GURU KASHI UNIVERSITY

Bachelor of Technology in Petroleum Engineering

Session: 2024-25

Department of Petroleum Engineering

GRADUATE OUTCOME OF THE PROGRAMME

The programme focuses on the principles of upstream and downstream areas of petroleum engineering, integration of petro refinery and petrochemical, so that they can analyze and solve engineering problems in the industry, while also able to adapt evolving technologies, practices, energy transition and energy sustainability for long-term career growth.

PROGRAMME OUTCOMES

After completing the programme the learner will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and a mechanical engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex mechanical engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex mechanical engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: 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.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex mechanical engineering activities with an understanding of the limitations.
6. The engineer and society: 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.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the mechanical engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: 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.

11. Project management and finance: 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.
12. Life-long learning: 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**
BPE116	Engineering Chemistry	Basic Science Course	3	0	0	3
BPE112	Engineering Mathematics–I	Basic Science Course	3	1	0	4
BPE117	Programming for Problem Solving	Engineering Science Course	3	0	0	3
BPE118	Communication Skills	Humanities Course	3	0	0	3
BPE119	Basics of Domestic Appliances	Engineering Science Course	2	0	0	2
BPE120	Manufacturing Practices	Engineering Science Course	1	0	4	3
BPE121	Engineering Chemistry Lab	Basic Science Course	0	0	2	1
BPE122	Programming for Problem Solving Lab	Engineering Science Course	0	0	2	1
BPE123	Communication Skills Lab	Humanities Course	0	0	2	1
BPE124	Basics of Domestic Appliances lab	Engineering Science Course	0	0	2	1
Total			**15**	**1**	**12**	**22**

Semester II						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE217	Basic Electrical Engineering	Engineering Science Course	3	1	0	4
BPE218	Engineering Physics	Basic Science Course	3	1	0	4
BPE215	Engineering Mathematics–II	Basic Science Course	3	1	0	4
BPE219	Engineering Graphics & Drawing	Engineering Science Course	1	0	4	3
BPE220	Engineering Physics Lab	Basic Science Course	0	0	2	1
BPE221	Basic Electrical Engineering Lab	Engineering Science Course	0	0	2	1
BPE222	Fundamental of Computer and Information Technology Lab	Engineering Science Course	0	0	2	1
BPE223	Indian Constitution	Value Added Course	2	0	0	NC*
Total			**12**	**3**	**10**	**18**
Note: *Non-credit (NC) course will be evaluated as satisfactory/ unsatisfactory						

Semester III						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE314	Engineering Mathematics-III	Basic Science Course	3	1	0	4
BPE315	Geology of Petroleum	Professional Core Course	3	0	0	3
BPE301	Material and Energy Balance	Engineering Science Course	2	1	0	3
BPE302	Fluid Flow	Professional Core Course	2	1	0	3
BPE303	Thermodynamics	Professional Core Course	2	1	0	3
BPE316	Heat and Mass Transfer	Professional Core Course	3	1	0	4
BPE306	Fluid Flow Lab	Professional Core Course	0	0	2	1
BPE317	Heat and Mass Transfer Lab	Professional Core Course	0	0	2	1
BPE308	Institutional Training*	Internship	0	0	0	2
Total			**15**	**5**	**4**	**24**
Note: *Institutional Training will be imparted in the Institute at the end of 2nd Semester for 4-weeks duration. However, it is not applicable to LEET Students.						

Semester IV						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE405	Mechanical Operations	Engineering Science Course	3	0	0	3
BPE402	Drilling Technology	Professional Core Course	3	0	0	3
BPE420	Drilling Fluids and Cements	Professional Core Course	3	1	0	4
BPE421	Elements of Reservoir Engineering	Professional Core Course	3	1	0	4
BPE417	Engineering & Solid Mechanics	Engineering Science Course	3	0	0	3
BPE422	Environment Science	Value Added Course	2	0	0	NC*
BPE423	Human Values and Ethics	Humanities Course	2	1	0	3
BPE408	Mechanical Operations Lab	Engineering Science Course	0	0	2	1
BPE424	Petroleum Engineering Lab-I	Professional Core Course	0	0	2	1
Total			**19**	**3**	**4**	**22**
Note: *Non-credit (NC) course will be evaluated as satisfactory/ unsatisfactory						

Semester V						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE517	Petroleum Production Operations-I	Professional Core Course	3	1	0	4
BPE518	Petroleum Refining Engineering	Professional Core Course	3	1	0	4
BPE514	Petrochemical Technology	Professional Core Course	3	1	0	4
BPE519	Offshore Drilling and Production Practices	Professional Core Course	3	1	0	4
BPE520	Entrepreneurship	Value Added Course	2	0	0	NC*
XXX	Professional Elective Course-I	Professional Elective Course-I	3	0	0	3
BPE521	Petroleum Engineering Lab-II	Professional Core Course	0	0	2	1
Total			**17**	**4**	**2**	**20**
Note: *Non-credit (NC) course will be evaluated as satisfactory/ unsatisfactory						

Semester VI						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE618	Petroleum Production Operations-II	Professional Core Course	3	1	0	4
BPE619	Natural Gas Engineering	Professional Core Course	3	0	0	3
BPE620	Well Logging and Formation Evaluation	Professional Core Course	3	1	0	4
BPE621	Computational Techniques	Engineering Science Course	3	0	0	3
BPE622	Chemical Reaction Engineering	Engineering Science Course	2	1	0	3
XXX	Professional Elective Course-II	Professional Elective Course-II	3	0	0	3
BPE623	Computational Techniques Lab	Engineering Science Course	0	0	2	1
BPE624	Chemical Reaction Engineering Lab	Engineering Science Course	0	0	2	1
Total			**17**	**3**	**4**	**22**

Semester VII						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE717	Process Economic and Management	Engineering Science Course	3	0	0	3
BPE718	Enhanced Oil Recovery	Professional Core Course	3	1	0	4
BPE719	Process Instrumentation and Control	Engineering Science Course	3	0	0	3
XXX	Professional Elective Course-III	Professional Elective Course-III	3	0	0	3
BPE720	Aptitude and Soft Skills	Value Added Course	2	0	0	NC*
XXX	XXX	Open Elective Course-I	3	0	0	3
BPE721	Process Instrumentation and Control Lab	Engineering Science Course	0	0	2	1
BPE722	Industrial Training**	Internship	0	0	0	4
Total			**17**	**1**	**2**	**21**
Open Elective-I (Open Elective Course for other Departments)						
OEC064	Disaster Preparedness & Planning	Open Elective Course	3	0	0	3

Note: *Non-credit (NC) course will be evaluated as satisfactory/ unsatisfactory

**The marks of 6 weeks Industrial Training undergone at the end of 6th semester will be included here.

Semester VIII						
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
BPE810	Oil and Gas Well Testing	Professional Core Course	3	1	0	4
BPE803	Health, Safety and Environment Management in Petroleum Operations	Professional Core Course	3	1	0	4
XXX	Professional Elective Course-IV	Professional Elective Course-IV	3	0	0	3
XXX	XXX	Open Elective Course-II	3	0	0	3
BPE811	Project Work	Project Work	0	0	4	2
Total			**12**	**2**	**4**	**16**
Grand Total			**124**	**21**	**42**	**165**
Open Elective-II (Open Elective Course for other Departments)						
OEC102	Non-Conventional Energy Resources	Open Elective Course	3	0	0	3

