pseudocode with examples.From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

UNIT II **12 Hours**

Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops, Arrays (1-D, 2-D), Character arrays and Strings

UNIT III **15 Hours**

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition required)

Function: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT IV **10 Hours**

Structure: Structures, Defining structures and Array of Structures
Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)
File handling (only if time is available, otherwise should be done as part of the lab)

Suggested Text/Reference Books

1. Byron Gottfried, Schaum's (1995), *Outline of Programming with C,* McGraw-Hill
2. E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill

SEMESTER-II

Course Title : COMMUNICATION SKILLS
Course Code: BPE204

L	T	P	Credits
3	0	0	3

Total hours 42

Course Outcomes: On successful completion of this course, the students would be able to:

1. Develop vocabulary and improve the accuracy in Grammar.
2. Apply the concepts of accurate English while writing and become equally ease at using good vocabulary and language skills.
3. Develop and Expand writing skills through Controlled and guided activities
4. Compose articles and compositions in English
5. Become autonomous and self-directed English language learners.

Course Content

UNIT I **10 Hours**

Vocabulary Building: The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

UNIT II **10 Hours**

Basic Writing Skills: Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

UNIT III **10 Hours**

Identifying Common Errors in Writing: Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés

UNIT IV **12 Hours**

Nature and Style of sensible Writing: Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion
Writing Practices: Comprehension, Précis Writing, Essay Writing

Suggested Text/Reference Books

1. Swan, Michael. (1995). *Practical English*. OUP.
2. Wood, F.T. (2007). *Remedial English Grammar*.Macmillan.
3. Zinsser, W. (2001). *On Writing Well*. Harper Resource Book.
4. Lyons, L. H.&Heasly, B.(2006). *Study Writing*. Cambridge University Press.

5. Kumar, S &Lata, P. (2011). *Communication Skills*. Oxford University Press.
6. CIEFL, Hyderabad. *Exercises in Spoken English. Parts. I-III*. Oxford University Press.

SEMESTER-II

Course Title : MANUFACTURING PRACTICES
Course Code: BPE205

L	T	P	Credits
1	0	4	3

Total hours 45

Course Outcomes: On successful completion of this course, the students would be able to:

1. Apply the various manufacturing methods in different fields of engineering.
2. Learn about the different fabrication techniques.
3. Learn about the practices in manufacturing of simple components using different materials.
4. Understand the advanced and latest manufacturing techniques being used in engineering industry.
5. Prepare different sand molds for various parts.

Course Content

UNIT I **10 Hours**

Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods

CNC machining, Additive manufacturing

UNIT II **15 Hours**

Fitting operations & power tools

Electrical & Electronics

Carpentry

UNIT III **10 Hours**

Plastic moulding, glass cutting

Metal casting

UNIT IV **10 Hours**

Welding (arc welding & gas welding), brazing [More hours can be given to Welding for Civil Engineering students as they may have to deal with Steel structures fabrication and erection; 3D Printing is an evolving manufacturing technology and merits some lectures and hands-on training.

Workshop Practice: (45 hours)

1. Machine shop - 6 hours
2. Fitting shop - 5 hours
3. Carpentry - 5 hours
4. Electrical & Electronics - 5 hours
5. Welding shop - 10 hours (Arc welding 5 hours) + gas welding 5 hours))

6. Casting - 5 hours
7. Smithy - 4 hours
8. Plastic moulding& Glass Cutting -5 hours

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Suggested Text/Reference Books

1. Raghuwanshi, B.S.(2009*). A Course in Workshop Technology, Vol 1 &II.*DhanpatRai&Sons.
2. Jain, R.K.(2010*).Production Technology.*Khanna Publishers.
3. Singh, S.(2003).*Manufacturing Practice.*S.K. Kataria&Sons.

SEMESTER-II

Course Title : ENGINEERING CHEMISTRY LAB
Course Code: BPE206

L	T	P	Credits
0	0	2	1

Total hours 15

Course Outcomes: On successful completion of this course, the students would be able to:

1. Estimate rate constants of reactions from concentration of reactants /products as a function of time
2. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
3. Apply the theoretical concepts for result analysis and interpret data obtained from experimentation
4. Identify the compound using a combination of qualitative test and analytical methods

Course Content

List of experiments **15 Hours**

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg

SEMESTER-II

Course Title : PROGRAMMING FOR PROBLEM SOLVING LAB
Course Code: BPE207

L	T	P	Credits
0	0	2	1

Total hours 15

Course Outcomes: On successful completion of this course, the students would be able to:
1. Create, read and write to and from simple text files.
2. Identify and correct logical errors encountered at run time
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration
4. Represent data in arrays, strings and structures and manipulate them through a program
5. Test and execute the programs and correct syntax and logical errors

Course content
List of programs **15 Hours**
Tutorial 1: Problem solving using computers
Lab1: Familiarization with programming Environment

Tutorial 2: Variable types and type conversions
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings, memory structure
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value
Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration)
Lab 8 and 9: Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling
Lab 12: File operations

Suggested Text/Reference Books

1. Byron Gottfried, Schaum's (1995), *Outline of Programming with C,* McGraw-Hill
2. E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill.

.

SEMESTER-II

Course Title : COMMUNICATION SKILLS LAB
Course Code: BPE208

L	T	P	Credits
0	0	2	1

Total hours 15

Course outcomes: On successful completion of this course, the students would be able to:

1. Illustrate the importance of pronunciation and apply the same day to day conversation
2. Apply verbal and non-verbal communication techniques in the Professional Environment
3. Develop coherence, cohesion and competence in Oral discourse.
4. Handle the interview process confidently.
5. Communicate contextually in specific personal and professional situations with courtesy.

Course Content

15 Hours

Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

SEMESTER-II

Course Title : NUMERICAL APTITUDE & REASONING ABILITY
Course Code: BPE209

L	T	P	Credits
1	0	0	1

Total hours 15

Course Outcomes: This course is designed to suit the need of the outgoing students and to acquaint them with frequently asked patterns in quantitative aptitude and logical reasoning during various examinations and campus interviews. On successful completion of this course, students would be able to:

1. Understand the basic concepts of quantitative ability
2. Understand the basic concepts of logical reasoning Skills
3. Acquire satisfactory competency in use of reasoning
4. Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning Ability
5. Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

Course Content

UNIT I **4 Hours**

1. Quantitative Ability (Basic Mathematics)
1.1. Number Systems
1.2. LCM and HCF
1.3. Decimal Fractions
1.4. Simplification
1.5. Square Roots and Cube Roots
1.6. Average
1.7. Problems on Ages
1.8. Surds & Indices
1.9. Percentages
1.10 Problems on Numbers

UNIT II **4Hours**

2. Quantitative Ability (Applied & Engineering Mathematics)
2.1. Logarithm
2.2. Permutation and Combinations
2.3 Probability
2.4 Profit and Loss
2.5 Simple and Compound Interest
2.6. Time, Speed and Distance

2.7. Time & Work
2.8. Ratio and Proportion
2.9. Area
2.10 Mixtures and Allegation

UNIT III **3 Hours**

3. Data Interpretation 6 hours
3.1. Data Interpretation
3.2. Tables
3.3. Column Graphs
3.4. Bar Graphs
3.5. Line Charts
3.6. Pie Chart
3.7. Venn Diagrams

UNIT IV **4 Hours**

4. Logical Reasoning (Deductive Reasoning)
4.1. Analogy
4.2. Blood Relation
4.3 Directional Sense
4.4. Number and Letter Series
4.5. Coding – Decoding
4.6. Calendars
4.7. Clocks
4.8. Venn Diagrams
4.9. Seating Arrangement
4.10. Syllogism
4.11. Mathematical Operations

Suggested Readings

1. A Modern Approach To Verbal & Non Verbal Reasoning By R S Agarwal
2. Analytical and Logical reasoning By Sijwali B S
3. Quantitative aptitude for Competitive examination By R S Agarwal
4. Analytical and Logical reasoning for CAT and other management entrance test By Sijwali B S
5. Quantitative Aptitude by Competitive Examinations by AbhijitGuha 4th edition

SEMESTER-II

Course Title : DIGITAL MARKETING
Course Code: BPE210

L	T	P	Credits
1	0	0	1

Total hours 15

Course Outcomes: To impart knowledge on executive skills, to get started in digital marketing, and managerial skills, that explains and prescribes how to make the most of your abilities. On successful completion of this course, students would be able to:

1. Use digital marketing to increase sales in today's business world.
2. Use Google AdWords and can optimize on-page / off-page.
3. Maintain a good social media strategy.
4. Understand web analytics to optimize your website for better traffic and revenue generation.
5. Grasp the concepts and become familiar management of e-commerce store, marketing and uploading of products on website.
6. Make WordPress account and create website.
7. Grasp the concepts and become familiar e-mail and affiliate marketing.

Course Content

UNIT I **4 Hours**

Introduction to Digital Marketing: Defining digital marketing, how is it different from traditional marketing and why is it relevant now?

Search Engine Optimisation (SEO): Techniques used to optimize any article, website, or blog for traffic & revenue generation.

Social Media Marketing: Using different social media platforms (Facebook/Instagram/Twitter) to connect with the audience & convert them to a call of action (purchase or form filling).

UNIT II **3 Hours**

Search Engine Marketing: Techniques used to increase the visibility of your webpage on Google search results (SERP); Search engine marketing mostly revolves around paid search advertising (text-based ads that are visible on top of every search result).

Web Analytics: Analyzing the behavior of visitors to a website through reports based on traffic source, referring sites, page views, and conversion rates of that website.

E-Commerce Management: Maintenance of an online product-listing website through product keyword research, product pricing, positive reviews, and customer retention.

UNIT III **4 Hours**

Planning and Creating a Website: How to create a website on WordPress and later use website analytics to track the behavior of visitors to a website.
Email Marketing:How to create and send product-based emails in bulk, and ensure that all of the emails have a good open rate and conversion rate.

UNIT IV **4 Hours**

Content Strategy: How to create content that matches the user intent and also your business goals.
Affiliate Marketing:Generation of traffic via a third party (company/website). The third party is paid a commission fee to drive traffic to your website.

Suggested Readings

1. Deiss, R. &Henneberry, R (2020). *Digital Marketing For Dummies, 1st edition*. Dummies.
2. Kingsnorth, S. (2019). *Digital Marketing Strategy – An Integrated Approach to Online Marketing, 2nd edition*. KoganPage.

SEMESTER-II

Course Title : STRESS MANAGEMENT
Course Code: BPE211

L	T	P	Credits
1	0	0	1

Total hours 16

Course Outcomes: On successful completion of this course, students would be able to:

1. Identify the nature and causes of stress in organizations
2. Knowledge of stress prevention mechanism
3. Demonstrate the strategies that help cope with stress
4. Apply stress management principles in order to achieve high levels of performance
5. Adopt effective strategies, plans and techniques to deal with stress

Course content

UNIT I **4 Hours**

1. Understanding Stress

1.1 Stress – concept, features, types of stress

1.2 Relation between Stressors and Stress

1.3 Potential Sources of Stress – Environmental, Organizational and Individual

1.4 Consequences of Stress – Physiological, Psychological and Behavioural Symptoms

1.5 Stress at work place – Meaning, Reasons

1.6 Impact of Stress on Performance

1.7 Work Stress Model

1.8 Burnout – Concept

1.9 Stress v/s Burnout

UNIT II **4 Hours**

2. Managing Stress – I

2.1 Pre-requisites of Stress-free Life

2.2 Anxiety - Meaning, Mechanisms to cope up with anxiety

2.3 Relaxation - Concept and Techniques

2.4 Time Management - Meaning, Importance of Time Management

2.5 Approaches to Time Management

2.6 Stress Management - Concept, Benefits

2.7 Managing Stress at Individual level

2.8 Role of Organization in Managing Stress/ Stress Management Techniques
2.9 Approaches to Manage Stress - Action oriented, Emotion oriented, Acceptance oriented.

UNIT III **4 Hours**

3. Managing Stress – II
3.1 Models of Stress Management - Transactional Model, Health Realization/ Innate Health Model
3.2 General Adaption Syndrome (GAS) - Concept, Stages
3.3 Measurement of Stress Reaction - The Physiological Response,
3.4 The Cognitive Response, TheBehavioural Response.
3.5 Stress prevention mechanism - Stress management through mind control and purification theory and practice of yoga education.
3.6 Stress management interventions: primary, secondary, tertiary.
3.7 Meditation – Meaning, Importance

UNIT IV **4 Hours**

4. Stress Management Leading to Success
4.1 Eustress – Concept, Factors affecting Eustress
4.2 Stress Management Therapy - Concept, Benefits
4.3 Stress Counselling - Concept
4.4 Value education for stress management
4.5 Stress and New Technology
4.6 Stress Audit Process
4.7 Assessment of Stress - Tools and Methods
4.8 Future of Stress Management

Suggested Readings

1. Heena T. Bhagtani. (2018). Stress Management. Himalaya Publishing House.
2. Dutta, P,K, (2010) Stress Management. Himalaya Publishing House.
3. Roy,S (2012). Managing Stress. Sterling Publication.

SEMESTER-II

Course Title : FIRE, SAFETY AND HAZARD
Course Code: BPE212

L	T	P	Credits
3	0	0	3

Total hours 45

Course Outcomes: On successful completion of this course, the students would be able to:
1. Know the concept of fire hazard
2. Characterize and use the type of fire extinguisher

Course Content

UNIT I **15 Hours**

Introduction: Concept of Loss prevention, acceptable risks, accident and loss statistics, nature of accident process, inherent safety.
Toxicology: Dose vs response, toxicants entry route, models for dose and response curves, TLV and PEL Industrial Hygiene: Identification, Material safety data sheets, Industrial hygiene evaluation, and control.

UNIT II **10 Hours**

Basics of Fires and Explosion:Fire triangle, definitions, flammability characteristics of liquid and vapors, LOC and inerting, types of explosions Designs for fire prevention

UNIT III **10 Hours**

Hazard identification: Hazard survey, checklist, HAZOP, safety reviews, what if analysis
Risk Assessment: Probability theory, event tree, fault tree, QRA and LOPA, Dow's fire and explosion index, Mond index, Dow's Chemical release model

UNIT IV **10 Hours**

Case Histories: Bhopal gas tragedy, flixborough disaster, Pasadena accident, IOCL disaster

Suggested Text/Reference Books

1. Crowl D A, Louvar J F, "Chemical Process Safety Fundamentals with applications", 2nd Prentice Hall, NJ (2002).
2. Coulson J M and Richardson J F , "Chemical Engineering",2nd , Vol 6, Pergamon, press (1999).
3. Dow Chemical Company, Dow's Chemical Exposure Index Guide, 1993, New York

4. Lees F P, Loss prevention in process Industries, 2nd ed, Butterworth, London, (1996)
5. Wells G L, Safety in process Plant Design, George godwin ltd., New York, (1980)

SEMESTER-II

Course Title : NON-CONVENTIONAL PETROLEUM RESOURCES
Course Code: BPE213

L	T	P	Credits
3	0	0	3

Total hours 45

Course Outcomes: On successful completion of this course, the students would be able to:
1. Study Introduction and present status of coal bed methane
2. Acquire basic knowledge about hydro-fracturing of coal bed methane seam and its operation.
3. Study status of gas hydrates and knowledge of formation and properties of gas hydrates.
4. Understand formation, properties and drilling of shale gas.
5. Acquire knowledge about gas hydrates accumulation in porous media. Gas extraction from gas hydrates

Course Content

UNIT I **10 Hours**

Introduction and present status of coal bed methane. Formation and properties of coal bed methane.
Thermodynamics of coal bed methane. Drilling, completion and logging of coal bed methane wells.

UNIT II **15 Hours**

Hydro-fracturing of coal bed methane seam. Production, installation and surface facilities. Well operation and production equipments. Treating and disposing produced water. Testing of coal bed methane wells.

UNIT III **10 Hours**

Introduction and present status of gas hydrates. Formation and properties of gas hydrates.
Thermodynamics of gas hydrates. Phase behavior of gas hydrates. Kinetics of gas hydrates. Drilling and completion of gas hydrates wells. Prevention and control of gas hydrates.
Gas hydrates accumulation in porous media. Gas extraction from gas hydrates. Uses and applications of gas hydrates.

UNIT IV **10 Hours**

Introduction and present status of shale gas. Formation and properties of shale gas. Drilling andcompletion of shale gas. Uses and applications of shale gas. Prevention and control of shale gas.
Environmental issues in shale gas exploration. Future prospects of shale gas.

Suggested Readings:

1. Mavor, M., Nelson C. R.(2011).*Coal Bed Reservoir Gas –in Place Analysis*. Nelson, Gas Research
Institute.
2. Saulsberry.J. L. & Paul, S.A (1996).*Guide to Coal Bed Methane Reservoir Engineering*.Gas Research Institute.