Professional Elective Courses

Course Code	Course Title
BPE901	Exploration Methods
BPE902	Oil and Gas Transportation System
BPE903	Directional Drilling
BPE904	Advanced Reservoir Engineering
BPE905	Pipeline Engineering
BPE906	Oil & Gas Marketing and Resource Management
BPE907	Recent Advances in Hydrocarbons
BPE908	Corrosion Technology
BPE909	Artificial Intelligence in Petroleum Engineering
BPE910	Multicomponent Distillation
BPE911	Chemical Technology
BPE912	Industrial Pollution Abatement
BPE913	Plant Utilities
BPE914	Polymer Technology
BPE915	Petroleum Engineering System Design
BPE916	Python for Oil and Gas
BPE917	Machine Learning in Petroleum Operations
BPE918	Cyber Security in Petroleum Industry
BPE919	Process Modeling and Simulation
BPE920	Modern Separation Processes
BPE921	Optimization Techniques
BPE922	Process Plant Design

Evaluation Criteria for Theory Courses

A. Continuous Assessment (30 Marks)

CA1 Surprise Test (Two best out of three) (10 Marks)

CA2 Assignment (10 Marks)

CA3 Case study/ portfolio (5 Marks)

B. Attendance (5 marks)

C. Mid Semester Test (30 Marks)

D. End Semester Exam (40 Marks)

Evaluation Criteria for Practical Courses

Performance of each practical (10 Marks)

Report (5 Marks)

Practical Viva (5 Marks)

Total (20 Marks) (Each Practical)

SEMESTER: I

Course Title: ENGINEERING CHEMISTRY
Course Code: BPE116

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Demonstrate Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and Nano particles,
2. Evaluate band structure of solids and the role of doping on band structures.
3. Distinguish the ranges of Vibrational and rotational spectroscopy of diatomic molecules, Applications, Nuclear magnetic resonance and magnetic resonance imaging
4. Rationalize periodic properties such as ionization potential, electro-negativity, Oxidation states and electro-negativity.

Course Content

UNIT1 **15 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 **10 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 characterization techniques, Diffraction and scattering.

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.

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 equilibriums, Water chemistry, Corrosion, Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT III **10 Hours**

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 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.

UNIT IV **10 Hours**

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.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

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

Course Title: ENGINEERING MATHEMATICS–I
Course Code: BPE112

L	T	P	Credits
3	1	0	4

Total hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. 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. Classify of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
3. Illustrate the Tool of power series and Fourier series for learning advanced Engineering Mathematics.
4. Use of functions of several variables that is essential in most branches of engineering and tools of matrices and linear algebra in a comprehensive manner.

Course Content

UNIT I **16 Hours**

Calculus: Evaluates 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 Hospital's rule; Maxima and minima.

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.

UNIT II **14 Hours**

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 III **15 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 **15 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.

Eigen values, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, Eigen bases, Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *G.B. Thomas and R.L. Finney. (2002). Calculus and Analytic geometry. Pearson.*
- *Veerarajan T. (2008). Engineering Mathematics for first year. Tata McGraw-Hill, New Delhi.*
- *Ramana B.V. (2010). Higher Engineering Mathematics. Tata McGraw Hill New Delhi.*
- *N.P. Bali and Manish Goyal. (2010). A text book of Engineering Mathematics. Laxmi Publications.*
- *B.S. Grewal. (2000). Higher Engineering Mathematics. Khanna Publishers.*
- *V. Krishnamurthy, V.P. Mainra and J.L. Arora. (2005). An introduction to Linear Algebra. Affiliated East–West press.*
- *Erwin Kreyszig. (2006). Advanced Engineering Mathematics. John Wiley & Sons.*

Course Title: PROGRAMMING FOR PROBLEM SOLVING
Course Code: BPE117

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Design the algorithms to write programs.
2. Illustrate 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. Implement conditional branching, iteration and recursion.

Course Content

UNIT I **15 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/Pseudo code 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 **15 Hours**

Arithmetic expressions and precedence: Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching Iteration and loops

Arrays: Arrays (1-D, 2-D), Character arrays and Strings

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 requirement.

UNIT III **8 Hours**

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 **7 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.

Transaction Modes
Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

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

Course Title: COMMUNICATION SKILLS
Course Code: BPE118

L	T	P	Credits
3	0	0	3

Total Hours: 45

Learning Outcomes: After completion of this course, the learner will 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.

Course Content

UNIT I **16 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 **14 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 **8 Hours**

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

UNIT IV **7 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.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Swan, Michael. (1995). Practical English. OUP.*
- *Wood, F.T. (2007). Remedial English Grammar. Macmillan.*
- *Zinsser, W. (2001). On Writing Well. Harper Resource Book.*

- *Lyons, L. H. & Heasly, B. (2006). Study Writing. Cambridge University Press.*
- *Kumar, S & Lata, P. (2011). Communication Skills. Oxford University Press.*
- *CIEFL, Hyderabad. Exercises in Spoken English. Parts. I-III. Oxford University Press.*

Course Title: BASICS OF DOMESTIC APPLIANCES
Course Code: BPE119

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. Acquire necessary skills/hand on experience/ working knowledge on multi meters, galvanometers, ammeters, voltmeters, ac/dc generators, motors, transformers, single phase and three phase connections, basics of electrical wiring with electrical protection devices.
2. Understand the working principles of different household domestic appliances.
3. Check the electrical connections at house-hold.
4. To learn the skills to repair the electrical appliances for the general troubleshooting and wiring faults.

Course Content

UNIT-I **7 Hours**

Basics of House wiring, Principles of working, parts and servicing of Electric fan, Electric Iron box, Water heater; Induction heater, Microwave oven; Refrigerator, Concept of illumination, Electric bulbs, CFL, LED lights, Energy efficiency in electrical appliances.

UNIT-II **8 Hours**

Electric Iron:

Type of Electric Iron – Ordinary type and automatic/Thermostat Control type/steam iron, Construction and working principle of electric irons; common defects, testing and repairs

Electric Stove:

Types of Electric Stoves- Coiled type, covered type, Hot Plate, Grill/Oven, Cooking Range- Construction and working principle of electric stoves, common defects, testing and repairs; Induction heater; OTG and Microwave oven; Three phase heater, star and Delta connections.

Electric Toasters:

Types of Toasters - Ordinary and Automatic; Construction and working principles of electric toaster; common defects, testing and repairs.

UNIT-III **7 Hours**

Table Lamp and Tube Light:

Construction, working principles and use of Table Lamp, Night Lamp and Tube Light; Common faults, their causes, testing and repair, LED Table lamp.

Electric Fan:

Type of Fans – ceiling fan, Pedestal fan, Bracket Fan, Exhaust Fan; Construction working principles, special characteristics and applications of Electric fans; Common faults, their causes, testing and repairs; Installation of Bracket Fan and Exhaust Fan.

UNIT-IV **8 Hours**

Electric Mixer, Grinder and Blender:

Construction, working principles, special characteristics and applications of Electric Mixer, Grinder and Blender; Common Faults, their causes, testing and repairs; Servicing maintenance and overhauling of Electric Mixer, Grinder and Blender.

Emergency Light and Stabilizer:

Constructions and working principles of Emergency Light and Stabilizer; Common faults, their causes, testing and repairs.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

1. *A Text book on Electrical Technology, B. L. Theraja. S. Chand & Co.*
2. *A Text book on Electrical Technology, A. K. Theraja.*
3. *Performance and design of AC machines, M. G. Say, ELBS Edn.*
4. *Handbook of Repair & Maintenance of domestic electronics appliances; BPB Publications.*
5. *Consumer Electronics, S. P. Bali, Pearson.*
6. *Domestic Appliances Servicing, K. P. Anwer, Scholar Institute Publications.*

Course Title: MANUFACTURING PRACTICES
Course Code: BPE120

L	T	P	Credits
1	0	4	3

Total Hours: 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply the various manufacturing methods in different fields of engineering.
2. Use 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

Course Content

UNIT I **8 Hours**

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

UNIT II **6 Hours**

CNC machining, Additive manufacturing, Fitting operations & power tools

UNIT III **6 Hours**

Electrical & Electronics Carpentry, Plastic moulding, glass cutting

UNIT IV **10 Hours**

Metal casting, 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:

1. Machine shop - 10 hours
2. Fitting shop - 8 hours
3. Carpentry - 6 hours
4. Electrical & Electronics - 8 hours
5. Welding shop - 8 hours (Arc welding 4 hrs. + gas welding 4 hrs.)

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

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

Course Title: ENGINEERING CHEMISTRY LAB
Course Code: BPE121

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Evaluate the 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

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.

Course Title: PROGRAMMING FOR PROBLEM SOLVING LAB
Course Code: BPE122

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will 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

Course Content

List of Experiments

1. Problem solving using computers
2. Familiarization with programming Environment
3. Variable types and type conversions
4. Simple computational problems using arithmetic expressions
5. Branching and logical expressions
6. Problems involving if-then-else structures
7. Loops, while and for loops
8. Iterative problems e.g., sum of series
9. 1D Arrays: searching, sorting
10. 1DArray manipulation
11. 2D arrays and Strings, memory structure
12. Matrix problems, String operations
13. Functions, call by value
14. Simple functions
15. Numerical methods (Root finding, numerical differentiation, numerical integration)
16. Numerical methods problems
17. Recursion, structure of recursive calls
18. Recursive functions
19. Pointers, structures and dynamic memory allocation
20. Pointers and structures
21. File handling
22. File operations

Suggested Readings

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

Course Title: COMMUNICATION SKILLS LAB
Course Code: BPE123

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will 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. Evaluate the interview process confidently.

Course Content

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

Course Title: BASICS OF DOMESTIC APPLIANCES LAB
Course Code: BPE124

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. Acquire necessary skills/hand on experience/ working knowledge on multimeters, galvanometers, ammeters, voltmeters, ac/dc generators, motors, transformers, single phase and three phase connections, basics of electrical wiring with electrical protection devices.
2. Understand the working principles of different household domestic appliances.
3. Check the electrical connections at house-hold.
4. To learn the skills to repair the electrical appliances for the general troubleshooting and wiring faults.

Course Content

Co-curricular Activities (Hands on Exercises):

1. Identifying Phase, Neutral and Earth on power sockets.
2. Identifying primary and secondary windings and measuring primary and secondary voltages in various types of transformers.
3. Observing the working of transformer under no-load and full load conditions.
4. Observing the connections of elements and identify current flow and voltage drops.
5. Studying electrical circuit protection using MCBs, ELCBs.
6. Dismantling and reassemble of reflector type room Heater.
7. Dismantling and reassembling of Electric Iron (i) Ordinary type (ii) Automatic/Thermostat control type.
8. Testing and repair of Electric Iron (i) Ordinary type (ii) Automatic/Thermostat control type.
9. Dismantling and reassembling of Electric Stove (i) Coiled type (ii) Covered type
   (a) Hot plate (b) Grill (iii) Induction Heater (iv) Microwave oven, (v) Three phase heater star and delta connection
10. Connection of Fluorescent tube light (FTL) circuit.
11. Testing and repair of (i) Table Lamp (ii) Night Lamp and (ii) Tube Light (iv) LED table lamp
12. Testing fault finding, repair and overhauling of electric fans.
13. Testing fault finding, repair and overhauling of (i) electric mixer (ii) grinder (iii) blender.
14. Testing fault finding, repair and overhauling of emergency light
15. Testing fault finding, repair and overhauling of voltage stabilizer (manual and automatic)

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

1. *A Text book on Electrical Technology, B. L. Theraja. S. Chand & Co.*
2. *A Text book on Electrical Technology, A. K. Theraja.*
3. *Performance and design of AC machines, M. G. Say, ELBS Edn.*
4. *Handbook of Repair & Maintenance of domestic electronics appliances; BPB Publications.*
5. *Consumer Electronics, S. P. Bali, Pearson.*
6. *Domestic Appliances Servicing, K. P. Anwer, Scholar Institute Publications.*

SEMESTER: II

Course Title: BASIC ELECTRICAL ENGINEERING
Course Code: BPE217

L	T	P	Credits
3	1	0	4

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the DC and AC electrical circuit elements with RLC.
2. Analysis of simple circuits with dc excitation. Superposition, The venin and Norton Theorems.
3. Use Single Phase AC Circuits and representation of alternating quantities and determining the power in these circuits.
4. Classify the different types of Electrical machines.

Course Content

UNIT I **15 Hours**

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's 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 **15 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 **15 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 **15 Hours**

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.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

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

Course Title: ENGINEERING PHYSICS
Course Code: BPE218

L	T	P	Credits
3	1	0	4

Total hours 60

Learning Outcomes: After completion of this course, the learner will 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 acquires data in order to explore physical principles, effectively communicate results, and 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.

Course Content

UNIT I **15 Hours**

Electrostatics: 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, Boundary conditions of electric field and electrostatic potential; method of images. 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 center of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

UNIT II **15 Hours**

Magneto statics: Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; vector potential and its solution for given current densities. Properties of magnetic materials: magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials.

Time Varying Field and Maxwell's Equation: Laws of Electromagnetic Induction, Self and Mutual induction, Concept of Displacement Current, Difference between Conduction Current and Displacement Current, Eddy Current, Maxwell's Equations, Derivation of Maxwell's Equations, Propagation of Electromagnetic Waves in Free Space, Solution of propagation of Plane Electromagnetic Wave in free space.

UNIT III **15 Hours**

Semiconductors: Intrinsic and extrinsic semiconductors, Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Semiconductor materials of interest for optoelectronic devices.

Modern Physics: Particle properties of wave: Planck's hypothesis, Qualitative discussion of Photoelectric effect and Compton Effect. Wave properties of particle: De Broglie wave as mater waves, Heisenberg's uncertainty principle and its application. Quantum Mechanics: Interpretation of wave function, Schrödinger equation (time dependent and time independent), particle in a box,

UNIT IV **15 Hours**

Wave Optics: Interference due to division of wavefront, Young's double slit expt., Principle of Superposition, Interference from parallel thin films, Newton rings, Michelson interferometer. Diffraction: Fresnel Diffraction, Diffraction at a straight edge, Fraunh offer diffraction due to N slits, Diffraction grating, dispersive and resolving power of Grating. Polarization**:** production of plane polarized light by different methods, Brewster and Malus Laws. Double refraction, Quarter & half wave plate, Nicol prism, specific rotation, Laurent's half shade polarimetry.

Laser: Introduction, principle of Laser, stimulated and spontaneous emission, Einstein's Coefficients, He-Ne Laser, Ruby Laser, Application of Lasers.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

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

Course Title: ENGINEERING MATHEMATICS –II
Course Code: BPE215

L	T	P	Credits
3	1	0	4

Total Hours: 60

Learning Outcomes: After completion of this course, the learner will 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.

Course Content

UNIT I **14 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.

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.

UNIT II **15 Hours**

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 III **15 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, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

UNIT IV **16 Hours**

Transform Calculus: Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions.

Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of Integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method, Fourier transforms.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Thomes, G. B. and Finney, R.L. (2010) Calculus and Analytic Geometry; Ninth Edition; Pearson Education*
- *Kreyszig, E. (1998) Advanced Engineering Mathematics; Eighth Edition, John Wiley and sons.*
- *Grewal, B.S. (1965) Higher Engineering Mathematics; Khanna Publishers, New Delhi.*
- *Babu Ram (2009) Advance Engineering Mathematics; First Edition; Pearson Education.*
- *Richard Courant and Fritz John (2012) Introduction to Calculus and Analysis, Volume II, V Springer Publication.*

Course Title: ENGINEERING GRAPHICS & DRAWING
Course Code: BPE219

L	T	P	Credits
1	0	4	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand about engineering drawing applications and its importance in society.
2. Learn about the visual aspects of engineering design.
3. Discuss the engineering graphics standards.
4. Classify the concept of solid modeling techniques.