SEMESTER-II

Course Title : WASTEWATER TREATMENT AND RECYCLING
Course Code: BPE214

L	T	P	Credits
3	0	0	3

Total hours 45

Course Outcomes: On successful completion of this course, the students would be able to:
1. Know types of water pollutants, sources and their effects.
2. Measure to treat waste water.

Course Content

UNIT I **15 Hours**

Introduction: Types of water pollutants, their sources and effects. BOD and COD, BOD5, oxygen sag curve, waste water sampling- grab and composite sample.

UNIT II **10 Hours**

Primary Treatment:Primary Treatment through settling techniques and equipments like flocculation, skimming, flotation.

UNIT III **10 Hours**

Secondary Treatment: Aerobic and anaerobic digestion, activated sludge process, trickle filter and oxidation ponds.

UNIT IV **10 Hours**

Tertiary Treatment: Ultrafiltration, Reverse Osmosis, Ozone Sterilization, Ultraviolet Light Sterilization, Carbon Filtration.

Suggested Readings:

1. Perkins H. C., Air Pollution, McGraw Hill, N.Y., 1974
2. Liptak B.G., Liu D. H. F., Environmental Engineers Handbook, 2nd Ed., CRC Press, 1999
3. Willisamson S.J., Fundamentals of Air Pollution, Addison Wesley Co. N.Y.,1973
4. Nemerow N.L., Liquid Wastes of Industry: Theory, Practices and Treatment, Addison Wesley Co. N.Y., 1971
5. Rao C.S., Environmental Pollution Control Engineering, 2nd Edition, New Age International Pvt. Ltd., 2006
6. Metcalf and Eddy, Waste-Water Engineering, 4th Edition, Tata McGraw Hill, 2007.
7. Mahajan S. P., Pollution Control in Process Industries, Tata McGraw Hill, 2008.

8. Sincero, A.P., Sincero, G.A., Environmental Engineering, Prentice-Hall of India, 1999.

SEMESTER-III

Course Title : MATERIAL AND ENERGY BALANCE	**L**	**T**	**P**	**Credits**
Course Code: BPE301	3	1	0	4

Total hours 60

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

1. Apply the knowledge of basic Chemical Engineering Calculations involving unit operations
2. Apply material balance on Chemical processes with & without chemical reaction.
3. Use laws of thermo physics and thermo chemistry for applying energy balance on Chemical processes.
4. Learn the concept of humidity and usage of psychometric charts.
5. Learn about Internal energy, Enthalpy, Heat capacity of gases, liquids, and solids

Course Content

UNIT I **10 Hours**

Introduction

Role of chemical engineering in industry, Schematic flow sheets including symbols, Unit operations and unit processes with reference to MEB calculations.

Introduction to units systems, Units and dimensions, mole, Specific gravity, Specific volume, Concentrations, Stoichiometry of chemical equations, Mole fraction and weight fraction, Degrees of freedom.

UNIT II **15 Hours**

Behavior of gas and liquid mixtures: Real gases, Bubble point and dew point temperatures, Henry's law, Duhring's plot. Saturation, Partial saturation, Relative saturation. Clausiusclapeyron equation, Cox chart and Duhring's plot.

UNIT III **20 Hours**

Material balance calculations: Law of conservation of mass and component. Simple mass balances, Material balance calculations without chemical reactions, Material balance calculations involving chemical reactions, Recycling, Bypass, Purge, Analysis of degree of freedom for material balance problems.

UNIT IV **15 Hours**

Energy balance calculations: Internal energy, Enthalpy, Heat capacity of gases, liquids, and solids, Latent heats, Heats of formation, combustion, reaction and dissolution, Enthalpy-concentration chart, Fuel heating value, Theoretical flame temperature, Energy balance calculations in unit operations and systems with and without chemical reactions, Humidity and humidity chart, Energy balance calculations in humidification and adiabatic cooling. Computer aided case studies of material and energy balances of various operations.

Suggested Readings:

1. Hougen, P.A., Watson, K.M., &Ragatz, R.A. (2018) *Chemical Process Principles Part–I: Material and Energy Balances*. CBS Publishers and Distributors Pvt Ltd.
2. Himmelbleau, D.M. & Riggs J.B. (2004). *Basic Principles and Calculations of Chemical Engineering*. Prentice Hall, 7th Edition.
3. Bhatt B.L.&Vora, S.M. (2004). *Stoichiometry*. Tata McGraw Hill Publishing Co. Ltd.
4. Felder, R. M. & Rousseau, R.W. (2004) Elementary *Principles of Chemical Processes*. John Wiley, 3rd Edition.
5. Reklaitis, G.V. (1983). *Introduction to Material and Energy Balances*. John Wiley.
6. Lewis, W.K., Radasch, A.H., & Lewis, H. C. (1954). *Industrial Stoichiometry Chemical Calculations of Manufacturing Processes*. McGraw Hill.
7. Hougen, O.A., Watson, K.M. &Ragatz, R.S. (2004). *Chemical Process Principles (Vol-I, 2nd Edition)*. CBS Publishers and Distributors Pvt Ltd.

SEMESTER-III

Course Title : FLUID FLOW
Course Code: BPE302

L	T	P	Credits
3	1	0	4

Total hours 55

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

1. Acquire knowledge about the basic principles of fluid mechanics.
2. Solve fluid flow problems with the application of the momentum and energy equations.
3. Identify the appropriate usage of ideal flow concepts, continuity equation and Bernoulli equation.
4. Solve the problems using methodical dimensional analysis.
5. Learn about the pipe flows as well as fluid machinery.

Course Content

UNIT I **10 Hours**

Introduction: Concept of fluid, difference between solids, liquids and gases; ideal and real fluids, Introduction to fluid statics and fluid flow

Fluid Statics: Normal forces in fluids, Manometers of different types, Forces on submerged bodies, Buoyancy and stability.

UNIT II **15 Hours**

Fluid Properties: Concept of capillarity, vapour pressure, compressibility and bulk modulus, Newtonian and non- Newtonian Fluids, Nature of turbulence, Eddy Viscosity, Flow in Boundary Layers.

Basic Equation of Fluid Flow: Momentum Balance, Continuity equation, Bernoulli's Equations, Navier Stokes Equations, Derivation and Application Dimensional Analysis of Fluid Flow Problems using Rayleigh method and Buckingham π method, Dimensionless numbers and their significance

UNIT III **15 Hours**

Flow of Incompressible Fluids: Concept of boundary layer, Laminar and Turbulent flow in pipes, Velocity distribution in pipes, Frictional Losses in pipes and fittings, effect of roughness, Fanning Equation, Estimation of Economic Pipe Diameter, Derivation of Hagen Poiseuille's equation and f =16/ Re.

Flow of compressible fluids: Compressible flow, basic equation, Mach number and its significance and isentropic flow through nozzles

UNIT IV **15 Hours**

Flow Measurement:

In closed channels - Pitot tube, Orifice meter, venturimeter, Rotameter

In open channels- Notches, Weirs

Fluid Machinery: Classification and performance of Pumps, Positive displacement pumps and its types, Centrifugal pumps- characteristic curves, Net positive Suction Head and cavitation, Turbines, Compressors, Blowers, Selection and specification.

Suggested Readings:

1. McCabe, W.L., Smith, J.C., & Harriot, P. (2005). *Module Operations of Chemical Engineering (7th Edition)*. McGraw Hill.
2. Backhurst, J.R., Harker, J.H., Coulson, J.F., & Richardson, J.M. (1999). *Chemical Engineering (Volume 1, 6th Edition)*. Butterworth Heinemann, 6th Edition.
3. Foust, A.S., Wenzel, L.A., Clump C.W. Maus L., & Anderson, L.B. (2008). *Principles of Module Operations (2nd Edition)*. John Wiley & Sons.
4. Raju, K.S. (2011). *Fluid Mechanics, Heat Transfer, and Mass Transfer: Chemical Engineering Practice*. John Wiley.

SEMESTER-III

Course Title : THERMODYNAMICS
Course Code: BPE303

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Apply the thermodynamic laws to chemical engineering processes.
2. Understand the thermodynamic principles for analysis of solutions, ideal solutions, their excess properties and residual properties.
3. Use thermodynamic principles for different types of chemical engineering systems
   such as vapor-liquid systems, liquid-liquid systems and solid-liquid systems.
4. Compare chemical reactions in relation to thermodynamic principles.
5. Solve problems involving more than one phase and chemical reactions through equilibria.

Course Content

UNIT I **10 Hours**

Brief Review: Review of First, Second and Third Law of Thermodynamics: First law of Thermodynamics, thermodynamics state and state functions, enthalpy, the steady state steady flow process, equilibrium, phase rule, reversible processes, Throttling process, Joule-Thomson coefficient, liquefaction of gasses, Standard heat of reaction, standard heat of formation, standard heat of combustion, flame temperature, enthalpy for phase change etc, Second law of thermodynamics, Heat engines, Entropy, Entropy changes of an ideal gas, Third law of thermodynamics.

UNIT I **10 Hours**

Volumetric Properties of Pure Fluids: PVT behaviour for an ideal gas, Virial equation of state, Applications of Virial equations, Cubic equation of state, Generalized correlations, Acentric factors.

Thermodynamic Properties of Fluid: Maxwell relations, Residual properties, two phase system, Thermodynamic diagram

UNIT III **15 Hours**

Equilibrium and Stability: Criteria of equilibrium, Chemical Potential, Application of equilibrium criteria, Clausiusclapeyon equation.

Phase Equilibria: Fugacity, Determining of fugacity of pure substances, Fugacity in mixture, Ideal solution, Excess properties, and Liquid phase properties from VLE data, Activity coefficients, and coefficient equations.

UNIT IV **10 Hours**

Chemical Reaction Equilibria: Reaction ordinate for single & multiple reactions, condition of equilibrium for a chemical reactions, Standard states and G, Temperature dependence of the equilibrium constant , Estimation of equilibrium rate constant , Homogeneous gas phase reactions, Heterogeneous chemical equilibrium.

Suggested Readings:

1. Smith, J.M., Van Ness, H.C., & Abbott, M.M. (2003). *Introduction to Chemical Engineering Thermodynamics (6th Edition).* McGraw Hill.
2. Rao, Y.V.C. (1997). *Chemical Engineering Thermodynamics (1st Edition).* Hyderabad: Universities Press (India) Ltd.
3. Kyle, B.G. (1999). Chemical and Process Thermodynamics (3rd Edition). Prentice Hall.
4. Denbigh, K.G. (1981). *Principles of Chemical Equilibrium (4th Edition*). Cambridge University Press.
5. Pitzer, K.S. (1995). *Thermodynamics (3rd Edition).* McGraw Hill.

SEMESTER-III

Course Title : ELEMENTS OF RESERVOIR ENGINEERING
Course Code: BPE304

L	T	P	Credits
2	1	0	3

Total hours 45

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

1. Learn about scope of reservoir engineering, characteristics, classifications and properties of oil and gas.
1. Know about definitions and their determination of reservoir rock properties, series and parallel combination of beds, fluid saturation, etc.
2. Know about the concept of effective and relative permeability, capillary pressure
3. Study the phase behavior of hydrocarbon, equilibrium ratio, fluid sampling, PVT properties determination, and their measurement, correlations, data reduction and applications.
4. Understand the principle of fluid flow in the porous media, linear, radial and spherical flow, steady and unsteady state flow.

Course Content

UNIT I **10 Hours**

Introduction to Elements of Reservoir Engineering: Fundamentals of reservoir engineering and classification of petroleum reservoir.

Reservoir Rocks: Characteristics of Reservoir Rocks, Classification and Nomenclature: Classic Reservoir Rocks, Carbonate Reservoir Rocks, Unconventional, Fractured And Miscellaneous reservoir Rocks, Marine And Non-Marine Reservoir Rocks, Concept of Shale Oil. Reservoir Rocks, Marine and Non-Marine Reservoir Rocks, Concept of Shale Oil.

UNIT II **10**

HoursReservoir Rock Properties: Porosity, permeability determination, combination of permeability in parallel & series beds, porosity- permeability relationship, fluid Saturation determination and significance, effective and relative permeability, wettability, capillary pressure characteristics, measurements and uses.

UNIT III **15**

HoursHydrocarbon Migration: Geological framework of migration and accumulation, 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 IV **10 Hours**

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

Suggested Readings:

1. Ahmed, T. (2006). *Reservoir Engineering Handbook*. Elsevier, 3rd Edition.
2. Slip Slider, H.C. (1983). *World Wide Practical Petroleum Reservoir Engineering Method*. Penn Well Publishing Company.
3. Gianluigi, C. (1994). *Principles of Petroleum Reservoir Engineering*. Elsevier.

SEMESTER-III

Course Title : HEAT TRANSFER
Course Code: BPE305

L	T	P	Credits
2	1	0	3

Total hours 45

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

1. Acquire knowledge about the basic laws of heat transfer.
2. Solve problems involving steady and unsteady state heat conduction in simple geometries with and without heat generation.
3. Study the heat transfer in natural and forced convection.
4. Solve simple radiation heat transfer problems, condensation and boiling.
5. Understand the heat transfer processes involved in evaporation and heat exchangers.

Course Content

UNIT I **15 Hours**

Modes of Heat Transfer

Conduction: Fourier's law, one dimensional heat conduction through plane and composite structures having plane wall, spherical & cylindrical geometry. Steady state heat flow with heat source through plane wall and cylindrical surface. Thermal conductivity of materials. Insulating materials and critical thickness of insulation. Unsteady-state conduction; Lumped heat capacity system, semi-infinite solid and Heisler chart.

Convection: Free and forced convection, Concept of thermal boundary layer, concept of overall heat transfer coefficient for laminar and turbulent flow, Heat transfer inside & outside tubes with significance of Nusselt, Prandtl, Reynolds, Biot, Fourier and Pecletnumbers.Modelling of convective heat transfer coefficient by using dimensional analysis for natural convection.

UNIT II **10 Hours**

Radiation: Distribution of radiant energy, Definition of emissivity, absorptivity, Reflectivity and transmissivity, concept of Black and Grey bodies, Planck's law of monochromatic radiation, Kirchhoff's law, Wien's displacement law, Stefan-Boltzmann law, definition of intensity of radiation. Radiation formula for radiation exchange between simple bodies, two parallel surfaces and between any source and receiver, radiation shields

Condensation and Boiling Heat Transfer: Dropwise and Filmwise condensation of pure and mixed vapours, Convective, Nucleate & Film boiling, Theory and correlations, critical boiling flux

UNIT III **10 Hours**

Heat exchangers: Double pipe heat exchanger, Shell-and-Tube heat exchangers, plate type heat exchanger, concept and calculation of log mean temperature difference, temperature correction factor for shell & tube exchangers, fouling factors, overall heat transfer coefficient Theory of Fins and their applications. Reboiler and Condensers, counter current dry contact Condenser, parallel current- wet contact Condenser.

UNIT IV **10 Hours**

Evaporators: Various types of evaporators- Standard vertical tube evaporator, basket type vertical evaporator, forced circulation evaporator and horizontal tube evaporators. Single effect evaporators and multi-effect evaporators and its various types of feed arrangements, boiling point elevation, capacity and economy of evaporators. Evaporation under vacuum.

Suggested Readings:

1. Holman, J.P. (2010). *Heat Transfer*. McGraw Hill, 10th Edition.
2. McAdams, W.H. (1985). *Heat Transmission*. Kreiger Publishing Co, 3rd Edition.
3. Backhurst, J.R., Harker, J.H., Coulson, J.F., & Richardson J.M. (1999). *Chemical Engineering, Volume 1*. Butterworth Heinemann, 6th Edition.
4. McCabe, W. L., Smith, J.C., & Harriot, P. (2005). *Module Operations of Chemical Engineering*. McGraw Hill, 7th Edition.
5. Kern, D.Q. (1983). *Process Heat Transfer*. McGraw Hill.
6. Kreith, F., Manglik, R.M., & Bohn, M.S. (2010). *Principles of Heat Transfer*. Brooks Cole Thomson Learning Publication, 7th Edition.
7. Incopera, F.P., DeWitt, D.P., Bergman, T.L., &Lavine, A.S. (2011). *Fundamentals of Heat and Mass Transfer*. John Wiley, 7th Edition.
8. Geankopolis, C J. (2004). *Transport Processes and Separation Process Principles*. Prentice Hall of India, 4th Edition (Eastern Economy Edition).
9. Coulson, J. M. & Richardson, J. F. (1999). *Chemical Engineering, Volume 1*. Pergamon Press.

SEMESTER-III

Course Title : FLUID FLOW LAB
Course Code: BPE306

L	T	P	Credits
0	0	2	1

Total hours 15

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

1. Understand the working of a centrifugal pump.
2. Understand Bernoulli's equation
3. Find the coefficient of discharge of fluids by venturimeter, orifice meter and V-notch etc.
4. Study of valves and fittings.
5. Find stability of floating body.

List of Experiments **15 Hours**

1. Characteristic curves of a centrifugal pump.
2. Determination of stability of a floating body.
3. Verification of Bernoulli's equation for flow process.
4. Measurement of flow by a venturimeter
5. Measurement of flow by an orifice meter.
6. Measurement of flow by a rotameter
7. Measurement of flow by a V-notch in an open channel.
8. Measurement of losses in various fitting and valves.
9. Measurement of losses due to contraction and expansion.
10. Measurement of losses due to variation in cross section/ shapes
11. Verification of laminar/ turbulent flow regime in a flow process
12. Study of valves and fittings

SEMESTER-III

Course Title : FLUID FLOW LAB
Course Code: BPE307

L	T	P	Credits
0	0	2	1

Total hours 15

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

1. Find the heat transfer coefficients of different common materials of different types.
2. List the heat losses and effect of insulation during the heat transfer.
3. Perform the operation of open pan / single effect / multi-effect evaporators.
4. Measure radiative heat transfer, condensation and boiling heat transfer.
5. Present their results in written form of report.

List of Experiments **15 Hours**

1. Determination of heat transfer coefficient for different types of heat transfer equipments.
2. Wilson Plots for unsteady state heat transfer in jacketed vessels.
3. Developing correlation of instantaneous heat transfer coefficients with time for steady deposition of scale on a heating surface.
4. Determination of heat losses from insulated pipes.
5. Performance characteristics of a shell and tube heat exchanger and an induced draft cooling tower.
6. Study and operation of long tube forced circulation and multiple effect evaporators.
7. Duhring's plot for solutions involving non-volatile solutes
8. To find the heat transfer coefficient of heat loss from a vertical cylinder by natural convection.
9. To find heat transfer coefficient for parallel flow and counter flow for double pipe heat exchanger.
10. To find heat transfer coefficient for heat loss.

SEMESTER-III

Course Title : Summer /Institutional Training
Course Code: BPE308

L	T	P	Credits
NA	NA	NA	S/US

Each student will be required to submit a report after the completion of industrial training. To address specific industry and research related problems:
Unit 1: Problem Identification
Unit 2: Literature survey and methodology
Unit 3: Framing of Experimentation set up and preliminary data collection
Unit 4: Future Deliverables &expected Outcome
The reports will be assessed by teacher in-charge of the training. The student has to appear in Viva-voce examination.

SEMESTER-III

Course Title : PETROCHEMICAL TECHNOLOGY
Course Code: BPE309

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Outline the applications of hydrocarbons in various industries such as fertilizer, power generation, petrochemicals etc
2. Study manufacturing of fertilizers such as ammonia and urea.
3. Understand polymerization and their properties, applications and production technologies.
4. Acquire knowledge about the higher hydrocarbons and aromatics
5. Learn about the classification and production of synthetic detergents.

Course Content

UNIT I **10 Hours**

Introduction: Application of various components of Hydro Carbon, Major Industrial Application- Fertilizer, Power generation, Petrochemicals, Sponge iron, glass Industry, Ceramic Industry.

Gas for Fertilizer Plant- Use of Methane; Reforming of Methane; shift Conversion of Synthesis gas; Air Separation (Making Oxygen and Nitrogen); Ammonia Synthesis.

Urea Reaction in presence of Catalyst; G as for Petrochemicals - Use of Ethane; Cracking of Ethane to Ethylene.

UNIT II **10 Hours**

Polymerization: Properties, applications and production technologies of the following commodity polymers - Polyethylene, LLDPE, HDPE, polypropylene, polystyrene, PVC; Propane cracking; Market for polymers and application of polymer.

UNIT III **10 Hours**

C_3, C_4 and higher hydrocarbons

C_3derivatives: Propane, propylene, Isopropyl alcohol, Acetone, Propylene oxide, Propylene glycol, Acrylonitrile, Acrylic acid.

C_4 derivatives: Butane, Butylene, Butylene oxide-glycol, Acetic acid from butane Higher Hydrocarbon derivatives: Separation of paraffins (Wax cracking).

UNIT IV **15 Hours**

Petroleum Aromatics: BTX Production:Naptha reforming, Paraxylene from Naptha Benzene derivatives: Phenol, Aniline, Benzoic acid , Styrene, Maleic anhydride. Toluene derivatives: Caprolactum, DMT, Terephalic acid, Phthalic anhydride. Xylene derivatives: Cumene, Naphthalene**.**

Dyes and pigments: Classification and production Synthetic Detergents: Classification, Manufacture of sulfonates -Keryl Benzene sulfonates (Surf).

Suggested Readings:

1. Chaudhary, U. R.(2011). *Fundamentals of petroleum and petrochemical engineering(1st Edition)* CRC Press.
2. Mall, I. D.(2007). *Petrochemical processes technology* Macmillan India.
3. Maiti, S,(1992). *Introduction to petrochemical*. Oxford & IBH Publishing Company.
4. Rao, B. K. B (2009) *Modern Petroleum refining processes (5th Edition).* Oxford & IBH Publishing Company.

SEMESTER-III

Course Title : CHEMICAL TECHNOLOGY
Course Code: BPE310

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Know about Extraction of oils, Hydrogenation of oils.
2. Acquire knowledge about types of pulp and manufacture of paper.
3. Acquire knowledge about manufacture of Soda ash by Solvay process and modified Solvay process.
4. Know about types of Portland cement, manufacture of Portland cement.
5. Understand manufacture of ammonia and urea.

Course Content

UNIT I **10 Hours**

Oils and Fats: Introduction, Extraction of oils, Hydrogenation of oils.
Sugar: Introduction, Juice extraction, defacation, concentration, refining

UNIT II **10 Hours**

Paper &Pulp: Introduction, Criteria for getting good quality paper, Types of pulp and Manufacture of paper by fourdrinier machine

Sulphuric Acid: Introduction, Grades of sulphuric acid, Manufacture of sulphuric acid by contact process.

Soda Ash Industry: Manufacture of Soda ash by Solvay process and Modified Solvay process.

UNIT III **15 Hours**

Glass: Introduction, Different types of glasses, raw materials required by glass industry, Manufacture of glass.

Cement Industry: Types of Portland cement, Manufacture of Portland cement.

Fertilizer Industry: Introduction, NPK, Manufacture of ammonia and urea, superphosphate and triple super phospate, mixed fertilizers, complex and compound fertilizers.

UNIT IV **10 Hours**

Polymer Industry: Definition of polymerisation, Types of polymerization, Manufacture of polyethylene, polyvinylchloride, semi-synthetic polymers and synthetic polymers.

Industrial Gases: Manufacture of Carbon-dioxide, Nitrogen and Oxygen.

Suggested Readings:

1. Waddams, A.L. (1980). *Chemicals from Petroleum(4th Edition).* Gulf Publishing Company.
2. Lewis, F.H. &Matar, S. (1981). *From Hydrocarbon to Petrochemicals*. Gulf Publishing Co.
3. Rao, B.K.B. (1998). *A Text on Petrochemicals(2nd Edition).*Khanna Publishers.
4. Mall, I.D. (2007). *Petrochemical Process Technology*. Macmillan India Limited.
5. Lowenheim, F.A. & Moran, M.K. (1975). *IndustrialChemicals(4th Edition).* John Wile.
6.Shreeve, T.A. (2017).*Chemical process Technology (5th Edition).*Mc Graw Hill Publication.
7.Dryden,(2005).*Outlines of Chemical Technology* .East west press publication.

SEMESTER-III

Course Title : INDUSTRIAL POLLUTION ABATEMENT
Course Code: BPE311

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Knowledge of environment and various pollutants
2. Knowledge and application of methods to remove air and water pollutants and environmental audit.

Course Contents

UNIT I **15 Hours**

Introduction: Ambient air and water standards, principle sources of pollution, Inter relationship between energy and environmental pollution, Prevention of environmental pollution through conservation.

Air Pollution: Principal air pollutants and their usual sources, Effects of air pollution on human health, animals and vegetation and materials, Atmospheric dispersion of air pollutants, Temperature inversions.

Ambient air sampling, dust fall jar and high volume sampler, stack sampling Air pollution control techniques – Process and equipment's used for the control of gaseous pollutants- equipment efficiency, gravity settler, cyclone separator, fabric filters, Electrostatic precipitators, scrubbers.

UNIT II **15 Hours**

Water Pollution: Types of water pollutants, their sources and effects. BOD and COD, BOD5, oxygen sag curve, waste water sampling- grab and composite sample.

Waste water treatment: Primary Treatment through settling techniques and equipments like flocculation, skimming, flotation. Secondary Treatment: aerobic and anaerobic digestion, activated sludge process, trickle filter and oxidation ponds.

UNIT III **10 Hours**

Solid Waste: Control and disposal, sanitary landfill, incineration, pyrolysis gasification and recycling.

UNIT IV **5 Hours**

Environmental Management System: Environment impact assessment, its concept and constituents, Environmental audit, ISO-14000 system.

Suggested Readings:

1. Perkins H. C., Air Pollution, McGraw Hill, N.Y., 1974

2. Liptak B.G., Liu D. H. F., Environmental Engineers Handbook, 2nd Ed., CRC Press, 1999
3. Willisamson S.J., Fundamentals of Air Pollution, Addison Wesley Co. N.Y.,1973
4. Nemerow N.L., Liquid Wastes of Industry: Theory, Practices and Treatment, Addison Wesley Co. N.Y., 1971
5. Rao C.S., Environmental Pollution Control Engineering, 2nd Edition, New Age International Pvt. Ltd., 2006
6. Metcalf and Eddy, Waste-Water Engineering, 4th Edition, Tata McGraw Hill, 2007.
7. Mahajan S. P., Pollution Control in Process Industries, Tata McGraw Hill, 2008.
8. Sincero, A.P., Sincero, G.A., Environmental Engineering, Prentice-Hall of India, 1999.

SEMESTER-IV

Course Title : GEOLOGY OF PETROLEUM
Course Code: BPE401

L	T	P	Credits
4	0	0	4

Total hours 45

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

1. Acquire knowledge about the general properties of rock forming minerals and their identification
2. Learn the rock classification and its identification
3. Study the rock deposition and stratification
4. Acquire basic knowledge about the various geological structure and their recognition
5. Acquire knowledge about the exploration methods such as surface geological and geophysical methods

Course Content

UNIT I **15 Hours**

Minerals: General properties; Classification of minerals and properties of common rock forming minerals.

Petrology: Rocks; Classification and description of some common rocks.

UNIT II **10 Hours**

Stratigraphy: Principles of Stratigraphy; Concepts of paleontology; Fossils, their mode of preservation and significance as indices of age and climate; Concept of index fossils; Broad stratigraphic subdivisions and associated rock types of important coal belts and oil fields of India.

UNIT III **10 Hours**

Structural Geology: Interpretation of topographic maps; Attitude of planar and linear structures; Effects of topography on outcrops. Unconformities, folds, faults and joints - their nomenclature, classification and recognition. Forms of igneous intrusions - dyke, sill and batholiths. Effects of folds and fractures on strata and their importance in exploration activities.

UNIT IV **10 Hours**

Exploration: Meaning, methods of exploration, surface geological methods-gravity methods, magnetic methods, geophysical methods-electrical resistivity methods, seismic, radiometric surveying.

Suggested Readings:

1. Rutely, H.H. (2005). *Elements of Mineralogy*. McGraw Hill.

2. Krishnan, M. S. (2006). *Geology of India (6th Edition)*. CBS Publishers & Distributors Pvt Ltd.
4. Mukherjee, P.K. (2013). *Introduction to Geology*. World Press Private Limited.
5. Billings, M.P. (1972). *Structural Geology (3rd Edition)*. Prentice Hall.
6. Kearey, P. & Brooks, M. (1991). *An Introduction to Geophysical Exploration (2nd Edition)*. Wiley-Blackwell.

SEMESTER-IV

Course Title : DRILLING TECHNOLOGY
Course Code: BPE402

L	T	P	Credits
3	1	0	4

Total hours 45

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

1. Understand the planning of the well
2. Acquire knowledge about the different operating systems of drilling rig
3. Know about the selection of proper bit compatible to the well
4. Acquire basic knowledge about rock through coring
5. Find the solutions of the different types of well problems

Course Content

UNIT I **15 Hours**

Well Planning: Introduction to oil well drilling, drilling planning approaches.
Rotary Drilling Method: Rig parts, selection and general layout.
Drilling Operations & Practices: Hoisting, circulation, Rotation, power plants and Power transmission, Rig wire line system handling & storage.

UNIT II **10 Hours**

Casing Design: Design of casing string, Liner Design and Setting, Casing landing practices, Buckling criteria and Calculation of well head loads. Casing while drilling.
Drill String: Parts, function and design.

UNIT III **10 Hours**

Drill Bits: Classification and design criteria of drag, rotary, roller, diamond and PDC bits.
Coring: Different methods of core drilling.

UNIT IV **10 Hours**

Well Problems and Solutions: Fatigue failure, Pipe sticking, lost circulation, Sloughing shales, Swabbing, surge, gas cap drilling, Blow out and kick control.
Oil well fishing: Fish classification, tools and techniques.
Basics of Drilling Fluids and Cementing.

Suggested Readings:

1. Gatlin, C. (1960). *Petroleum Engineering: Drilling and Well Completion*. Prentice Hall.

2. Bourgoyane, A.T. (1986). *Applied Drilling Engineering*. (Spe Textbook Series, Vol 2). Society of Petroleum Engineers.
3. Adam, N.J. (1985). *Drilling Engineering: A complete Well Planning and Approach*. PennWell Books.
4. Rabia, H. (1986). *Oil Well Drilling*. Kluwer Law International

SEMESTER-IV

Course Title : CHEMICAL REACTION ENGINEERING
Course Code: BPE403

L	T	P	Credits
2	1	0	3

Total hours 45

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

1. Study the basic concepts of chemical reaction engineering and develop rate laws for homogeneous reactions
2. Design calculations of ideal reactors for single and complex reactions for isothermal and non-isothermal reactors.
3. Compare the relative performance of different reactors.
3. Draw various RTD curves and predict the conversion from a non-ideal reactor using tracer information.
4. Understand the optimal reactor configurations and operating policies for systems involving multiple reactions.

Course Content

UNIT I **10 Hours**

Introduction: Introduction & Importance of Chemical Reaction Engineering, Kinetics of homogeneous reactions, Concepts of reaction rates, rate equation, rate constant, order & molecularity, Mechanism for Elementary & Non-elementary reaction.

UNIT II **15 Hours**

Design for Single Reactions: Material balance equation for ideal batch reactor and its use for kinetic interpretation of data and isothermal reactor design for simple & complex rate equation.

Performance equations for CSTR and PFR and their use for kinetic interpretation and design.

Comparison of batch reactor, CSTR & PFR, Recycle reactor, concept of yield & selectivity.

Reactor combinations of CSTR and PFR

UNIT III **10 Hours**

Design for Multiple Reactions: Quantitative treatment of Series & parallel multiple reaction in a batch reactor, CSTR & PFR, Concept of Product distribution for multiple reactions.

Temperature & Pressure effects: Concept of adiabatic & non-isothermal operations, Energy balance equation for Batch, CSTR & PFR and their application to design of reactors, optimal temperature progression, multiple steady states in CSTR.

UNIT IV **10 Hours**

Non –Ideality: Basics of non-ideal flow, residence time distribution, States of segregation. Measurement and application of RTD, E-Age distribution function & F-curve and inter-relationship between them, Conversion in non-ideal reactors.

Suggested Readings:

1. Levenspiel, O. (2004). *Chemical Reaction Engineering (3rd Edition*). John Willey.
2. Smith, J.M. (1981). *Chemical Engineering Kinetics (3rd Edition).* McGraw Hill.
3. Peacock, D.G. & Richardson, J.F. (1994). *Chemical Engineering, (Volume 3, 3rd Edition*). Butterworth Heinemann.
4. Walas, S.M. (1959). *Reaction Kinetics for Chemical Engineers (3rd Edition).* Tata McGraw Hill.
5. Denbigh, K.G. & Turner, J.C.R. (1984). *Chemical Reactor Theory - An Introduction (3rd Edition).* Cambridge University Press.
6. Fogler, H.S. (2006). *Elements of Chemical Reaction Engineering (4th Edition).* Prentice Hall.

SEMESTER-IV

Course Title : PETROLEUM REFINING AND ENGINEERING
Course Code: BPE404

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Acquire basic knowledge about the national energy scenario
2. Study the various petroleum resources, drilling techniques for obtaining crude 3.petroleum & various regulations for crude oil production
3. Acquire knowledge about the various crudes & identify desirable properties of 5.Petroleum fractions and testing methods.
4. Understand the various pretreatment and refining processes like distillation, extraction, de-waxing etc.
5. Know about the various conversion processes like cracking, reforming, alkylation, polymerization and is isomerization.