Course Content

UNIT I **9 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 Involutes; 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 **12 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 **14 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, shares, 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 **10 Hours**

Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to Credits ate drawings, Credits ate, 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 Credits eating 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).

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

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

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

Course Title: ENGINEERING PHYSICS LAB
Course Code: BPE220

L	T	P	Credits
0	0	2	1

Total hours: 15

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

1. Illustrate the working p-n junction diode.
2. Analyse and solve various engineering problems.
3. Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
4. Design new instruments with practical knowledge.

Course Content

List of experiments **15 Hours**

1. To study the V-I characteristics of P-N junction.
2. To verify the logic gates.
3. To calculate the acceleration due to gravity “g” using simple pendulum.
4. To find the moment of inertia of flywheel.
5. To measure the diameter of a small spherical/cylindrical body using Vernier calipers/screw gauge.
6. To draw V-I characteristics of Zener diode and determine reverse breakdown voltage.
7. To study the controls and obtain a wave using Cathode Ray Oscilloscope.
8. To find the resolving power of the prism.
9. To determine the angle of the given prism.
10. To determine the refractive index of the material of a prism.
11. To understand the phenomenon Photoelectric effect as a whole.
12. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
13. To determine the Planck's constant from kinetic energy versus frequency graph.
14. To plot a graph connecting photocurrent and applied potential.
15. To determine the stopping potential from the photocurrent versus applied potential graph.

Note: Students will perform any 7-8 experiments from the syllabus.

Course Title: BASIC ELECTRICAL ENGINEERING LAB
Course Code: BPE221

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Analysis of Resistive Circuits and Solution of resistive circuits with independent sources.
2. Understand the Two Terminal Element Relationships for inductors and capacitors and analysis of magnetic circuits.
3. Analysis of Single-Phase AC Circuits, the representation of alternating quantities and determining the power in these circuits.
4. Compare different types of Electrical machines and classify different electrical measuring equipment's and understanding their principles

Course Content

List of Experiments

1. To study basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. real-life resistors, capacitors and inductors.
2. To verify Ohm's law.
3. To verify Kirchhoff's voltage and current laws.
4. To verify Superposition Theorem.
5. To verify Thevenin Theorem.
6. To obtain the sinusoidal steady state response of R-L circuit – impedance calculation and verification. Observation of phase differences between current and voltage.
7. To obtain the sinusoidal steady state response of R-C circuit – impedance calculation and verification. Observation of phase differences between current and voltage.
8. To study resonance phenomenon in R-L-C series circuits.
9. To perform open circuit and short circuit test on a single-phase transformer and calculate the efficiency.
10. Demonstration of cut-out sections of machines: Induction machine (squirrel cage rotor and slip ring arrangement) and single-phase induction machines.
11. To connect, start and reverse the direction of rotation by change of phase-sequence of connections of three phase induction motor.
12. To connect, start and reverse the direction of rotation of single-phase induction motor.
13. To demonstrate working of DOL starter for three-phase induction motor.

Course Title: FUNDAMENTAL OF COMPUTER AND INFORMATION TECHNOLOGY LAB

Course Code: BPE222

L	T	P	Credits
0	0	2	1

Total Hours: 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Understand the concept of input and output devices of Computers
2. Study to use the Internet safely, legally, and responsibly.
3. discuss an operating system and its working, and solve common problems related to operating systems
4. Learn basic word processing, Spreadsheet and Presentation Graphics Software skills

Course Content

1. Various Components of a Computer.
2. Introduction to Microsoft Word & Presentation
3. Make a simple presentation on your college,
4. use 3D effects on prescribed presentation
5. Applications of MS-Office MS-Word
6. MS-Excel
7. MS-PowerPoint
8. Create web pages for your college using different tags.
9. Web Browser and E-Mail
10. Conversion of a word documents into PDF/ Image conversion using image file format.

SEMESTER-III

Course Title: ENGINEERING MATHEMATICS-III
Course Code: BPE314

L	T	P	Credits
2	1	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Comprehend 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. Analyze any real-life system with limited constraints and depict it in a model form.
4. Convert the problem into a mathematical model.

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.

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.

UNIT III **10 Hours**

Nature and development of Operations Research: some mathematical preliminaries, OR and managerial decision making, OR applications in industrial and non-industrial fields. Linear Optimization Models: formulation of linear programming problem, graphical solution, sensitivity analysis in graphical solution, comparison of graphical and simplex algorithm, simplex algorithm, computational procedure in simplex, penalty method, two phase method, degeneracy, duality and its concept, application of LP model to product mix and production scheduling problems.

UNIT IV **10 Hours**

The transportation model: solution methods, balanced and unbalanced problems, Vogel's approximation method, degeneracy in transportation problems. Assignment problem, methods for solving assignment problems. The traveling salesman problem. Numerical on transportation, assignment and traveling salesman method. Computer algorithms for solution to LP problems. Dynamic programming problems: model formulation, computational procedures, solution in different stages. Game theory Use terminology, Rules for Game theory, Saddle point, Mixed Strategies (2X2 Games), Mixed Strategies (2Xn Games or mX2 Games), Mixed Strategies (3X3 Games)

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Mobile Teaching, Self-Learning, Collaborative Learning.

Suggested Readings:

- Rohatgi, V.K., Saleh, A.K. Md. E. (2008). *An Introduction to Probability and Statistics*. Wiley and Sons.
- Milton, J.S., Arnold J.C. (2017). *Introduction to Probability and Statistics*. McGraw Hill.
- Ross, S.M. (2013). *A First Course in Probability*. Pearson Education India.
- Taha, H A. (2004). *Operations Research - An Introduction*. Prentice Hall of India Private Limited.
- Hillier, F.S. (1994). *Operations Research*. CBS Publishers & Distributors.
- Mustafi, C.K. (1996). *Operations Research*. New Age International.

Web-graph:

1. Probability and Statistics - Course (nptel.ac.in)
2. Introduction to Operations Research - Course (nptel.ac.in)
3. Operational research ppt | PPT (slideshare.net)

Course Title: GEOLOGY OF PETROLEUM
Course Code: BPE315

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 knowledge about the general properties of rock forming minerals, their classification and identification
2. Study the rock deposition and stratification
3. Acquire basic knowledge about the various geological structure and their recognition
4. 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:

- *Rutely, H.H. (2005). Elements of Mineralogy. McGraw Hill.*
- *Krishnan, M. S. (2006). Geology of India (6th Edition). CBS Publishers & Distributors Pvt Ltd.*
- *Mukherjee, P.K. (2013). Introduction to Geology. World Press Private Limited.*

- *Billings, M.P. (1972). Structural Geology (3rd Edition). Prentice Hall.*
- *Kearey, P. & Brooks, M. (1991). An Introduction to Geophysical Exploration (2nd Edition). Wiley-Blackwell.*

Course Title: MATERIAL AND ENERGY BALANCE
Course Code: BPE301

L	T	P	Credits
2	1	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply the knowledge of basic Chemical Engineering Calculations involving unit operations
2. Interpret Internal energy, Enthalpy, Heat capacity of gases, liquids, and solids
3. Apply material balance on Chemical processes with & without chemical reaction for optimization of processes or plant.
4. Apply the laws of thermos-physics and thermos-chemistry in energy balance on Chemical processes.

Course Content

UNIT I **10 Hours**

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

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

UNIT II **10 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. Clausius Clapeyron equation, Cox chart and Duhring's plot.