Course Content

UNIT I **10 Hours**

Introduction to petroleum industry: World petroleum resources, petroleum industry in India. Origin, exploration, drilling and production of petroleum crudes, Transportation of crudes and products.

UNIT II **15 Hours**

Crude pretreatment: Composition and classification of crudes, methods of evaluation: ASTM, TBP and EFV distillation. Properties and specifications of petroleum products such as LPG, gasoline, naphtha, kerosene, diesel oils, lubricating oils, waxes and the like.

Testing of petroleum products:

(i) Physical test: Density and specific gravity, viscosity.
(ii) Chemical test: Organic and inorganic constituents.
(iii) Flammability Test: Flash point, volatility.
(iv) Knock Rating Test: For Gasoline Octane Number.

UNIT III **10 Hours**

Separation Processes: Design and operation of topping and vacuum distillation units, Tube still furnaces, Solvent extraction processes for lube

oil base stock and for aromatics from naphtha and kerosene steams, solvent dewaxing.

UNIT IV **10 Hours**

Conversion Process: Thermal cracking, visbreaking and coking processes. Catalytic cracking, reforming, hydroprocessing, alkylation, polymerization and isomerisation.

Safety and pollution considerations in refineries.

Suggested Readings:

1. Nelson, W.L. (1985). *Petroleum Refinery Engineering (5th Edition).* McGraw Hill.

2. Hobson, G.D. & Pohl. W. (1984). *Modern Petroleum Technology (5th Edition).* John Wiley.

3. Guthrie, V.B. (1960). *Petroleum Products Handbook.* McGraw Hill.

4. Rao, B.K. (2009). *Modern Petroleum Refining Processes (5th Edition).* Oxford & IBH Publishing Co.

SEMESTER-IV

Course Title : MECHANICAL OPERATIONS
Course Code: BPE405

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Study the particulate solids characterization and its screening.
2. Identify various processes related to solid particles such as agitation and mixing, size reduction, filtration, settling and fluidization.
3. Understand conveying of bulk solids, conveyors and conveyor selection.
4. Find capacity and effectiveness of a screen and calculation of average size of particle.
5. Acquire knowledge about the processes involving motion of particles through fluids though Sedimentation and Fluidization and the relevant equipment

Course Content

UNIT I **10 Hours**

Characterization and Handling of Solids: Characterization of solid particles: Shape, size, specific surface, Particle size distribution

Properties of particulate masses: Major distinctive properties, pressures in masses of particles, angle of internal friction, angle of repose.

Conveying of bulk solids: Basic idea of conveyor, conveyor selection, screw, belt, vibrating, continuous flow and pneumatic conveyors.

Storage and weighing: bulk storage, bin storage, feeders (vibrating hopper, screw feeder, belt feeder), batch and continuous weighing.

UNIT II **15 Hours**

Screening: Capacity and Effectiveness of a screen, calculation of average size of particles in mixture by screen analysis, types of screens.

Agitation and Mixing: Agitation of low viscosity particle suspensions: axial flow impellers, radial flow impellers, close-clearance stirrer, unbaffled tanks, baffled tanks, basic idea for designing agitators. Power number, Froude number, power consumption in agitation.

Mixing of Solids: Types of mixers, various mixers for cohesive solids, power requirements, mixing index, axial mixing. Mixers for free flowing solids: ribbon blenders, screw mixers, tumbling mixers import wheels, mixing index in blending granular solids, mixing index at zero time, rate of mixing.

UNIT III **10 Hours**

Size Reduction

Principles of Comminution: Criteria for comminution, characteristics of products, Energy and Power requirements, Bond's, Rittinger's and Kick's Law and Work Index.

Size Reduction Equipment: Crushers, Grinders, and ultrafine grinders cutting machines, equipment operation.

Filtration

Classification of filters, various types of cake filters, principles of cake filtration, clarifying filters: liquid clarification, Gas cleaning, principles of clarification.

Filtration Equipment and centrifuges and their selection, Cross flow filtration, micro filtration

UNIT IV **10 Hours**

Settling

Motion of particles through fluids: Terminal velocity, hindered settling, Stoke's law.

Gravity settling processes: Classifiers, clarifiers, thickeners, flocculation, rate of sedimentation

Centrifugal Settling processes: Cyclones, hydroclones, decanters, tubular, disk and nozzle discharge centrifugal sludge separators, Centrifugal class fitters, principles of centrifugal sedimentation.

Fluidization

Fluidization and fluidized bed, conditions for fluidization, Ergun equation and Kozeny-Carman equation, minimum fluidization velocity, types of fluidization, expansion of fluidized beds and particulate fluidization, continuous fluidization; industrial applications.

Suggested Readings:

1. McCabe, W. L., Smith, J. C., & Harriot, P. (2005). *Module Operations of Chemical Engineering (7th Edition).* McGraw Hill.
2. Foust, A.S., Wenzel, L.A., Clump, C.W., Maus. L., & Anderson, L. B. (2008). *Principles of Module Operations (2nd Edition).* John Wiley.
3. Harker, J. H., Richardson, J. F., &Backhurst, J. R. (2003). *Chemical Engineering (Volume 2, 5th Edition).* Butterworth-Heineman.
4. Badger, W.L. &Banchero, J.T. (1955). *Introduction to Chemical Engineering.* McGraw Hill.
5. Perry, R.H. & Green, D. W. (2008). *Chemical Engineers' Handbook (8th Edition).* McMcGraw Hill.

SEMESTER-IV

Course Title : CHEMICAL REACTION ENGINEERING LAB
Course Code: BPE406

L	T	P	Credits
0	0	2	1

Total hours 15

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

1. Study the reaction kinetics using various types of reactors such as batch, PFR and CSTR.
2. Find the residence time distribution for PFR and Packed Bed Reactor.
3. Know about the kinetic studies in a PFR followed by a CSTR.
4. Learn the temperature dependence of rate constant using CSTR.
5. Study of temperature dependence of rate constant using CSTR

List of Experiments **15 Hours**

1. Kinetic studies in a Batch reactor
2. Kinetic studies in a Plug Flow reactor
3. Kinetic studies in a PFR followed by a CSTR
4. RTD studies in a PFR
5. RTD studies in a Packed Bed Reactor.
6. RTD studies in CSTRs in series
7. Studies on micellar catalysis
8. Study of temperature dependence of rate constant using CSTR.
9. Kinetic studies in sono-chemical reactor
10. Batch reactive distillation
11. Kinetics of photochemical reaction
12. Study of heterogeneous catalytic reaction
13. Study of gas-liquid reaction

SEMESTER-IV

Course Title : PETROLEUM ENGINEERING LAB
Course Code: BPE407

L	T	P	Credits
0	0	2	1

Total hours 15

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

1. Find the quality control of lubricating oils and explore its application.
2. Study the Petroleum Products and their applications in quality control.
3. Learn about Physical and thermal of crude oil.
4. Acquire knowledge about the crude oil distillation.
5. Study of softening point of bitumen.

List of Experiments **15 Hours**

1. Determination of viscosity of given petroleum fraction using viscometer.
2. Study of vapour pressure of gasoline using Reid Vapour pressure apparatus.
3. Determination of Aniline Point of given petroleum fraction.
4. Determination of density of petroleum fraction.
5. Determination of Smoke Point of Kerosene.
6. Determination of Flash and fire Point of given petroleum fraction.
7. Determination of Cloud and pour Point of given petroleum fraction.
8. Determination of Carbon Residue of given petroleum fraction using Rams Bottom Carbon Residue apparatus.
9. Determination of Calorific value of given petroleum fraction using Bomb Calorimeter.
10. Study of distillation of crude oil or mixture of petroleum fractions.
11. Determination of surface tension of given oil.
12. Study of softening point of bitumen.

SEMESTER-IV

Course Title : MECHANICAL OPERATIONS LAB
Course Code: BPE408

L	T	P	Credits
0	0	2	1

Total hours 15

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

1. Study the concept of fluidization.
2. Acquire knowledge about the operating characteristics of crushing and grinding equipment
3. Understand various principles of the filtration and analyze working of filtration equipment.
4. Find the efficiency of various separating equipment.

List of Experiments **15 Hours**

1. Verification of Stokes Law.
2. Screen analysis of given sample for its particle size distribution.
3. Determination of average size (different averages) from screen analysis.
4. Determination of variation in pressure drop & bed height With respect to superficial velocity for a bed of solids.
5. Determination of minimum fluidization velocity for a bed of solids.
6. Operating characteristics of crushing and grinding equipments (Jaw crusher, Roll crusher, Ball mill).
7. Evaluation of the filtration constants for $CaCO_3$ slurry in water and cake compressibility.
8. Determination of %age recovery of coal in froth from coal and sand mixture.
9. Determination of thickener capacity using batch sedimentation.
10. Determination of characteristics of centrifuge as a filter.
11. Determination of the separation efficiency of the classifier.

SEMESTER-IV

Course Title : PETROLEUM EXPLORATION METHODS
Course Code: BPE409

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. know the basics of geophysics and exploration activities and the prominent theories behind the exploration methods
2. know the seismic exploration methods
3. know the methods of data processing for survey activities
4. know the effects of geological exploration methods on environment

Course Content

UNIT I **15 Hours**

Geological and geo-chemical methods: Surface indication of oil/gas accumulation. Accumulation parameters; Regional and local structures. Time of generation vis-à-vis accumulation.

Geochemical methods of prospecting: Soil-chemical survey, source-rock characterization; Hydro-geochemistry as exploration tool. Plate tectonics and hydrocarbon accumulation.

UNIT II **5 Hours**

Geological exploration processes: Sequence of operation. Field development: Prognostication of reserve.

UNIT III **15 Hours**

Geophysical exploration methods and their significance

Magnetic survey: Survey instruments Geo-magnetic anomalies, field methods, Datacorrection and reduction. Anomaly interpretation. Response for different type of geologicalstructures, Remote Sensing.

Gravity method: Measuring instruments, Gravity anomaly, Data correction and reduction. Free- air and bouguer anomalies. Anomaly interpretation. Application.

UNIT IV **10 Hours**

Seismic methods: Type, Methodology of refraction profiling. Field survey arrangements. Recoding instruments. Data correction, special shooting methods: Fan and broadside. Data interpretation and application in identification of structures. Reflection seismograph and seismogram relative advantage over refractive survey. Common depth point profiling and stacks time correction. Well seismic methods. Vertical seismic profiling.Interpretation.3D data acquisition and interpretation, application of reflection survey.

Suggested Readings:

1. Allen P.A. and J.R. Allen, Basin Analysis: Principles and Applications, Second edition, Wiley Blackwell, 2005.
2. Beacon, M., Simm,R., and Redshaw, T., 3D Seismic Interpretation, Cambridge University Press, 2003.
3. Coffeen, J. A., Interpreting Seismic Data Workbook, PennWell Books, 1984.
4. Dobrin, M.P. and Savit, C. H., Principles of Geophysical Prospecting, 4th Edition, McGraw Hill, 1988.
5. Rao Ramchandra M. B., Outline of Geophysical Prospecting, EBD Publishing, 1987.

SEMESTER-IV

Course Title : POLYMER TECHNOLOGY
Course Code: BPE410

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Acquire knowledge about various types of Polymers, rubbers and elastomers, their characteristics and synthesis
2. Study the concept of polymerization methods and structure- property relationships of polymers.
3. Compare various processing & manufacturing techniques of polymers and their testing.
4. Acquire knowledge about various types of polymer with structure
5. Know about molecular weight of polymer

Course Content

UNIT I **10 Hours**

Introduction to polymer science, Classification of polymer structure Molecular weight, Chemical structure & Thermal transition.

UNIT II **15 Hours**

The synthesis of high polymers Step-growth polymerization. Chain growth polymerization.Polymerization techniques, Reactions of synthetic polymers, special topics in polymer, synthesis, Chemical structure determination.

UNIT III **10 Hours**

Solution & solid-state properties, Viscosity & Rubber elasticity.
Degradation, stability & environmental issues, polymer additives, blends & composites.

UNIT IV **10 Hours**

Commodity thermoplastics &fibers, elastomers, thermosets, engineering &speciality polymers.

Suggested Readings:

1. Sinha, R. (2002).*Outlines of Polymer Technology*. Prentice Hall of India.
2. Ghosh, P.(2001).*Polymer Science and Technology*. Tata McGraw Hill.

SEMESTER-IV

Course Title : PLANT UTILITIES
Course Code: BPE411

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Understand various sources of water and their treatment, cooling water and various fuels.
2. Draw Flow diagram for demineralization of water, ion and cation exchanger
3. Acquire knowledge about steam generation and its distribution.
4. Know about classification of fuels, solid (coal), liquid and gaseous fuel and their properties.
5. Acquire knowledge of various utility equipment of plant.

Course Content

UNIT I **10 Hours**

Water: Sources of water, Types of water, Raw water and treated water – Soft water and DM water, Quality of water (temporary and permanent hardness), COD, BOD, PH, TDS, Treatment of water – filtration and bleaching, Storage of water

Demineralization of Water: Flow diagram for demineralization of water, ion and cation exchanger, regeneration of ion & cation exchanger, degasser, reaction with resins (cation and anion resins)

UNIT II **10 Hours**

Steam Generation: Saturated and superheated steam, quality of steam, simple numericals related to the enthalpy changes using steam tables and mollier diagrams, non-condensables in steam.

Fuels: Classification of fuels, solid (coal), liquid and gaseous fuel and their properties.

UNIT III **10 Hours**

Steam Distribution: Specification of steam pipe, layout of piping, steam trap, steam ejectors

Cooling water: Cooling towers, recycling of water, principles, details of problems like scaling, use of inhibitors like sodium hexameta phosphate, sodium triphosphate etc. Types of cooling towers-induced draught, forced draught.

UNIT IV **15 Hours**

Utility Equipment:

Boilers: Coalfired, oil fired, Babcox, water tubes and fire tube - Cochran, Lancashire.
Compressors: Centrifuge, reciprocating.
Blowers: Centrifuge, reciprocating.
Refrigeration, absorption, compression and vapor compression.

Suggested Readings:

1. Jain, P.C. (2004).*Engineering Chemistry*.Dhanpat Rai Publishing Company.
2. Timmerhaus, P. (2017).*Plant Economics(5th Edition).*McGraw Hill Publication.
3.Ludvig, E.(1964).*Applied Process Design for Chemical and Petrochemical Plants(4thEdition).*Gulf Publishing, Houston.

SEMESTER-IV

Course Title : WEB DESIGNING AND DEVELOPMENT
Course Code: BPE412

L	T	P	Credits
2	0	0	2

Total hours 45

Course Outcomes: On successful completion of this course, students will be able to:
1. Understand web theory to basic programming techniques.
2. Use fundamental skills to maintain web server services required to host a website.
3. Use scripting languages and web services to transfer data and add interactive components to web pages.
4. Create and manipulate web media objects using editing software
5. Learn HTML, CSS

Course Content

UNIT I **10 Hours**

Introduction to HTML: HTML Common tags- List, Tables, images, forms, Frames; Cascading Style sheets; Introduction to JavaScript: Scripts, Objects in Java Script, Dynamic HTML with Java Script XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX

UNIT II **15 Hours**

Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK Introspection, Using Bound properties, Bean Info Interface, Constrained properties Persistence, Customizes, Java Beans API, Introduction to EJB's Web Servers and Servlets: Tomcat web server,Introduction to Servelets: Lifecycle of a Servelet, JSDK, The Servelet API, The javax.servelet Package, Reading Servelet parameters, and Reading Initialization parameters. The javax.servelet HTTP package, Handling Http Request & Responses, Using Cookies-Session Tracking, Security Issues

UNIT III **10 Hours**

Introduction to JSP: The Problem with Servelet. The Anatomy of a JSP Page, JSP Processing. JSP Application Design with MVC Setting Up and JSP Environment: Installing the Java Software Development Kit, Tomcat Server & Testing Tomcat

JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing – Displaying Values Using an Expression to Set an Attribute, Declaring Variables and Methods Error Handling and Debugging Sharing Data between JSP pages, Requests, and Users Passing Control and Date between Pages – Sharing Session and Application Data – Memory Usage Considerations

UNIT IV **10 Hours**

Database Access: Database Programming using JDBC, Studying Javax.sql.* package, Accessing a Database from a JSP Page, Application – Specific Database Actions, Deploying JAVA Beans in a JSP Page, Introduction to struts framework. One android application development

Suggested Readings:

1.Bates C. (2000). *Web Programming. building internet applications(3rd Edition).*WILEY Dreamtech.

2.Naughton,P. &Schildt, H. (1999) .*The complete Reference Java 2(3rd Edition).*Osborne Publishing.

SEMESTER-IV

Course Title : TOTAL QUALITY MANAGEMENT
Course Code: BPE413

L	T	P	Credits
2	0	0	2

Total hours 45

Course Outcomes: On successful completion of this course, students will be able to:
1. Acquire knowledge about the dimensions of product quality or service quality for the same.
2. Understand the various philosophies related to Quality Management.
3. Draw and justify the Pareto chart to prioritize the defects.
4. Know about the four levels of benchmarking and / or enlist and brief seven step benchmarking model.
5. Know about the advanced techniques of TQM

Course content

UNIT I **10 Hours**

Qualityand Total Quality Management, Excellence in manufacturing/service, factors of excellence, relevance of TQM, benefits of TQM.

Concept and definition of quality, total quality control (TQC) and Total Quality Management (TQM), salient features of TQC and TQM. Total Quality Management Models.

UNIT II **15 Hours**

Just-in-time (JIT): Definition: Elements, benefits, equipment layout for JIT system, Kanban system MRP (Material Requirement planning) vs JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation, Role of JIT in lean manufacturing.

Customer Satisfaction: data collection and complaint, redressal mechanism.

Planning Process: Policy development and implementation, plan formulation and implementation.

UNIT III **10 Hours**

Process Management: Factors affecting process management, Quality function development (QFD), and quality assurance system.

Total Employees Involvement (TEI): Empowering employees: team building, quality circles, reward and Recognition, education and training, Suggestion schemes.

UNIT IV **10 Hours**

Problems solving Defining problem, Problem identification and solving process, QCtools.
Benchmarking definition, concept, process and types ofbenchmarking.
Quality Systems: Concept of quality system standards: relevance and origin of ISO 9000, Benefits, Elements of ISO 9001, ISO 9002, ISO9003.
Advanced techniques of TQM: Design of experiments: failure mode effect analysis: Taguchi methods.

Suggested Readings:

1. Raju,S.(2014).*Total Quality Management. (1st Edition).* Tata McgrawHill.
2. Zairi.M.(1991).*TQM for engineers (1st Edition).*AdityaBooks.
3.Hradeskym, J.L.(2017).*Total Quality Management Handbook*.McGrawHill.
4. Dalela&Saurabh.(1999).*ISO 9000 quality System*.StandardPublishers.

SEMESTER-IV

Course Title : REFRIGERATION AND AIR CONDITIONING
Course Code: BPE414

L	T	P	Credits
2	0	0	2

Total hours 45

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

1. Understand the air refrigeration, vapour compression refrigeration, different types of refrigerants, vapour absorption and steam jet refrigeration system.
2. Know about the working of single stage, multistage and cascade refrigeration.
3. Evaluate cooling and heating load and design of HVAC system.
4. Develop and design RAC system and evaluate different expansion and control devices and air-conditioning systems.
5. Apply the knowledge of psychrometry to various psychrometricprocesses.

Course Content

UNIT I **10 Hours**

Basic Concept:

Natural and Mechanical refrigeration, Application of Refrigeration, Units of refrigeration and Coefficient of performance, Refrigeration effect, cooling capacity and COP of a refrigerator, Heating effect, Heating capacity and COP as heat pump, Reversed Carnot cycle and its limitations

Bell Coleman Cycle and Aircraft Refrigeration:

Bell Coleman Cycle and its analysis, optimum COP and pressure ratio, Necessity of air craft refrigeration - air cycle refrigeration systems and their comparison

Module 3: Vapour Compression Refrigeration Cycle:

Vapour compression cycle on P-V, P-H and T-S diagrams, Deviation of actual cycle from theoretical cycle, Compressor capacity and volumetric efficiency, Analysis of theoretical and actual vapour compression cycles, Effect of suction pressure, Discharge pressure, Subcooling, super heating and pressure drop in valves on performance and cooling capacity.

UNIT II **15 Hours**

Vapour Absorption Refrigeration Cycle (No Mathematical Analysis): Principle of absorption system, components of the system, Desirable properties of absorption system refrigerant and absorbent, Aqua - ammonia absorption refrigeration system, Lithium Bromide - water absorption system, Theory of mixtures, temperature concentration and

enthalpy concentration diagrams, Comparison between absorption and compression systems, Electrolux refrigeration system.

Refrigerants: Classification and nomenclature of refrigerants, Desirable thermodynamic, chemical and physical properties of refrigerants, Comparative study of commonly used refrigerants and their fields of application, Azeotropes, Effect of moisture and oil miscibility, Refrigerants dying agents and antifreeze solution, Leak detection and charging of refrigerants, Environmental aspects of conventional refrigerants, Ecofriendly refrigerants and action plan to reduce ecological hazards.

Non - Conventional Refrigeration Systems (No Mathematical Analysis): Steam Jet Refrigeration, Cascade Refrigeration System, Mixed Refrigeration Systems, Vortex Tube Refrigeration, Thermoelectric cooling, Linde and Claude cycles, Cryogenics and its engineering applications.

UNIT III **10 Hours**

Air Conditioning Concept and Applications: Psychometric properties of air, Dry bulb, wet bulb and dew point temperatures, Relative and specific humidity, Degree of saturation adiabatic saturation temperature, Enthalpy of air and water vapours, Psychometric chart. Human requirement of comforts, Effective temperature and comfort charts, Industrial and comfort air conditioning.

Psychometric Processes: Sensible heating and cooling, Cooling with dehumidification, Heating with dehumidification, by-pass factor, chemical dehumidification, adiabatic mixing, air washer.

Calculations for Air –conditioning Load and for Rate and state of Supply Air: Sources of heat load, sensible and latent heat load, sensible heat factor, apparatus dew point temperature, Rate and state of supply - air for air- conditioning of different types of premises.

UNIT IV **10 Hours**

Refrigeration Controls: General aspects, Hand expansion valve, Automatic expansion valve, Thermostatic expansion valve, Capillary tube, Low side float, High side float, Solenoid valves.

Measurement Instruments - Air Conditioning: Measurement of humidity, Measurement of infiltration, Measurement of pressure, Measurement of air flow, Measurement of temperature.

Application of Refrigeration and AirConditioning: Food preservation, Cold storage, Refrigeration method for trucks and trailors, Water coolers, Desert cooler, Ice system of air conditioning, Air conditioning of theatres.

Suggested Readings:

1. Arora,C.P. (2017).*Refrigeration and Conditioning(3rd Edition).*Tata McGraw Hill.
2. Prasad, M.(1985).*Refrigeration and Conditioning (3rd Edition).*Wiley Eastern Limited.

3. Jordon &Priester.(1991).*Refrigeration and Conditioning*.Prentice Hall of India.
4. Stoecker,W.F.(1983).*Refrigeration and Conditioning(2nd Edition)*.McGraw Education.
5. Rajput, R.K.(2013).*Refrigeration and Conditioning*.Khanna Publications.

SEMESTER-V

Course Title : DRILLING FLUIDS AND CEMENTS
Course Code: BPE501

L	T	P	Credits
3	1	0	4

Total hours 60

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

1. Acquire knowledge about the basic functions of drilling fluids, the properties are responsible to achieve these functions and how to get the properties of mud.
2. Learn about the different types of drilling fluids, their advantages and disadvantages and different key factors that drive decisions about the selecting types
3. Study drilling fluid parameters.
4. Understand the different well cementing practices and their role in oil and gas well.
5. Know about the mechanism of well cementing and design procedure and calculate cement slurry, surface power and other requirements.

Course Content

UNIT I **15 Hours**

Overview of Drilling Fluids: Clay chemistry and its application to drilling fluids, Types of clays, hydration, flocculation, aggregation and dispersion.

Classification, Types and applications of Drilling Fluids: Water based, oil based, emulsion based, polymer based, Surfactant based, Foam based and Aerated drilling fluids.

UNIT II **15 Hours**

Drilling Fluid Characteristics: Basic functions, properties, maintenance and treatments of drilling fluids.

Drilling fluid calculations.

UNIT III **15 Hours**

Rotary Drilling Hydraulics: Rheology of drilling fluids, Pressure loss calculations and Rig hydraulics.

Cementing, Cements & cement slurry: Objectives of cementing, oil well cements, Classification of cement, Slurry design, Slurry additives, Factors influencing cement slurry design, Cementing equipments.

UNIT IV **15 Hours**

Cementing Methods: Primary cementing, Stage cementing, Liner cementing, Plugging, Squeeze Cementing techniques in practice. Deep well cementing, Characteristics of good quality cementation. Cementing calculations.

Suggested Readings:

1. Gatlin, C. (1960). *Petroleum Engineering: Drilling and Well Completion.* Prentice Hall.
2. Azar, J. J. & Samuel, G.R. (2007). *Drilling Engineering.* Penn Well Corporation.
3. French Oil and Gas Industry Assn. (1982), *Drilling Mud and Cement Slurry Rheology Manual.* Gulf Publishing Company.
4. Smith, P.K. (1976).*Cementing (2nd Edition).* SPE Pulications.
5. Caenn, R. & Darley, H.C.H. (2011). *Composition and Properties of Drilling and Completion Fluids.* Gulf Professional publishing.
6. ASME Shale Shaker Committee. (2004). *Drilling Fluids Processing Handbook.* Gulf Professional publishing
5. McCabe, W.L., Smith, J.C., & Harriot, P. (2005). *Module Operations of Chemical Engineering (7th Edition).* McGraw Hill.

SEMINAR-V

Course Title : PROCESS INSTRUMENTATION AND CONTROL

Course Code: BPE502

L	T	P	Credits
3	1	0	4

Total hours

60

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

1. Analyze first and second order systems
2. Study linear and non-linear systems.
3. Analyze various types of controllers (P, PI & PID) and their transfer functions.
4. Understand a given system for its frequency response and stability.
5. Know about the process, identification and control strategies such as cascade, ratio and feed forward control

Course Contents

UNIT I **15 Hours**

Instrumentation: Classification of measuring instruments, Elements of measuring instruments, Static and dynamic characteristics of instruments, Error analysis. Instruments for the measurement of temperature, Pressure, Liquid level, and moisture content, Instruments and sensors for online measurements.

UNIT II **15 Hours**

Process Control Introduction:

General Principles of process control, Time domain, Laplace domain and frequency domain, dynamic and control.

Linear Open loop Systems: Laplace domain analysis of first and second orders systems, linearization,Response to step, pulse, impulse and ramp inputs, Physical examples of first and second order systems such as thermocouple, level tank, U-tube manometer etc., Interacting and non-interacting systems distributed and lumped parameter systems, dead time.

UNIT III **15 Hours**

Linear Closed-loop Systems: Controllers and final control elements, Different types of control valves and their characteristics, Development of block diagram, Transient response of simple control systems, Stability in Laplace domain, Root locus analysis.

Frequency Response: Frequency domain analysis, Control system design by frequency response, Bode stability criterion, Different methods of tuning of controllers.

UNIT IV **15 Hours**

Process Applications: Introduction to advanced control techniques as feed forward, feedback, cascade, ratio, Smith predictor, Internal model control, Digital computer control, Direct digital control and supervisory control and data acquisition, Multivariable control, Applications to equipments such as heat exchangers, distillation columns, reactors etc.

Suggested Readings:

1. Eckman, D.P. (1974). *Industrial Instrumentation.* Wiley Eastern.
2. Harriott, P. (2001). *Process Control*, McGraw Hill.
3. Patranabis, D. (2001). *Principles of Process Control (2nd Edition)*. McGraw Hill.
4. Pollard. (1971). *Process Control for Chemical and Allied Industries.* Butterworth Heinnemann.
5. Weber, T.W. (1988). *An Introduction to Process Dynamics &Control.*Kreiger Publishing Co.
6. Coughanour, D. R. (2009). *Process System Analysis & Control.* McGraw Hill.
7. Coughanour, D. R. & Leblanc, S. (2009). *Process System Analysis and Control (3rd Edition).* McGraw Hill.
8. Stephanopoulos, G. (1990). *Chemical Process Control - An Introduction to Theory and Practice (1st Edition).* Prentice Hall of India.
9. Peacock, D.G. & Richardson, J.F. (1994). Chemical Engineering, (Volume 3, 3rd Edition). Butterworth Heinemann.
10. Bequette, B.W. (2003). *Process Dynamics: Modeling, Analysis and Simulation.* Prentice Hall.

SEMESTER-V

Course Title : STRENGTH OF MATERIALS
Course Code: BPE503

L	T	P	Credits
2	1	0	3

Total hours 45

Course Outcomes: On successful completion of this course, students would be able to:

1. To understand the basic concepts of the stresses and strains for different materials and strength of structural elements.
2. To know the development of internal forces and resistance mechanism for one dimensional and two dimensional structural elements.
3. To analyse and understand different internal forces and stresses induced due to representative loads on structural elements.
4. To analyse and understand principal stresses due to the combination of two dimensional stresses on an element and failure mechanisms in materials.
5. To evaluate the behavior of torsional members, columns and struts.

Course Content

UNIT I **10 Hours**

Mechanical Properties and Testing: Concept of strength, yield strength, ultimate strength hardness, impact strength, ductility, brittleness, tensile, compressive, bending, torsion, hardness and impact tests.

Theory of Bending: Review of bending moment, shear force, bending and shear stresses, bending & shear stresses in composite beams.

UNIT II **15 Hours**

Unsymmetrical Bending: Principal axes, analytical and graphical methods, stresses due to unsymmetrical bending 7-polygen deflections of beams under unsymmetrical bending.

Slopes and Deflections of Beams: Slopes and deflections in beams and cantilevers, calculation of slopes and deflections using double integration moment area theorems and Macaulay's method.

UNIT III **10 Hours**

Theories of failure: Strain energy, various theories of failure, their necessity and significance, graphical representation of theories of failure.

Torsion of shafts and springs: Torque, angle of twist and shear stresses in hollow and solid shafts with in elastic limit, assumptions intrusion, power transmitted by a shafts, analysis of close coil spring subjected to axial load couple. Shafts subjected to torsion

UNIT IV **10 Hours**

Thin Cylinders/ spheres: Thin cylinders subjected to internal pressure, circumferential and longitudinal stress and strains, maximum shear stress, increase in diameter and volume, thin spheres subjected to internal pressure.

Columns: Columns under Uni-axial loads, buckling of columns slenderness ratio and conditions, derivations of Euler's formula for elastic – buckling load, equivalent length, Rankin – Garden empirical formula.

Suggested Readings

1. Timoshenko, S. (2002).*Strength of Materials Vol-I: Elementary Theory and Problems*. CBS Publishers, 3rd Edition.

2. Vazirani V.N. &Ratwani. (2016). *Analysis of Structures Vol. I*. Khanna Publishers.

3. Bansal, R.K. (2010). *Strength of Materials*. Luxmi Publishers, 4th Edition.

4. Popov, E. P. (1999).*Engineering Mechanics of Solids*. Prentice Hall, 2nd Edition.

SEMESTER-V

Course Title : MASS TRANSFER
Course Code: BPE504

L	T	P	Credits
2	1	0	3

Total hours 45

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

1. Apply the principles of mass transfer.
2. Understand the concepts of Diffusion and various laws governing diffusion in solids, liquids & gases.
3. Know about the concept of mass transfer coefficients in designing of co-current, counter-current & continuous-contact columns.
4. Acquire basic knowledge about the processes involving gas absorption, drying of solids, humidification operations
5. Acquire knowledge aboutdehumidification equipment , water cooling towers & spray chambers

Course Content

UNIT I **10 Hours**

Introduction: Importance and classification of mass transfer operations in Chemical Engineering.

Diffusion: Diffusion in gases and liquids, Fick's First law of diffusion, Mass balance in simple situations - with and without chemical reaction.Diffusion in solids, diffusion through porous solids and polymers, unsteady state diffusion

UNIT II **15Hours**

Interphase Mass transfer: Theories of Mass transfer, Individual and overall mass transfer coefficients, Convective mass transfer.

Distillation: Roult's law, ideal solutions, x-y & H-x-y diagrams, Flash vaporisation and condensation. Differential distillation, Batch distillation, Rayleigh equation, Steam distillation, Binary distillation, McCabe-Thiele and Ponchon-Savarit method, Total reflux, minimum and optimum reflux ratios, Efficiency – local, overall and Murphree efficiency.

UNIT III **10 Hours**

Liquid-liquid extraction & Leaching: Extraction equipment, equilibrium diagram. Choice of solvent. Single stage and multistage counter-current extraction with/without reflux. Continuous contact extractors. Leaching equipment and equilibrium. Single stage and multistage cross current and counter current leaching.