UNIT III **13 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 **12 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Webliography:

1.https://archive.nptel.ac.in/courses/102/106/102106069/
2. https://onlinecourses.nptel.ac.in/noc20_bt07/preview
3. https://nptel.ac.in/courses/102106069
4.https://archive.nptel.ac.in/courses/103/105/103105209/

Course Title: FLUID FLOW
Course Code: BPE302

L	T	P	Credits
2	1	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic principles of fluid mechanics.
2. Identify the appropriate usage of ideal flow concepts, continuity equation and Bernoulli equation.
3. Apply momentum and energy equations to solve fluid flow problems.
4. Illustrate the flow in pipe as well as fluid machinery.

Course Content

UNIT I **15 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 **10 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 **10 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 **10 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.

Transaction Mode

Lecture, e-Team Teaching,Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Webo-graphy:

1.Fluid Flow Operations - Course (nptel.ac.in)

2. (870) Mod-01 Lec-01 Introduction and Fundamental Concepts - I - YouTube

3. NPTEL: Chemical Engineering - NOC: Fluid Flow Operations

Course Title: THERMODYNAMICS
Course Code: BPE303

L	T	P	Credits
2	1	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply the thermodynamic laws to chemical engineering processes.
2. Interpret the thermodynamic principles for analysis of solutions, ideal solutions, their excess properties and residual properties.
3. Classify chemical engineering systems based on thermodynamic principles such as vapor-liquid systems, liquid-liquid systems and solid-liquid systems.
4. 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 II **10 Hours**

Volumetric Properties of Pure Fluids: PVT behavior 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, Clausius Clapeyon 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 chemical reactions, Standard states

and G, Temperature dependence of the equilibrium constant, Estimation of equilibrium rate constant, Homogeneous gas phase reactions, Heterogeneous chemical equilibrium.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Webo-graphy:

1.NPTEL:: Chemical Engineering - NOC: Chemical Engineering Thermodynamics

2. Mod-01 Lec-01 Thermodynamics and the Chemical Industry - YouTube

3. NPTEL :: Chemical Engineering - NOC: Advanced Thermodynamics

4. Thermodynamics | PPT (slideshare.net)

Course Title: HEAT AND MASS TRANSFER
Course Code: BPE316

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic laws of heat transfer.
2. Apply knowledge to solve problems involving steady and unsteady state in simple geometries.
3. Apply the principles of mass transfer.
4. Interpret the concept of mass transfer coefficients in designing of co-current, counter-current & continuous-contact columns.

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 Peclet numbers. Modeling of convective N 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 Film wise condensation of pure and mixed vapors, Convective, Nucleate & Film boiling, Theory and correlations, critical boiling flux

UNIT II **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 **10 Hours**

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 vaporization 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Holman, J.P. (2010). Heat Transfer. McGraw Hill, 10th Edition.*
- *McAdams, W.H. (1985). Heat Transmission. Kreiger Publishing Co, 3rd Edition.*
- *Backhurst, J.R., Harker, J.H., Coulson, J.F., & Richardson J.M. (1999). Chemical Engineering, Volume 1. Butterworth Heinemann, 6th Edition.*
- *McCabe, W. L., Smith, J.C., & Harriot, P. (2005). Module Operations of Chemical Engineering. McGraw Hill, 7th Edition.*
- *Treybal, R.E. (2001). Mass Transfer Operations (3rd Edition). McGraw Hill.*
- *Sherwood, T. K., Pigford, R.L., &Wilke, C.R. (1975). Mass Transfer, Chemical Engineering Series. McGraw Hill.*
- *Skelland, A.H.P. (1985). Diffusional Mass Transfer. Kreiger Publishing Co.*

Webo-graphy:

1. NPTEL :: Chemical Engineering - NOC: Heat Transfer
2. NPTEL : NOC: Heat Transfer (Chemical Engineering) (digimat.in)
3. Heat Transfer - Course (nptel.ac.in)
4. Heat transfer | PPT (slideshare.net)
5. Lectures on Heat Transfer - Introduction - Applications - Fundamentals - Governing Laws | PPT (slideshare.net)
6. https://archive.nptel.ac.in/courses/103/103/103103145/
7. Lecture Notes On Mass Transfer | PDF | Diffusion | Mass Transfer (scribd.com)
8. Mass transfer process in chemical technologies - online presentation (ppt-online.org)

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 and stability of floating body.
3. Find the coefficient of discharge of fluids by venture meter, orifice meter and V-notch etc.
4. Study of valves and fittings.

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 venture meter
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

Course Title: HEAT AND MASS TRANSFER LAB
Course Code: BPE317

L	T	P	Credits
0	0	2	1

Total hours 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Use the fundamental concepts of mass transfer in real engineering problems.
2. Interpret 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, distillation, liquid-liquid extraction and leaching

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. 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.
8. Determination of liquid hold up in a packed column.
9. To find the mass transfer coefficient for the vaporization of organic vapor to air.
10. To verify the Rayleigh's equation for batch distillation.
11. To find the height equivalent to a theoretical plate and height of a transfer unit for the packed distillation column under total reflux.

Suggested Readings:

- *Holman, J.P. (2010). Heat Transfer. McGraw Hill, 10th Edition.*
- *McAdams, W.H. (1985). Heat Transmission. Kreiger Publishing Co, 3rd Edition.*
- *Backhurst, J.R., Harker, J.H., Coulson, J.F., & Richardson J.M. (1999). Chemical Engineering, Volume 1. Butterworth Heinemann, 6th Edition.*
- *McCabe, W. L., Smith, J.C., & Harriot, P. (2005). Module Operations of Chemical Engineering. McGraw Hill, 7th Edition.*
- *Treybal, R.E. (2001). Mass Transfer Operations (3rd Edition). McGraw Hill.*

- *Sherwood, T. K., Pigford, R.L., &Wilke, C.R. (1975). Mass Transfer, Chemical Engineering Series. McGraw Hill.*

Webo-graphy:

1. Virtual Lab - Heat Transfer Lab (google.com)
2. Welcome to Virtual Labs - A MHRD Govt of india Initiative (vlabs.ac.in)

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 and 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, hydro clones, 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Course Title: DRILLING TECHNOLOGY
Course Code: BPE402

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Summarize the planning of the well
2. Acquire knowledge about the different operating systems of drilling rig
3. Apply the knowledge for the selection of proper bit compatible to the well
4. 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

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

Webo-graphy:

1.NPTEL :: Mining Engineering - NOC: Drilling and Blasting Technology
2.Drilling Technology - an overview | Science Direct Topics
3. Drilling Rig Technologies (oil-gasportal.com)

Course Title: DRILLING FLUIDS AND CEMENTS
Course Code: BPE420

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 and 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Course Title: ELEMENTS OF RESERVOIR ENGINEERING
Course Code: BPE421

L	T	P	Credits
3	1	0	4

Total hours 60

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.
2. Know about definitions and their determination of reservoir rock properties, series and parallel combination of beds, fluid saturation, etc.
3. Know about the concept of effective and relative permeability, capillary pressure
4. Study the phase behavior of hydrocarbon, equilibrium ratio, fluid sampling, PVT properties determination, and their measurement, correlations, data reduction and applications.

Course Content

UNIT I **15 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 **15 Hours**

Reservoir 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 Hours**

Hydrocarbon 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 **15 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.

Transaction Mode
Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Course Title: ENGINEERING AND SOLID MECHANICS
Course Code: BPE417

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the basic concepts of rigid body kinematics.
2. Interpret the laws associated with force system
3. Apply the concept of force system to solve the problems related to shear force, bending moment, slope and deflections in different types of beams subjected to various types of loadings.
4. Apply the concept of stress and strain at a point and stress analysis in various machine elements like thin cylinder, sphere, spring, beams and shafts.