UNIT IV **10 Hours**

Other Mass Transfer Operations:

- **Adsorption** Types, nature of adsorbents, Adsorption equilibria- single species- Langmuir, Freundlich isotherms, Adsorption operations –single stage and multi stage, Adsorption column sizing
- **Crystallization:** Equilibria and yields, Methods of forming nuclei in solution and crystal growth,equipments- vacuum crystallizer, Draft tube-baffle crystallizer.
- **Drying of solids:** Rate of drying curves, Through circulation drying, Continuous drying, Types of dryers.
- **Humidification operations:** VLE& Enthalpy, Reference substance plots, vapour gas mixtures, concept of adiabatic saturation, psychometric charts, adiabatic operations-humidification operations and water cooling operations. Dehumidification Equipments: water cooling towers & spray chambers

Suggested Readings:

1. Treybal, R.E. (2001). *Mass Transfer Operations (3rd Edition)*. McGraw Hill.
2. Sherwood, T. K., Pigford, R.L., & Wilke, C.R. (1975). *Mass Transfer, Chemical Engineering Series*. McGraw Hill.
3. Backhurst, J.R., Harker, J.H., Coulson, J.F., & Richardson, J.M., (1999). *Chemical Engineering- Volume 1 (3rd Edition)*. Butterworth Heinemann.
4. Skelland, A.H.P. (1985). *Diffusional Mass Transfer*. Kreiger Publishing Co.
5. McCabe, W.L., Smith, J.C., & Harriot, P. (2005). *Module Operations of Chemical Engineering (7th Edition)*. McGraw Hill.

SEMESTER-V

Course Title : ENVIRONMENTAL STUDIES
Course Code: BPE505

L	T	P	Credits
2	0	0	2

Total hours 29

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

1. Study various environmental variables and interpret results.
2. Get elementary knowledge about the concept of Ecosystem in real life
3. Learn about solutions to environmental problems related to resource use and management.
4. Compare the results of scientific studies of environmental problems.
5. Acquire basic knowledge of the various types of pollutants and their effects on human life.

Course Content

UNIT I **6 Hours**

Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.

Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

UNIT II **7 Hours**

Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity.

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution, Pollution case studies.

UNIT I **10 Hours**

Disaster Management: Floods, earthquake, cyclone and landslides.

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Waste land reclamation. Consumerism and waste products.Environment Protection

Act.Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness.

UNIT IV **6 Hours**

Human Population and the Environment: Population growth, variation among nations. Population explosion–Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS.Women and child Welfare.Role of Information Technology in Environment and human health.Case studies.

Suggested Readings:

1. Agarwal, K. C. (2001). *Environment Biology*. Bikaner: Nidi Publications Limited.
2. Jadhav, H. &Bhosale, V.M. (1995). *Environment Protection and Laws*. Delhi: Himalaya Publication House.
3. Rao, M. N. &Datta, A.K. (1987). *Waste Water Treatment.* Oxford & IBH Publications Co. Pvt. Ltd.
4. Goyal, A. (2020). *Environmental Studies*. Notion Press, New Delhi.

SEMESTER-V

Course Title : Process Control Laboratory
Course Code: BPE506

L	T	P	Credits
0	0	2	1

Total hours 15

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

1. Study the liquid level tank, interacting / non-interacting tank dynamics.
2. Solve the first order or higher order differential equations
3. Acquire basic knowledge about types of control valves.
4. Study of control valve characteristics.
5. Study basics of non ideal flow.

List of Experiments

1. Calibration of temperature, pressure, flow and composition measuring instruments.
2. Study of process dynamics of a liquid level tank
3. Study of process dynamics of interacting / non-interacting tank
4. Study of process dynamics of some processes.
5. Investigation of the operation of pneumatic and electronic controllers with proportional integral derivative action.
6. To determine the best setting of a controllers with controlling an actual process.
7. To solve first order or higher order differential equations with the help of an analog computer/ computer and to study control problems by simulation.
8. To control the level of liquid in the process tank using multi process trainer for different controller settings.
9. Study of control valve characteristics.
10. Study of Programmable Logic Control system.

SEMESTER-V

Course Title : Strength of Materials Lab
Course Code: BPE507

L	T	P	Credits
0	0	2	1

Total hours 15

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

1. Analyze the tensile and compressive strength of a specimen for applying in a practical design based project work.
2. Determine the hardness, impact strength, fatigue strength to analyze the application of a specific material for a given design requirements for different loading conditions of structures or machines.
3. Understanding the bending in beams and to analyze the bending stresses which further build the foundation of using modern analysis software.
4. Evaluate the capacity of a material to withstand torsional stresses for a safe and sustainable design of machine elements.

List of Experiments **15 Hours**

1. Determination of yield points, tensile strength and ultimate strength of mild steel specimen.
2. Determination of compressive strength of mild steel specimen.
3. Bending test of mild steel specimen.
4. Tensile test of a specimen of brittle material.
5. Torsion test of a mild steel specimen.
6. Determination of Brinell hardness of ductile and brittle materials.
7. Determination of Rockwell Hardness of a hard material.
8. Performance of Vickers's Hardness test.
9. Determination of Impact strength of a specimen.

SEMESTER-V

Course Title : MASS TRANSFER LAB
Course Code: BPE508

L	T	P	Credits
0	0	2	1

Total hours 15

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

1. Use the fundamental concepts of mass transfer and use those concepts to real engineering problems.
2. Learn the concepts of diffusion and various laws governing diffusion in solids, liquids & gases.
3. Operate equipment based upon processes involving gas absorption, drying of solids,adsorption, crystallization, distillation, liquid-liquid extraction and leaching

List of Experiments **15 Hours**

1. To find out the critical moisture content of the given material and to find out the equations for constant and falling rate period of drying.
2. Determination of liquid hold up in a packed column.
3. To find the mass transfer coefficient for the vaporisation of organic vapour to air.
4. To verify the Rayleigh's equation for batch distillation.
5. To find the height equivalent to a theoretical plate and height of a transfer unit for the packed distillation column under total reflux.
6. To find the yield of crystals using batch crystallizer
7. To find the efficiency of rotary drier using a granular solid
8. To find the efficiency of a distillation column.
9. To study the adsorption characteristics and plot adsorption isotherm.
10. To find the yield of a natural oil by leaching from biomass.
11. To study liquid-liquid extraction in a packed column.
12. To determine mass transfer coefficient from a wetted wall column.

SEMESTER-V

Course Title : NATURAL GAS ENGINEERING
Course Code: BPE509

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Understand the formation, composition and utilization of natural gas.
2. Compare the different natural gas processing processes.
3. Study the natural gas flow concept in pipeline and exposure of different flow measurement devices.
4. Acquire knowledge about the natural gas underground storage and converting the natural gas in different valuable products.
5. Know about the distribution parameters of gas.

Course Content

UNIT I **10 Hours**

Introduction: Composition, properties, fields & reserves in India and energy scenario; major NG producing industries of India and their contribution to Indian economy; techniques of utilization.

UNIT II **15 Hours**

Gas Processing: Conventional and advanced separation techniques; free liquid removal; low temperature separation; dehydration processes: chemical and refrigeration system. Natural gas sweetening: amine process; sulphur recovery; LPG, LNG & CNG systems. Specifications of NG for transportation in pipelines, NG Utilization**:** uses, underground storage, conservation & concept of peak shaving etc. CBM, NG hydrates & in-situ coal gasification, conversion of gas to liquid (GTL); NGL: process, system, storage, transportation and utilization.

UNIT III **10 Hours**

Transportation of NG: Compression calculations; gas stations & transmission; city gas distribution system; gas flow measurement: orifice meter, turbine meter, principles and performance; compressor sizing.

UNIT IV **10 Hours**

Marketing, retailing and gas trading: Underground storage, System and production performance. CBM, NG hydrates & in-situ coal gasification, conversion of gas to liquid (GTL).

Suggested Readings:

1. Bradley, H.B. (1987). *Petroleum Production Handbook.* SPE Publication.

2. Skimmer, D.R. (1982). *Introduction to Petroleum Production, Volume-1, 2 & 3.* Gulf Publishing.
3. Katz, D.L. & Lee, R.L. (1990). *Natural Gas Engineering-Production and Storage.* McGraw-Hill.
4. Kumar, S. (1987). *Gas production Engineering*. Gulf Publishing.

SEMESTER-V

Course Title : MATERIALS SCIENCE & ENGINEERING
Course Code: BPE510

L	T	P	Credits
3	0	0	3

Total hours 45

Course Learning Outcomes: On successful completion of this course, students would be able to:
1 .Appreciate the necessity of engineering materials, Smart Sensors and its applications in various fields.
2. Identify possible cause of failure due to fatigue and Creep.
3. Demonstrate the knowledge of nucleation, Crystal growth, Solid solution and Phase diagrams.
4. Appreciate the significance and applications of Various heat treatment processes.
5. Explain the definition and classification and fabrication processes of composite materials.

Course Content

UNIT I **10 Hours**

Mechanical Behavior : Stress- Strain diagram showing ductile and brittle behavior of materials, Linear and non-linear elastic behavior and properties, mechanical Properties in plastic range, Yield strength offset yield strength, ductility, ultimate tensile strength, toughness plastic deformation of single crystal by slip and twinning.Atomic diffusion, flick's laws of Diffusion, Factors attaching the Diffusion

Fracture: Types, creep: Description of the phenomenon with examples, 3 stages of creep properties, stress relaxation fatigue: types of fatigue lauding with examples,Mechanism of fatigue, Fatigue properties, Fatigue testing and S-N diagram.

UNIT II **15 Hours**

Heat Treating of metals: TTT curves, Continuous cooling curves, Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austemparing,hardenability, Surface hardening methods like Carburizing, Cyaniding Nitriding, flame hardening and induction hardening, age hardening of aluminum and copperalloys.

Ferrous and non ferrous materials: Properties composition and use of grey cush iron, malleable iron, SG iron and steel. Copper alloys- brasses and bronzes, aluminum alloys Al-Cu, Al-Si, Al-Zn alloys

UNIT III **10 Hours**

Solidification and phase diagram: Mechanism of solidification, Homogenous and Heterogeneous nucleation. Cristal Growth, Cast metal strictures, Phase diagram. Solid solutions, Substitution and Interstitial solid solution, Hume rothary rule, Intermediate phase, construction of equilibrium diagram involving complete and partial solubility, lever rule, Gibb's phase rule.

Composite materials: Definition, classification, type of matrix materials andreinforcements, advantages and application of composites**.**

Processing of FRP Composites: Layup and curing, fabricating process, open and closed mould process, hand layup technique; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

UNIT IV **10 Hours**

Metal Matrix Composites: Reinforcement materials, types, characteristics and selection, base metals selection. Need for MMC's and its application

Smart Materials: Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magnetoelectric Materials. Magnetorheological Fluids, Electrorheological Fluids, Shape Memory Materials, Fiber-Optic Sensors. Smart Sensor, Actuator and Transducer Technologies: SmartSensors:Accelerometers; Force Sensors; Load Cells; Torque Sensors; Pressure Sensors;Microphones; Impact Hammers.

Suggested Readings

1.Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.

2. Mechanics of Composite Materials, Second Edition, Autar K. Kaw, CRC Press, 2005.

3. Smart Materials and Structures - M. V. Gandhi and B. So Thompson - Chapman & Hall, London; New York -1992 (ISBN: 0412370107).

4. Materials Science and Engineering,William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001

5. Materials Science, Shackleford.,& M. K. Muralidhara, Pearson Publication – 2007.

6. "Material Science & Metallurgy For Engineers", Dr. V.D. Kodgire& S. V. Kodgire, Everest Publication.

7. "Mechanical Behavior & Testing Of Materials", A. K. Bhargava, C.P. Sharma.PHI Learning Private Ltd.

SEMESTER-V

Course Title : PIPELINE ENGINEERING
Course Code: BPE511

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Study theory and different formulae of the flow of fluids in oil / gas pipelines
2. Understand construction of pipelines, materials, project specifications, general equipment specifications.
3. Apply application of corrosion protection and control techniques
4. Know about hydrates, wax & scale - formation and prevention.
5. Acquire knowledge about city distribution network of oil / gas.

Course Content

UNIT I **10 Hours**

Introduction: Objective and scope of pipeline as a means of fluid transportation with special reference to crude oil/gas/refined products, Economics of Pipeline transportation.

Design of Pipeline: Factors influencing oil, gas and refined products as pipeline design; Hydraulic surge and water hammer; specific heat of liquids; river crossing; pipe size and station spacing etc.

UNIT II **15 Hours**

Theory and different formulae of the flow of fluids in oil/gas pipelines; basic equations for the flow of fluids through pipes; different flow equations for laminar and turbulent flow of compressible and incompressible fluids (Newtonian); Introduction to the flow of Non- Newtonian fluids through pipes; multiphase flow and loop pipelines.

Construction of pipelines; materials; project specifications,general equipment specifications.

UNIT III **10 Hours**

Corrosion protection and Control; Design of cathodicprotection system, Pipeline automation. Module 6: Offshore Pipeline: Design and control of Sag and Overbend; Description of stinger; and Riser, articulated stinger, construction of offshore pipeline.

UNIT IV **10 Hours**

Hydrates, wax & scale - formation and prevention. Crude conditioning and use of additives to improve flow conditions.

City distribution network of oil/gas. Lease and custody transfer.

Suggested Readings:

1. Nayyar, M.L.(1992).*Piping Handbook. (6th Edition).* Mc Graw-Hill.
2. Johan J. M.(1992) .*Piping Design Handbook. (1st Edition).*CRCPress.
3. Luyben, W. L.(1989*). Process Modeling Simulation and Control for Chemical Engineers (2nd Edition).* Mc Graw Hill.

SEMESTER-VI

Course Title : OFFSHORE DRILLING AND PRODUCTION PRACTICES
Course Code: BPE601

L	T	P	Credits
3	0	0	4

Total hours 60

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

1. Understand the complexity of operating in a typical offshore environment in different parts of the world.
2. Study the types of offshore platforms.
3. Know about the installation of conductors, risers and landing bases up to the completion of drilling from different types of platforms in or stepwise manner.
4. Acquire knowledge about the storage and transportation of extracted petroleum.
5. Outline the challenges in deep water and their possible solutions.

Course Content

UNIT I **15 Hours**

Sea states and weather: Meteorology, oceanography. Sea - bed soil condition. Wave condition. Wave - structure interaction.

UNIT II **15 Hours**

Off-shore structures: Fixed platform, jack-up rig: design and operational features mobile units; semi-submersible, floating structures, description and installation, station keeping, mooring and dynamic positioning system.

UNIT III **15 Hours**

Off-shore drilling: Well head and sea floor connection; conductor and riser. Off-shore well completion: Platform and sub-sea completion system, well control and work-over system.

UNIT IV **15 Hours**

Sub-sea technology in deep water – use of divers and robots. Off-shore production: Platform oil and gas processing, water and gas injection system. Storage for oil; SPM & SBM system. Deep water technology: use of remote operating vehicle (ROV).

Suggested Readings:

1. El-Reedy, M.A. (2012). *Offshore Structures: Design, Construction and Maintenance.* Gulf professional Publication.

2. Chakraborty, S.K. (2006). *Handbook of Offshore Engineering,Volume-I and II.* Elsevier.

SEMESTER-VI

Course Title : NUMERICAL METHODS
Course Code: BPE602

L	T	P	Credits
3	0	0	4

Total hours 60

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

1. Apply numerical methods to find solution of algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations
2. Use various interpolation methods and finite difference concepts to find roots of polynomial equations using numerical analysis.
3. Differentiate numerical integration and differentiation and Work out on numerical differentiation and integration whenever and wherever routine methods are not applicable
4. Explain how to interpolate the given set of values and the curve fitting for various polynomials
5. Work numerically on the ordinary differential equations using different methods through the theory of finite differences and Runge-Kutta method.

Course Content

UNIT I **15 Hours**

Introduction & Error analysis: Introduction to Numerical methods and its significance in engineering, classification of errors, significant digits and numerical stability.

Linear Algebraic Equations: Cramer's rule, Gauss Elimination and LU Decomposition, Gauss-Jordan elimination, Gauss-Seidel and Relaxation Methods.

UNIT II **15 Hours**

Non Linear Algebraic Equations: Single variable successive substitutions (Fixed Point Method), Multivariable successive substitutions, single variable Newton-Raphson Technique, Multivariable Newton-Raphson Technique.

Eigen values and Eigen vectors of Matrices: FaddeevLeverrier's Method, Power Method.

UNIT III **15 Hours**

Function Evaluation: Least squares curve-fit (Linear Regression), Newton's interpolation formulae (equal intervals), Newton's Divided Difference Interpolation Polynomial, Lagrangian Interpolation Unequal intervals).

Numerical Differentiation, Numerical Integration or Quadratures (Trapezoidal, Simpson's 1/3 and 3/8 rules), Extrapolation Technique of Richardson and Gaunt.

UNIT IV **15 Hours**

Ordinary Differential Equations (ODE-IVPs) and partial differential Equations: The Finite difference Technique, Runge-Kutta method

Suggested Readings:

1. Gupta, S.K. (2009). *Numerical Methods for Engineers (2nd Edition).* New Age International Publishers.
2. Jain, M.K., Iyengar, S.R.K., &Jain, R.K. (2012).*Numerical Methods for Scientific and Engineering Computation.* New Age International.
3. Finlayson, B.A. (1980).*Nonlinear Analysis in Chemical Engineering.*MCGraw Hill
4. Villadsen, J. and Michelsen, M.L. (1978).*Solution of Differential Equation Models by Polynomial Approximation.* Prentice Hall.
5. Rice, R.G. & Do Duong, D. (1995).*Applied Mathematics and Modelling for Chemical Engineers.* John Wiley.
6. Sastry, S.S. (2005).*Introductory Methods of Numerical Analysis (4th Edition).* Prentice Hall of India.

SEMESTER-VI

Course Title : PROBABILITY AND STATISTICS
Course Code: BPE603

L	T	P	Credits
3	0	0	4

Total hours 45

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

1. Describe the Probability and its distributions such as binomial distributions, poisson distribution and basic laws of total probability and compound probability in statistics.
2. Categorize appropriate sampling processes such as random sampling, large sample tests of means and proportion. *t*-student, (chi square) and *F* distributions (without derivation) and testing of hypothesis based on them.
3. Recall the methods of classifying and analyzing data relative to single variable and multiple variables.
4. Distinguish between the practical purposes of a large and a small sample and understand that correlation coefficient is independent of the change of origin and scale
5. Use different kinds of distribution of probability and statistics to solve real life problems like Discrete uniform, binomial, geometric, negative binomial, hyper geometric, Poisson.

Course Content

UNIT I **10 Hours**

Algebra of Sets: sets and classes, limit of a sequence of sets, rings, sigma-rings, fields, sigma-fields, monotone classes.

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence, problems. (5 hours)

UNIT II **10 Hours**

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quantiles, Markov inequality, Chebyshev's inequality, problems. (5 hours)

UNIT III **10 Hours**

Special Distributions: Discrete uniform, binomial, geometric, negative binomial, hyper geometric, Poisson, continuous uniform, exponential, gamma, Weibull, Pareto, beta, normal, lognormal, inverse Gaussian, Cauchy,

double exponential distributions, reliability and hazard rate, reliability of series and parallel systems, problems.
Function of a random variable, problems.

Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation and regression, independence of random variables, bivariate normal distribution, problems.

Transformations: functions of random vectors, distributions of order statistics, distributions of sums of random variables, problems.

UNIT IV **15 Hours**

Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions, problems.

Descriptive Statistics: Graphical representation, measures of locations and variability.

Estimation: Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample and two sample problems of normal populations, confidence intervals for proportions, problems.

Testing of Hypotheses: Null and alternative hypotheses, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neyman-Pearson Fundamental Lemma, tests for one sample and two sample problems for normal populations, tests for proportions, Chi-square goodness of fit test and its applications, problems.

Suggested Readings:

1. Rohatgi, V.K.,Saleh, A.K. Md. E.(2008).*An Introduction to Probability and Statistics(2nd Edition).* Wiley and sons.
2. Milton, J.S., Arnold J.C.(2017).*Introduction to Probability and Statistics(4th Edition).* McGraw Hill Education.
3. Larson,H.J.(1969).*Introduction to Probability Theory and Statistical Inference(3rd Edition).*
4. Ross,S.M.(2013).*A First Course in Probability (9th Edition).* Pearson Education India.

SEMESTER-VI

Course Title : BASICS OF RESEARCH
Course Code: BPE604

L	T	P	Credits
2	0	0	2

Total hours 45

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

1. Identify and discuss the role and importance of research in the social sciences.
2. Identify and discuss the issues and concepts salient to the research process.
3. Choose the appropriate research design and develop appropriate research hypothesis for a research project.
4. Discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.
5. Describe the appropriate statistical methods required for a

Course content

UNIT I **10 Hours**

Research: Objectives of Research, Research Types, Research Methodology, Research Process – Flow chart, description of various steps, Selection of research problem.

UNIT II **10 Hours**

Research Design: Meaning, Objectives and Strategies of research, different research designs, important experimental designs, Completely randomized, Randomized block, Latin Square, Factorial Experimental Design.

UNIT III **10 Hours**

Data Collection Methods: Data Collection Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research.

UNIT IV **15Hours**

Sampling Methods: Different methods of Sampling: Probability Sampling methods, Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling and Multistage Sampling. Non Probability Sampling methods, Sample size.Technical Writing and reporting of research.

Types of research report: Dissertation and Thesis, Report Format – Cover page, introductory page, Text, Bibliography, Appendices, Typing instructions, Oral Presentation. Research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism

Transactional Mode: Video based Teaching**,** Collaborative Teaching**,** Cooperative Teaching**,** Quiz, E-Team Learning.

Suggested Readings:

1.C. R. Kothari, GauravGarg.(2004).*Research Methodology Methods and Techniques.*New Age International publishers.

2. Ranjit Kumar.(2005).*Research Methodology: A StepbyStep Guide for Beginners.*SAGE.

3. Donald Cooper, Pamela Schindler.*(*2006*). Business Research Methods.*McGraw-Hill.

4. Creswell, John W. (2013).*Research design: Qualitative, quantitative, and mixed methods approaches.* Sage publications,

SEMESTER-VI

Course Title : NUMERICAL METHODS LAB
Course Code: BPE605

L	T	P	Credits
0	0	2	1

Total hours 15

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

1. Apply basics of numerical methods in real applications.
2. Evaluate roots of polynomial equations using numerical analysis.
3. Understand numerical integration and differentiation.
4. Know about the use of computer in numerical methods applications to solve engineering problems.
5. Know about Application of Newton's formula for numerical differentiation

List of Experiments **15 Hours**

1. Solution of a system of linear equations in unknowns by Gaussian elimination.
2. Gauss-Seidel iterative method to solve a linear system of equations.
3. To find the inverse of matrix by Gauss-Jordan method.
4. Application of Faddeev- Leverrier's method.
5. Method for finding dominant Eigen value and corresponding Eigen vectors by power method.
6. Solution of nonlinear equation by Newton Raphson method.
7. Application of Newton's formulae for interpolation.
8. Application of Lagrange polynomial interpolation formula.
9. Application of Newton's formula for numerical differentiation.
10. Numerical integration by Trapezoidal rule.
11. Numerical integration by Simpson's rules.
12. Solution of an O.D.E. by RungeKutta Methods.
13. Application of finite difference technique

SEMESTER-VI

Course Title : OIL AND GAS TRANSPORTATION SYSTEM
Course Code: BPE606

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Study the transportation of petroleum & its products.
2. List and explain the various parameters related to oil transportation through pipeline.
3. Understand the flow of oil through pipeline.
4. Know about the control arrangement of pipelines.
5. Acquire knowledge about the distribution parameters of gas.

Course Content

UNIT I **15 Hours**

Road and rail transport of crude oil & product. Tanker design, safety features. Oceanic transport of oil and liquefied natural gas: design of ocean going tankers and safety features.

Pipe line transport of oil and gas: Route selection, pipe line construction process and equipment: trenching, aligning, connecting pipes, corrosion protection, lowering & back filling.

UNIT II **10 Hours**

Flow of oil and gas through pipelines. Pressure drop calculation, types, sizing and location of pumps and compressor. Instrumentation and control.

UNIT III **10 Hours**

Flow measurement and control arrangement. Corrosion in pipelines: Types, chemical and electro-chemical process; coating, cathodic protection principle and design.

UNIT IV **10 Hours**

Pipe line branching: Gas distribution control. Offshore pipe line: Sag and overbend; stinger and riser, under-water welding.

Suggested Readings:

1. Liu, H. (2003*). Pipeline Engineering (1st Edition).*CRC Press.
2. Antaki, G.A. (2003). *Piping and Pipeline Engineering: Design, Integrity and Repair (1st Edition).*CRC Press.

SEMESTER-VI

Course Title : COAL BED METHANE AND GAS HYDRATES
Course Code: BPE607

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Know about formation and properties of coal bed methane. Present status of coal bed methane
2. Know hydro-fracturing of coal, seam activation of well
3. Acquire knowledge about drilling and completion of gas hydrate wells, prevention & control of gas hydrates, gas hydrates accumulation in porous medium
4. Know about gas hydrates accumulation in porous medium. Gas extraction from gas hydrates.
5. Understand the uses and application of coal bed methane and gas hydrates

Course Content

UNIT I **15 Hours**

Formation and properties of coal bed methane. Present status of coal bed methane. Formation and properties of coal bed methane. Exploration & Evaluation of coal bed methane. Drilling, completion and logging of coal bed methane wells. Hydro-fracturing of coal, seam activation of well. Testing of coal bed methane wells.

UNIT II **10 Hours**

Introduction and present status of gas hydrates. Formation and properties of gas hydrates. Exploration and evaluation of gas hydrates.

UNIT III **10 Hours**

Drilling and completion of gas hydrate wells. Prevention & control of gas hydrates. Gas hydrates accumulation in porous medium. Gas extraction from gas hydrates.

UNIT IV **10 Hours**

Uses and application of gas hydrates.

Suggested Readings:

1. John, C.(2003). *Natural Gas Hydrates. A guide for engineers(3rd Edition).*Gulf Publications.
2. Ali, F., Jones, S. A. &Meldau R. F.(1997).*Practical Heavy Oil Recovery*.SPE.

3. Downey, M. W., Morgan, W. A. &Threet, J. C. (2001).*Petroleum Provinces of Twenty First Century.* American Association of Petroleum Geologists.
4. Warner, H.R. (2007).*Emerging and Peripheral Technologies(6th Edition).*Petroleum Engineering Handbook.

SEMESTER-VI

Course Title : OIL & GAS MARKETING AND RESOURCE MANAGEMENT
Course Code: BPE608

L	T	P	Credits
3	0	0	3

Total hours 45

Course Outcomes: On successful completion of this course, the students will be able to
1. Know the structure of oil and gas industry
2. Marketing in oil and gas sector

Course Content

UNIT I **15 Hours**

Introduction: The development of Oil & Gas Industry, Structure of Oil & Gas Industry,
Introduction to Indian Oil & Gas Industry, India hydrocarbon vision 2050. Petroleum resource classification, Analysis of resource management.
Natural Gas: What is Natural Gas, Measuring Natural Gas, Pipeline quality Natural Gas. Demand, Supply & Storage of Natural Gas: Gas Production, Sources of demand in India, Supply system, Pipeline operations & network, Storage of Natural Gas, Liquified Natural Gas Plant & Operations, Gas Scale pattern in India, Gas regulations in India, Gas trading, gas pricing.

UNIT II **10 Hours**

Coal Bed Methane: Introduction, Present status of Coal Bed Methane, CBM storage and scale, CBM pricing in India. Crude Oil: Crude oil specification, measuring/Custody transfer of crude Oil, Crude Oil transportation, Crude Oil production in Indi, Crude Oil Refineries, products from Crude Oil.

UNIT III **10 Hours**

International & National Institutions of Oil & Gas: OPEC, OECD, OIDB, DGH, PNGRB, CHT, PII, PPAC, PCRA. Petroleum Contracts: NEPL- Role & Background, Types of Contracts and fiscal components, production sharing contracts in India, Crude Oil trading and pricing, CBM Contracts and Shale Gas Contracts.

UNIT IV **10 Hours**

Trade practices & Taxation: Norms on various trade practices, Element of Petroleum Development Policy, Financial and taxation issues. Risk Management: Source of risk, managing risks by risk reduction, diversification, and uncertainty and decision analysis by decision tree.

Suggested Readings:

1.Werner,S.(2016). *Managing Human Resources in the Oil & Gas.* PennWell Corp.

2. Colombano, A.(2017).*Petroleum Refining & Marketing.*

SEMESTER-VI

Course Title : ENHANCED OIL RECOVERY
Course Code: BPE609

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Study principles and Mechanism of terms related to oil recovery.
2. Know about water flooding and properties.
3. Understand various chemical flooding and their applications.
4. Study miscible displacement processes and their application.
5. Understand thermal recovery processes and their applications.

Course Content

UNIT I **10 Hours**

Principles and Mechanism. Screening criteria, macroscopic displacement of fluids: Areal sweep efficiency. Vertical sweep efficiency Displacement efficiency, mobility ratio, well spacing.

UNIT II **10 Hours**

Water flooding in reservoir: Equation of motion. Continuity, solution methods, Pattern flooding, recovery etc., permeability heterogeneity.

UNIT III **15 Hours**

Chemical flooding: Polymer flood; mobility control in-situ permeability modification, foam flooding; WAG process. Surfactant flooding, miscellar/polymer flooding, micro emulation phase behavior, wettability modification, Alkaline flooding.

UNIT IV **10 Hours**

Miscible displacement processes – miscibility condition, high pressure gas injection, enriched gas injection, LPG flooding, carbon dioxide flooding, alcohol flooding.

Thermal Recovery processes: Hot water flooding, steam flooding, cyclic steam injection, in-situ combustion, air requirement; combustion front monitoring, microbial oil recovery. (5 hours)

Suggested Readings:

1. Bradley, H. B.(1992).*Petroleum Engineering Handbook(3rd Edition).* Society of Petroleum Engineers.
2. Lake L.(1989).*Enhanced Oil Recovery*. Prentice Hall.

3. Green, D. W. &Willhite, G. P.(2018).Enhanced *Oil Recovery(3rd Edition).*Society of Petroleum Engineers.

SEMESTER-VI

Course Title : DIRECTIONAL DRILLING
Course Code: BPE610

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. To Understand directional coordinates and techniques
2. Understand three-dimensional geometry of directional well profiles
3. Ability to check the profile of the progressive well and to correct the deflected well path
4. Acquire knowledge of well monitoring without interrupting the drilling progress
5. Gain Awareness of different bottom drive drilling systems and their applications

Course Content

UNIT I **15 Hours**

Objectives, Types of deflection tools, tool orientation, Directional well profiles, Well path deflection & correction.

Positive displacement motors and Turbo-drills - motor description, Power calculation and applications.

Auto-track and verti-track system. Rotary Steerable motors, Geo-steering tools.

UNIT II **10 Hours**

Horizontal well objectives and selection, Different profiles, Drilling techniques, Mud requirements & characteristics, casing and drill string requirements and completion programs.

UNIT I **10 Hours**

Slant Hole Drilling: Objectives and selections, Well profiles and applications. Down the hole well

Surveying: Well surveying objectives, surveying methods, Surveying Analysis methods and calculations for well coordinates.

UNIT I **10 Hours**

Objectives of MWD/ LWD, MWD tools, Telemetry system and data interpretation. Directional Drilling Problems and Their Remedies.

Suggested Readings:

1. Schlumberger. (2013).*Introduction to Directional Drilling*.
2. Neal J.A. (1985).*Drilling Engineering-A complete well planning approach*. Penn Well publishingCompany Tulsa Okhlama.
3. Rabia, H. (2017).*Well Engineering and Construction.*EntracConsulting.

SEMESTER-VI

Course Title : PROCESS ECONOMICS AND MANAGEMENT
Course Code: BPE611

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Investigate and prepare the balance sheet, income statement and estimation of capital investment, total product costs.
2. Acquire knowledge about the concept of interest cost, depreciation and taxes.
3. Outline profitability and replacement analysis.
4. Know about the general procedure for determining optimum conditions.
5. Study the concept of Intellectual Property Right (IPR) and patent system

Course Content

UNIT I **15 Hours**

Cost Estimation: Factors affecting investment and production costs, Capital investments - fixed investments and working capital. Cost indices. Estimating equipment costs by scaling 6/10 factor rule. Methods for estimation capital investment. Estimation of total product cost. Different costs involved in the total product for a typical chemical process plant.

Interest & Investment Costs: Types of interest (simple & compound interest), Nominal & Effective Rates of interest, Continuous interest, Present worth & discounts, perpetuities, capitalized costs, Interest & Investment costs.

Taxes & Insurance: Types of taxes and tax returns, Property taxes, excise taxes, income taxes, Types of Insurance & Legal Responsibility.

UNIT II **10 Hours**

Depreciation: Purpose of Depreciation as cost, Types of Depreciation, Depletion, Service life., Salvage value, Present value, Methods of Determining Depreciation , Straight- line method, Declining Balance Method, Sum of the years Digits method, Sinking Fund Method, Single Unit & Group Depreciation.