Course Content

UNIT I **10 Hours**

Introduction, Point Kinematics: Moving point in various coordinate systems (Cartesian, Cylindrical, Path)

Rigid body kinematics: Translation and rotation, relative motion, angular velocity, General motion of a rigid body, General relative motion

UNIT II **10 Hours**

Equivalent force systems, Resultant forces, Linear and Angular Momentum, Laws of motion (Euler's Axioms), Free Body Diagrams, Dynamics of point mass models of bodies. Equilibrium of rigid bodies, distributed forces, Analysis of structures: Struts, Forces in Beams: Shear Force and Bending Moment

UNIT III **10 Hours**

Frictional forces, Laws of Coulomb friction, impending motion Inertia tensor, Principal Moments of Inertia, Moment of momentum relations for rigid bodies, Euler's Equations of Motion

UNIT IV **15 Hours**

State of stress at a point, equations of motion, principal stress, maximum shear stress, Concept of strain, strain displacement relations, compatibility conditions, principal strains, transformation of stress/strain tensor, state of plane stress/strain.

Uniaxial stress and strain analysis of bars, thermal stresses, Torsion of circular bars and thin-walled members, bending of straight/curves beams, transverse shear stresses, deflection of beams, Buckling of columns

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Text / Reference Books:

- *Singh. (1999). Applied Mechanics. Kataria Publications.*
- *Khurmi, R. S. (2007). Engineering Mechanics (21st Edition). Tata McGraw Hill.*
- *Prasad, I. B. (1996). Applied Mechanics (4th Edition). Khanna Publications.*
- *Shames, l. H. (2005). Engineering Mechanics (4th Edition). Prentice Hall of India.*

Webo-graphy:

1. Prof. N.B.HUI Lecture of solid mechanics | PPT (slideshare.net)
2. Engineering Mechanics | PPT (slideshare.net)
3. NPTEL :: Civil Engineering - NOC: Mechanics of Solids

Course Title: ENVIRONMENT SCIENCE
Course Code: BPE422

L	T	P	Credits
2	0	0	NC

Total hours 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret various environmental variables and results.
2. Summarize the concept of Ecosystem and apply knowledge in real life.
3. Apply knowledge for the solutions to environmental problems related to resource use and management.
4. Compare the results of scientific studies of environmental problems.

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 **8 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 III **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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Webo-graphy:

1. Environmental Science - Course (nptel.ac.in)
2. Environmental Studies - Course (swayam2.ac.in)
3. Environmental studies | PPT (slideshare.net)
4. PPT - CHAPTER 1 Introduction to Environmental Studies PowerPoint Presentation - ID:9436089 (slideserve.com)

Course Title: HUMAN VALUE AND ETHICS
Course Code: BPE423

L	T	P	Credits
2	1	0	3

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 and assess their own ethical values and the social context of problems
4. 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, and 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Course Title: MECHANICAL OPERATIONS LAB
Course Code: BPE408

L	T	P	Credits
0	0	2	1

Total hours 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the concept of fluidization.
2. Acquire knowledge about the operating characteristics of crushing and grinding equipment
3. Compare various principles of the filtration and analyze working of filtration equipment.
4. Evaluate 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.

Webo-graphy:

1. Virtual Labs - NPTEL Labs for Chemical Engineering (vlab.co.in)

Course Title: PETROLEUM ENGINEERING LAB-I
Course Code: BPE424

L	T	P	Credits
0	0	2	1

Total hours 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Find the quality control of lubricating oils and explore its application.
2. Compare the petroleum products and analyze their applications.

List of Experiments **15 Hours**

Part-A

1. To find out plastic viscosity, yield point and gel strength using Fann Viscometer.
2. To find of sand content in drilling mud.
3. To find out mud weight of drilling fluid using Mud Balance.
4. To find out Funnel Viscosity of drilling mud using Marsh Funnel.
5. To determine Filter Cake and Fluid loss in drilling mud.
6. To determine Resistivity of drilling mud.
7. To determine surface tension and interfacial tension using surface tension meter.

Part-B

1. To determine the effective porosity.
2. To determine the water separatability of petro oil.
3. To determine the permeability of the given core sample by Ruska Liquid or Gas Permeameter.
4. To study the properties of core sample.
5. To plug the core of desired size from the rock sample.

Note: Student has to perform/ study minimum of five experiments.

Suggested Reading

- *Neal J. Adams. (1965). Drilling Engineering-A complete well planning approach. Penn Well Publishing Company*
- *Carl Gatlin. (1965). Drilling Well Completions. PHI.*
- *L.P. Dake. (1978). Fundamentals of Reservoir Engineering. Elsevier Science.*
- *Tarek Ahmed. (2006). Reservoir Engineering Handbook. Gulf Professional Publishing.*

Semester V

Course Title: PETROLEUM PRODUCTION OPERATIONS–I
Course Code: BPE517

L	T	P	Credits
3	1	0	4

Total hours 60

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

1. Understand production equipment and operations in oil and gas industry
2. Design the production system to optimize the oil and gas recovery
3. Understand the SRP working and application considerations
4. Understand the Gas Lift working and application considerations

Course Content

UNIT I **10 Hours**

Well Equipment Well Head Equipment, Christmas Tree, Valves, Hangers, Flow Control Devices, Safety Devices and Packers; Well Completion Design: Completions Techniques.

UNIT II **15 Hours**

Oil and Gas Production Optimization Self-flow Well Characteristics, Inflow performance, Outflow performance, Multiphase flow in tubing and flow-lines, Wellhead and Choke performance; Nodal System Analysis; Fluid Production Handling System.

UNIT III **15 Hours**

SRP and Gas Lift Systems Introduction, Objectives and Classifications; Sucker Rod Pump: Surface and Sub-surface Working System, Classifications, Selection Criteria, Advantages and Disadvantages Dynamometer System and its Applications. Introduction, Classifications on the Basis of Installations and Applications, System Characteristics, Applications, System Advantages and Disadvantages.

UNIT IV **20 Hours**

Other Artificial Lifts Introduction, Working Principle, Advantages and Disadvantages, and Selection Criterion of Electrical Submersible Pump, Progressive Cavity Pump, Hydraulic Pump, Plunger Lift, Common Problems Affecting Artificial Lift Selection. Workover Operations Sick Well Analysis; Water and Gas Shut Off; Well Servicing and Workover: Introduction, Problem Identification, Workover Operations, Workover Equipment; Rig Selection; Rigless Intervention: Snubbing Unit and Coiled Tubing Unit.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Thomas O. & Alan P. (1982). Production Operations Vol.- 1 & Vol. 2. Oil and Gas consultants international.*
- *D. Perrin. (1999). Well Completion and Servicing. Technip.*
- *Kermit E. and H. Dale (1977). The Technology of Artificial Lift Methods, Vol– 1. Pennwell Books.*
- *Michael J. and Daniel H. (1994). Petroleum Production Systems Petroleum Engineering Series. Prentice hall*

Course Title: PETROLEUM REFINING ENGINEERING
Course Code: BPE518

L	T	P	Credits
3	1	0	4

Total hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Compare various petroleum resources, drilling techniques for obtaining crude petroleum & various regulations for crude oil production
2. Acquire knowledge about the various crudes & identify desirable properties of Petroleum fractions and testing methods.
3. Interpret various pretreatment and refining processes like distillation, extraction, de-waxing etc.
4. Analyze 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 **20 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 **15 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 **15 Hours**

Conversion Process: Thermal cracking, vis breaking and coking processes. Catalytic cracking, reforming, hydro processing, alkylation, polymerization and isomerization.

Safety and pollution considerations in refineries.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Nelson, W.L. (1985). Petroleum Refinery Engineering (5th Edition). McGraw Hill.*
- *Hobson, G.D. & Pohl. W. (1984). Modern Petroleum Technology (5th Edition). John Wiley.*
- *Guthrie, V.B. (1960). Petroleum Products Handbook. McGraw Hill.*
- *Rao, B.K. (2009). Modern Petroleum Refining Processes (5th Edition). Oxford & IBH Publishing Co.*

Webo-graphy:

1. NPTEL : Chemical Engineering - Petroleum Refinery Engineering
2. Petroleum Technology - Course (nptel.ac.in)
3. Petroleum Refining | PPT (slideshare.net)
4. Petroleum refinery and its product | PPT (slideshare.net)

Course Title: PETROCHEMICAL TECHNOLOGY
Course Code: BPE514

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. 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 **15 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 **15 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 **15 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).