UNIT III **10 Hours**

Profitability: Profitability Alternative Investments & Replacement: Profitability standards, Mathematical methods of profitability evaluation: Rate of return on investment, Discounted cash flow method, Net Present worth, Capitalised costs, pay out period. Determination of Acceptable investment, Alternatives when an investment must be made, Alternative analysis by method of return on incremental investment, Alternative analysis incorporating minimum return as a cost, Replacements, Balance sheets & Income statement.

UNIT IV **10 Hours**

Optimum Design: General procedure for Determining optimum conditions, Procedure with one variable, Procedure with Two or More variables, Break even chart for production schedule and its significance for optimum analysis. Examples of optimum design in a Chemical Process Plant.

IPR and Patent Systems: Intellectual property, IPRs and its types, Patent claims, legal decision making process and ownership of tangible and intellectual property. Indian patent system, current IPR laws and legislations in India for IPR Documents required for filing patent, infringement of patents and remedies.

Suggested Readings:

1. Peters, M.S. &Timmerhaus, K.D. (2003). *Plant Design and Economics for Chemical Engineers (4th Edition).* McGraw Hill.
2. Ulrich, G.D. (1984). *A Guide to Chemical Engineering Process Design and Economics.* John Wiley.
3. Guthrie, K.M. (1974). *Process Plant Estimation, Evaluation and Control.* California: Craftsman Book Company.
4. Douglas. (1998). *Conceptual Design of Chemical Processes.* McGraw Hill.
5. Riestra, V. (1983). *Project Evaluation in Chemical Process Industries.* McGraw Hill.

SEMESTER-VI

Course Title : COMPUTER AIDED DESIGN
Course Code: BPE612

L	T	P	Credits
2	0	0	2

Total hours 29

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

1. Attain knowledge in art and design analysis, follow social and technological developments and propose contemporary approach to new research subjects.
2. Interrelate and interpret the past, today and future of design.
3. Think and express themselves in two and three dimensions.
4. Know basic concepts of visual realization, hidden line removal.
5. Acquire knowledge about process planning, tool path generation and verification, Design and Engg applications.

C**ourse Content**

UNIT I **7 Hours**

Introduction: Overview of conventional design & manufacturing process, computer's role in design, benefits of computer application, relation of CAD with CAM, history of CAD development, current trends in CAD. **CAD Hardware & Software:** Central processing unit, memory, input &output devices, types of computer systems, computer programming, general information of various software for CAD, types of file formats & their exchange, graphics standards**.**

UNIT II **8 Hours**

Geometric Modeling: Curve representation methods, surface representation methods, half spaces, boundary representation (B-rep), sweep representation, constructive solid geometry (CGS), solid manipulations, modeling facilities desired.

Transformations: Translation, rotation, scaling symmetry, reflection, homogeneous transformations, orthographic projections, axonometric projections, oblique projections, perspective transformation.

UNIT III **8 Hours**

Visual Realization: Basicconceptsofvisualrealization,hiddenlineremoval,hiddensurfaceremoval,shadingsurfacesandsolids visibility techniques, sorting coherence, hidden line removal for curved surface.

CAD and CAM integration: Introduction, part production cycle, manufacturing system, process, integration requirements, process planning, tool path generation and verification, Design and Engg. applications.

UNIT IV **7 Hours**

Introduction to Reverse Engineering and Rapid Prototyping

Introduction to Design and Engineering Applications: Geometry and mass property formulations.

Practice on Drafting and Modeling systems: Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling on available CAD packages.

Suggested Readings:

1. Groover&Zimmer. (2003).*CAD/ CAM. (1st Edition).* PrenticeHall.
2. Zeid,I.(2019). *CAD/ CAM.TheoryandPractice(2nd Edition).*McGrawHill.
3. Mortenson,M.E. (2006).*GeometricModeling.* Industrial Press.

SEMESTER-VI

Course Title : OPERATION RESEARCH
Course Code: BPE613

L	T	P	Credits
2	0	0	2

Total hours 30

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

1. Study the role of operations research in decision-making, and its applications in industry and formulate and design real-world problems through models & experiments
2. Know about various types of deterministic models like linear programming, transportation model etc.
3. Acquire knowledge about various types of stochastic models like waiting line model, project line model, simulation etc.
4. Compare the relationship between a linear program and its dual and perform sensitivity analysis.
5. Understand different decision making environments and apply decision making process in the real world situations.

Course Content

UNIT I **7 Hours**

Introduction: Origin & development of OR and its role in solving industrial problems: General approach for solving OR problems. Nature and characteristic feature of OR. Use and limitation of OR. Classification of mathematical models.

Deterministic Models: Formulation of deterministic linear mathematical models: Graphical and simplex techniques for solution of linear programming problems, Big M method and two phase method, Introduction to duality theory and sensitivity analysis: transportation models, test for optimality, degeneracy in transportation. Assignment problems (Hungarian method) travelling salesman problems, and sequencing models; Introduction to goal programming; Solution techniques of linear goal programming problems.

UNIT II **8 Hours**

Probabilistic Models: Decision making: various decision making environments. Maximum and minimum models; Introduction to decision tree. Game theory: Solution of simple two person zero-sum games: Examples of simple competitive situation.

Simulation: Concept general approach and application. Use of Monte-Carlo simulation technique to queuing and inventory problems.

Dynamic Programming: Introduction to deterministic and probabilistic dynamic programming. Solution of simple problems. Advantages of dynamic programming.

UNIT III **8 Hours**

Queuing theory: Types of queuing situation: Queuing models with Poisson's input and exponential service, their application to simple situations.

Replacement Models: Replacement of items that deteriorate, Replacement of items whose maintenance and repair costs increase with time, replacement of items that fail suddenly; replacement of items whose maintenance costs increase with time and value of money also changes, individual replacement policy, group replacement policy.

UNIT IV **7 Hours**

Inventory models: Classification of inventory control models: Inventory models with deterministic demand, inventory models with probabilistic demand, and inventory models with price breaks. Advantages and disadvantage of inventory.

Network models:PERT& CPM introduction, analysis of time bound project situations, construction of net works, identification of critical path, slack and floats, crashing of network for cost reduction, resource leveling and smoothening.

Suggested Readings:

1. Wagner,H.M.(1980).*Principles of Operations Research. (2nd Edition).* Prentice Hall.

2. Gupta,P.K.,&Hira,D.S.(1976).*Operations Research.(5th Edition).*S. Chand & Co.

3. Taha.(1919).*Introduction to Operation Research(10th Edition).*Pearson Education.

4. Hiller, F.S. &Liberman,G.I.(2017).*Introduction to Operation Research. (10th Edition).*Holden Ray.

SEMESTER-VI

Course Title : HUMAN VALUE AND ETHICS
Course Code: BPE614

L	T	P	Credits
2	0	0	2

Total hours 30

Course Outcomes: On successful completion of this course, students would be able to:

1. Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field
2. Identify the multiple ethical interests at stake in a real-world situation or practice
3. Articulate what makes a particular course of action ethically defensible
4. Assess their own ethical values and the social context of problems
5. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data.

Course content

UNIT I **7 Hours**

Human Values: Morals, Values and Ethics - Integrity - Work Ethic - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - Commitment - Empathy - Self-Confidence - Character – Spirituality.

UNIT II **8 Hours**

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.

UNIT III **7 Hours**

Engineering As Social Experimentation: Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT IV **8 Hours**

Safety, Responsibilities And Rights: Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational

crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

Suggested Readings:

1. Raghavan, B.S. (2009). *Human Values and Professional Ethics (3rd Edition).* S. Chand & Company.
2. Chakraborty, D. & Chakraborty, B.K. (2016). *Human Values and Ethics.* Himalaya Publishing House.

SEMESTER-VII

Course Title : RESEARCH METHODOLOGY
Course Code: BPE701

L	T	P	Credits
4	0	0	4

Total hours 55

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

1. Understand some basic concepts of research and its methodologies.
2. identify appropriate research topics
3. Select and define appropriate research problem and parameters.
4. Organize and conduct research (advanced project) in a more appropriate manner.
5. Know how to write a research report and thesis

Course Content

UNIT I **15 Hours**

RESEARCH FORMULATION AND DESIGN: Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

UNIT II **15 Hours**

DATA COLLECTION AND ANALYSIS: Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

SOFT COMPUTING: Computer and its role in research, Use of statistical software SPSS, GRETL etcin research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems

UNIT III **15 Hours**

RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING: Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

UNIT IV **10 Hours**

INTERPRETATION AND REPORT WRITING: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

Suggested Readings:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

SEMESTER-VII

Course Title : OIL & WELL TESTING TECHNIQUES	**L**	**T**	**P**	**Credits**
Course Code: BPE702	4	0	0	4

Total hours 60

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

1. Know about testing of drill stem and wire line.
2. Knowledge of various testing methods of fluid and well.

Course Content

UNIT I **15 Hours**

Drill stem testing, RFT, Wire-line Testing: System. Interpretation.
Flow of compressible fluid through porous media; Unsteady state, semi-steady state fluid flow equations, diffusivity equation. Solution techniques.

UNIT II **15 Hours**

Pressure-transient tests: pressure draw-down, build-up test, interpretations; skin factor.

UNIT III **15 Hours**

Multi-rate test, Reservoir limit test, Injection and fall-off test, interference testing, pulse testing.

UNIT IV **15 Hours**

Type curves: generation and interpretation. Gas well testing, fractured wells, dual porosity reservoirs.

Suggested Readings:

1. Pressure buildup and flow tests in wells; C.S. Mathews and D.G. Russel; Vol-1; SPE
2. Gas Reservoir Engineering; John Lee, Robert A. Wattenbarger; Vol-5; SPE
3. Advances in Well Testing; Robert C. Earlougher; Vol-5; SPE

SEMESTER-VII

Course Title : WELL LOGGING
Course Code: BPE703

L	T	P	Credits
4	0	0	4

Total hours 60

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

1. Study about different well logging methods and role of mud logging in formation evaluation
2. Understand the borehole environment and its effect on log measurement.
3. Acquire knowledge about the different open hole well log and its principle, and application in reservoir characterization
4. Study advanced logging method
5. Know about different production logging tools and their application.

Course Content

UNIT I **15 Hours**

Aims and objectives of well logging. Reservoir formations. Borehole conditions. Fundamental concepts in borehole geophysics physical properties of reservoir rocks. Formation parameters and their relationships: formation factor, porosity, permeability, resistivity, water and hydrocarbon saturations, and movable oil. Archie's and Humbles equations. (9 hours)

Principles, instrumentation, operational procedures and applications of different geophysical logs: S.P., electrical, induction, nuclear, sonic, caliper, temperature, dip and direction. Natural gamma ray spectrometry log, nuclear magnetic log, litho density log, neutron activation technique, thermal neutron decay time log, chlorine and oxygen logs.

UNIT II **15 Hours**

Recording, transmission and processing of log data. Formation evaluation for hydrocarbons.

Qualitative and quantitative interpretations of well log data. Overlays and cross-plots.

Determination of reservoir parameters – porosity, resistivity, permeability, water and hydrocarbon saturation, movable oil. Lithology determination by neutron, density and sonic cross-plots, dual mineral method, triporosity method, litho porosity cross-plot (M-N plot), clean sand and shaly sand interpretations.

UNIT III **15 Hours**

Sub-surface correlation and mapping from log data. Delineation of fractures from logs. Production logging. Well logging for metallic and non-metallic minerals: radioactive and non-radioactive evaporates, coal, sulphur. Borehole geophysics for groundwater exploration. Effective pay thickness of an aquifer. Saline water-fresh water interface from log data. Determination of groundwater flow direction by logs.

UNIT IV **15 Hours**

Theoretical computations of normal and lateral log responses. Identification and delineation of sub-surface formations from well log data. Calculation of reservoir parameters: formation factor, porosity, permeability, resistivity, water and hydrocarbon saturations, and movable oil. Subsurface correlation of formations and interpretation of field data. (9 hours)

Suggested Readings:

1. William, C.L., Gary, C.P. (2004).*Standard Handbook of petroleum and Natural Gas Engineering(2nd Edition)* Gulf Professional Publishing.
2.Helander, D.P.(1983).*Fundamentals Of Formation Evaluation*. Oil and gas consultants.
3. Dewan, J.T.(1983).*Essentials of Modern Open-Hole Log Interpretation'*.Pen Well Books.
4. Serra.O(1984).*Fundamentals of Well log Interpretation*. Elsevier Science Publisher, New York.

SEMESTER-VII

Course Title : HEALTH, SAFETY AND ENVIRONMENT MANAGEMENT IN PETROLEUM OPERATIONS
Course Code: BPE704

L	T	P	Credits
4	0	0	4

Total hours 60

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

1. Knowledge of health, safety and environmental management to oil and gas sector.
2. Apply the safety measures in oil and gas sector

Course Content

UNIT I **15 Hours**

Health hazard: Toxicity, physiological, asphyxiation, respiration and skin effects. Effect of sour gases (H2S and CO) on human health. Effect of corrosive material and atmosphere during sand control, fracturing and acidization operations.

Safety analysis: Operational risk in drilling, production and handling of oil and gas, fire hazard: safety system in drilling, production operations. Manual and automatic shut down systems, blow down systems. Gas leakage, fire detection and suppression systems. Hazard and failure mode analysis: safety analysis: disaster and crisis management.

UNIT II **15 Hours**

Environment Health and Safety Management. Impact of oil and gas on air, water and soil pollution, impact of drilling and production operations, offshore problems, oil-spill control. Environmental impact assessment. Waste treatment & management methods, effluent water treatment and disposal. Contaminated soil remediation.

UNIT III **15 Hours**

Noise pollution and remediation measure. Industrial Accident & Prevention: Safety sampling, Accident and Safety Audit; Legal requirements, Disaster Planning and control. Safety in offshore operations.

UNIT IV **15 Hours**

Gas detection, fire detection and suppression, personal protection measures. Occupational Physiology: Respiratory and skin effect. HSE regulations; oil mines regulations.

Suggested Readings

1. S. Chandrasekaran. (2016). Health, Safety and Environmental Management in Offshore and Petroleum Engineering. Wiley.
2. Wise Global Trading Ltd. (2015). Introduction to Oil and Gas Operational Safety. Taylor & Francis.

SEMESTER-VII

Course Title : PROCESS EQUIPMENT DESIGN
Course Code: BPE705

L	T	P	Credits
0	0	4	2

Total hours 15

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

1. Study the mechanical design of process equipment.
2. List and discuss the various design parameters of process equipment.
3. Design of pressure vessels such as thin or thick walled, under pressure and load.
4. Design of heads and closures, supports.

Course Content

1. Process Design of Shell and Tube Heat Exchanger
2. Process Design of Condensers
3. Process Design of Agitated vessels. Introduction to plate heat exchangers and its design
4. Specification sheet for Heat exchangers.
5. Design of Sieve Tray Column and column internals
6. Design of Bubble Cap / Packed Column and column internals
7. Specification sheet for fractionating column
8. Design of Homogeneous Reactors
9. Design of Heterogeneous reactors – Fixed bed
10. Design of Heterogeneous reactors – fluidised bed
11. Types of Flow Sheets
12. Overview of plant layout

Suggested Readings

1. Coulson, Richardson &Sinnott, R.K. (2005). *Chemical Engineering Volume-6 – An Introduction to Chemical Engineering Design (4th Edition).* Elseveir Butterworth Heinemann.
2. Perry, R.H. & Green, D.W. (2008). *Chemical Engineers' Handbook (8th Edition).* Mc-Graw Hill.
3. Coker, A.K. (2007), *Ludwig's Applied Process Design in Chemical & Petrochemical Plants- Vol 1 (4th Edition).* Gulf Publication- Butterworth Heinemann.
4. Siddiqui, S. (2010). *Ludwig's Applied Process Design in Chemical & Petrochemical Plants – Volume 2 (4th Edition).* Gulf Publication.
5. Ludwig, E.E. (2001). *Applied Process Design in Chemical & Petrochemical Plants- Vol 3 (3rd Edition).* Gulf Publication- Butterworth Heinemann.

6. Vilbrandt, F.C. & Dryden, C.E. (1959). *Chemical Engineering Plant Design (4th Edition).* McGraw Hill. Peters, M.S. &Timmerhaus, K.D. (2003). *Plant Design and Economics for Chemical Engineering (5th Edition).* McGraw Hill.
8. Molyneux, F. (1963). *Chemical Plant Design-I.* Butterworth Heinemann.

SEMESTER-VIII

Course Title : INTERNSHIP
Course Code: BPE801

L	T	P	Credits
0	0	0	20

Each student will be required to submit a report after the completion of industrial training. To address specific industry and research related problems:
Unit 1: Problem Identification
Unit 2: Literature survey and methodology
Unit 3: Framing of Experimentation set up and preliminary data collection
Unit 4: Future Deliverables &expected Outcome
The reports will be assessed by teacher in-charge of the training. The student has to appear in Viva-voce examination.