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Course Title: OFFSHORE DRILLING AND PRODUCTION PRACTICES
Course Code: BPE519

L	T	P	Credits
3	1	0	4

Total hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the complexity of operating in a typical offshore environment in different parts of the world.
2. Compare and classify the types of offshore platforms.
3. Examine the installation of conductors, risers and landing bases up to the completion of drilling from different types of platforms in or stepwise manner.
4. 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).

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

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

Webo-graphy:

1. HSE Practices for Offshore and Petroleum Industries - Course (nptel.ac.in)
2. Offshore drilling in petroleum | PPT (slideshare.net)

Course Title: ENTREPRENEURSHIP
Course Code: BPE520

L	T	P	Credits
2	0	0	NC

Total Hours: 30

Learning Outcomes: After completion of this course, the learner will be able to:

1. Assess the commercial viability of new technologies, business opportunities and existing companies
2. Plan, organize, and execute a project or new venture with the goal of bringing new products and service to the market
3. Carry out scientific research in the field of entrepreneurship
4. Improved your interpersonal and collaborative skills

Course Content

UNIT I **8 Hours**

Introduction to Generic Skills: Importance of Generic Skill Development (GSD), Global and Local Scenario of GSD, Life Long Learning (LLL) and associated importance of GSD.

Managing Self: Knowing Self for Self-Development- Self-concept, personality, traits, multiple intelligence such as language intelligence, numerical intelligence, psychological intelligence etc., Managing Self – Physical- Personal grooming, Health, Hygiene, Time Management, Managing Self – Intellectual development -Information Search: Sources of information, Reading: Purpose of reading, different styles of reading, techniques of systematic reading, Note Taking: Importance of note taking, techniques of note taking, Writing: Writing a rough draft, review and final draft. Managing Self – Psychological, Stress, Emotions, Anxiety-concepts and significance, Techniques to manage the above.

UNIT II **7 Hours**

Managing in Team: Team - definition, hierarchy, team dynamics, Team related skills- sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background, Communication in group - conversation and listening skills.

UNIT III **8 Hours**

Task Management: Task Initiation, Task Planning, Task execution, Task close out, Exercises/case studies on task planning towards development of skills for task management

Problem Solving: Prerequisites of problem solving- meaningful learning, ability to apply knowledge in problem solving, Different approaches for problem solving. Steps followed in problem solving. Exercises/case studies on problem solving.

UNIT IV **7 Hours**

Entrepreneurship: Introduction, Concept/Meaning and its need, Competencies/qualities of an entrepreneur, Entrepreneurial Support System e.g., District Industry Centres (DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institute (SISIs), Small Industries Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State/National level. Market Survey and Opportunity Identification (Business Planning)- How to start a small-scale industry, Procedures for registration of small-scale industry, List of items reserved for exclusive manufacture in small-scale industry, Assessment of demand and supply in potential areas of growth, understanding business opportunity, Considerations in product selection, Data collection for setting up small ventures. Project Report Preparation- Preliminary Project Report, Techno-Economic Feasibility Report, Exercises regarding "Project Report Writing" for small projects.

Transaction Modes

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

Suggested Readings

- *Khanka, S. S. (2006). Entrepreneurial development. S. Chand Publishing.*
- *Desai, V. (2009). Dynamics of Entrepreneurial Development and Management (PP. 119-134). Himalaya Publishing House.*
- *Kennedy, A. (2015). Business development for dummies. John Wiley & Sons.*

Webo-graphy:

1. https://onlinecourses.nptel.ac.in/noc21_mg70/preview
2. https://nptel.ac.in/courses/110106141
3. https://onlinecourses.swayam2.ac.in/cec20_mg19/preview

Course Title: PETROLEUM ENGINEERING LAB-II
Course Code: BPE521

L	T	P	Credits
0	0	2	1

Total hours 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Find the quality control of lubricating oils and explore its application.
2. Compare the petroleum products and analyze their applications in quality control.

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.

Course Title: PETROLEUM PRODUCTION OPERATIONS – II
Course Code: BPE618

L	T	P	Credits
3	1	0	4

Total hours 60

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

1. To identify and mitigate the problems encountered during production operations.
2. To select, operate and maintain the separators in functioning condition.
3. To select and operate the suitable storage facility for produced hydrocarbon.
4. To be able to perform well intervention jobs to improve productivity.

Course Content

UNIT I **15 Hours**

Sick Well Analysis; Water and Gas Shut Off: Extraneous Gas and Water Entry into Wellbore; Source Identification, and Control Measures. Well Servicing and Workover: Introduction, Problem Identification, Workover Operations, Workover Equipment; Safety Procedures; Rig Selection; Rig less Intervention: Snubbing Unit and Coiled Tubing Unit; Workover Fluid; Planning and Economics.

UNIT II **15 Hours**

Sand production: Causes, Effects, Factors Affecting Sand Production, Sand Control Techniques, Produced Sand Analysis, Gravel Size Selection, Gravel Packing. Formation Damage: Sources, Effects, Mechanisms and Remedial Measures of Formation Damage; Corrosion and Scale Formation: Causes, Effects, Prevention, and Control Measures; Wax and Asphaltene; Control; Well Subduing; Well Activation.

UNIT III **15 Hours**

Well stimulation: Hydraulic Fracturing, Prop pant fracturing, Acid fracturing, design and optimization of fracturing processes, Acidization, Design consideration in Matrix acidizing, Designing Matrix acidizing in carbonates. Separation: Introduction, Factors Affecting Separation and Separation Mechanism; Separators: Types, Components, Control Systems, and Comparison; Operation and Maintenance of Separators, Operation Problems, Safety Features of Separators. De-Emulsification, Dehydration and Desalination of Crudes; Produced Water Treating System.

UNIT IV **15 Hours**

Storage: Purpose, Classification (Offshore / Onshore / Underground), Types of Tanks, Tank Selection, Tank construction, Tank Inspection and

Maintenance, Operation and Safety of Tanks. Vapor Control: Purpose, Factors Contributing to Vapor Losses, Conservation Measures, Evaporation Prevention, Vapor Recovery System.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Arnold K. and Stewart. (1994). Surface Production Operations Vol.- 1 & Vol. 2. Oil and Gas consultants international.*
- *D. Perrin (1999). Well Completion and Servicing. Technip.*
- *Michael J. (1994). Petroleum Production Systems. Prentice Hall Petroleum Engineering Series.*

Course Title: NATURAL GAS ENGINEERING
Course Code: BPE619

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the formation, composition and utilization of natural gas.
2. Compare the different natural gas processing processes.
3. Evaluate the natural gas flow concept in pipeline and exposure of different flow measurement devices.
4. Summarize the natural gas underground storage and converting the natural gas in different valuable products.

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).

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Bradley, H.B. (1987). Petroleum Production Handbook. SPE Publication.*
- *Skimmer, D.R. (1982). Introduction to Petroleum Production, Volume-1, 2. Gulf Publishing.*
- *Katz, D.L. & Lee, R.L. (1990). Natural Gas Engineering-Production and Storage. McGraw-Hill.*
- *Kumar, S. (1960). Gas production Engineering. Gulf Publishing.*

Webo-graphy:

1. Natural Gas Engineering - Course (nptel.ac.in)
2. 1. natural gas overview | PPT (slideshare.net)
3. Gas engineering | PPT (slideshare.net)

Course Title: WELL LOGGING AND FORMATION EVALUATION
Course Code: BPE620

L	T	P	Credits
3	1	0	4

Total hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Compare different well logging methods and role of mud logging in formation evaluation
2. Interpret the borehole environment and its effect on log measurement.
3. Understand the fundamental principles governing the formation evaluation techniques and correlate their significances to petro-physical properties.
4. Compare various direct and indirect well logging tools and techniques.

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.

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 II **15 Hours**

Introduction: History, methods of gathering formation properties data: Mud logging, Coring, LWD/MWD, Open hole logging, cased hole logging, Modern logging techniques; Logging operations, data acquisition, processing and log presentations. The Borehole Environment, Pressures in the borehole, Drilling

Mud, Invasion of drilling fluids. Temperature and Caliper Logs. Review of common rock forming minerals in sedimentary rocks, classification of rocks, porosity, permeability, saturation.

UNIT IV **15 Hours**

Radioactive Logs: Natural Gamma Ray logging: Principles and applications of total and spectral Gamma Ray logging; Formation density and litho-density logs: Principles and applications; Neutron Logging: Principles and applications

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *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.*
- *Dewan, J. T. (1983). Essentials of Modern Open-Hole Log Interpretation'. Penn Well Books.*

Webo-graphy:

1. Well Logging Introduction| Petroleum Engineering| IPE| GATE 2021 - YouTube
2. (871) Well Logging Introduction| Petroleum Engineering| IPE| GATE 2021 - YouTube

Course Title: COMPUTATIONAL TECHNIQUES
Course Code: BPE621

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner 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. Explain how to interpolate the given set of values and the curve fitting for various polynomials
4. Evaluate ordinary differential equations using different methods through the theory of finite differences and Runge-Kutta method.

Course Content

UNIT I **10 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 **10 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: Fadden Leverrier'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 **10 Hours**

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

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Goyal, A, and Rakshit, M. (2019). Numerical Methods (1st Edition). NIPA New Delhi.*
- *Gupta, S.K. (2009). Numerical Methods for Engineers (2nd Edition). New Age International Publishers.*
- *Jain, M.K., Iyengar, S.R.K., &Jain, R.K. (2012). Numerical Methods for Scientific and Engineering Computation. New Age International.*
- *Sastry, S.S. (2005). Introductory Methods of Numerical Analysis (4th Edition). Prentice Hall of India.*

Webo-graphy:

1. Numerical methods - Course (nptel.ac.in)
2. numerical methods | PPT (slideshare.net)
3. PPT - Numerical Methods PowerPoint Presentation, free download - ID:5621241 (slideserve.com)

Course Title: CHEMICAL REACTION ENGINEERING
Course Code: BPE622

L	T	P	Credits
2	1	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret 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.
4. Draw various RTD curves and predict the conversion from a non-ideal reactor using tracer information.

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 **13 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 **12 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Levenspiel, O. (2004). Chemical Reaction Engineering (3rd Edition). John Willey.*
- *Smith, J.M. (1981). Chemical Engineering Kinetics (3rd Edition). McGraw Hill.*
- *Peacock, D.G. & Richardson, J.F. (1994). Chemical Engineering, (Volume 3, 3rd Edition). Butterworth Heinemann.*
- *Fogler, H.S. (2006). Elements of Chemical Reaction Engineering (4th Edition). Prentice Hall.*

Webo-graphy:

1. NPTEL :: Chemical Engineering - NOC:Chemical Reaction Engineering-I
2. https://www.slideshare.net/SyedMuhammadUsmanSha/what-is-cre
3. Lecture 1 - Introduction of CRE | PDF (scribd.com)
4. CRE PPT - PPT New | PDF | Chemical Reactor | Sewage Treatment (scribd.com)

Course Title: COMPUATIONAL TECHNIQUES LAB
Course Code: BPE623

L	T	P	Credits
0	0	2	1

Total hours 15

Learning Outcomes: After completion of this course, the learner will be able to:

1. Apply basics of numerical methods in real applications.
2. Evaluate the roots of polynomial equations using numerical analysis.
3. Interpret the numerical integration and differentiation.
4. Apply the use of computer in numerical methods applications to solve engineering problems.

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 Runge-Kutta Methods.
13. Application of finite difference technique

Webo-graphy:

1. NPTEL :: Multidisciplinary - NOC: Numerical Methods for Engineers
2. numerical methods | PPT (slideshare.net)

Course Title: CHEMICAL REACTION ENGINEERING LAB

Course Code: BPE624

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. Study the 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

Course Title: PROCESS ECONOMICS AND MANAGEMENT
Course Code: BPPE717

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner 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. Interpret the general procedure for determining optimum conditions.

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, capitalized 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Webo-graphy:

1. NPTEL : Chemical Engineering - NOC: Plant Design and Economics
2. Process engineering economics i industrial engineering management | PPT (slideshare.net)

Course Title: ENHANCED OIL RECOVERY
Course Code: BPE718

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. 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 and thermal recovery processes and their application.

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)

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Readings:

- *Bradley, H. B. (1992). Petroleum Engineering Handbook (3rd Edition). Society of Petroleum Engineers.*

- *Lake L. (1989). Enhanced Oil Recovery. Prentice Hall.*
- *Green, D. W. & Willhite, G. P. (2018). Enhanced Oil Recovery (3rd Edition). Society of Petroleum Engineers.*

Course Title: PROCESS INSTRUMENTATION AND CONTROL
Course Code: BPE719

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. State about various measuring instruments.
2. Analyze various types of controllers (P, PI & PID) and their transfer functions.
3. Interpret a given system for its frequency response and stability.
4. Analyze the process, identification and control strategies such as cascade, ratio and feed forward control

Course Contents

UNIT I **10 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 **10 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 **10 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Harriott, P. (2001). Process Control. McGraw Hill.*
- *Patranabis, D. (2001). Principles of Process Control (2nd Edition). McGraw Hill.*
- *Coughanour, D. R. (2009). Process System Analysis & Control. McGraw Hill.*
- *Coughanour, D. R. & Leblanc, S. (2009). Process System Analysis and Control (3rd Edition). McGraw Hill.*
- *Stephanopoulos, G. (1990). Chemical Process Control - An Introduction to Theory and Practice (1st Edition). Prentice Hall of India.*
- *Peacock, D.G. & Richardson, J.F. (1994). Chemical Engineering, (Volume 3, 3rd Edition). Butterworth Heinemann.*
- *Bequette, B.W. (2003). Process Dynamics: Modeling, Analysis and Simulation. Prentice Hall.*

Webo-graphy:

1.NPTEL :: Chemical Engineering - Process Control and Instrumentation
2. Chemical Process Instrumentation - Course (nptel.ac.in)
3. Instrumentation and process control fundamentals | PPT (slideshare.net)

Course Title: APTITUDE & SOFT SKILLS
Course Code: BPE720

L	T	P	Credits
2	0	0	NC

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. Solve campus placements aptitude papers covering Quantitative Ability.
3. Compete in various competitive exams.
4. Develop effective communicative skills

Course Content

UNIT I **4 Hours**

Quantitative Aptitude Data interpretation: data graphs (bar graphs, pie charts, and other graphs representing data), 2- and 3-dimensional plots, maps, and tables Numerical computation and estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series Mensuration and geometry Elementary statistics and probability.

UNIT II **4 Hours**

Communication Skills: Process, Non-verbal communication, Barriers to Communication & cross-cultural; Organs of Speech: Manners and Articulation of Sounds, Emotional Intelligence, Decision Making, Negotiation and Persuasion

UNIT III **3 Hours**

Analytical Aptitude Logic: deduction and induction, Analogy, Numerical relations and reasoning.

UNIT IV **4 Hours**

Oral Presentation: Countering stage fright, Structure & style of presentation; Group Discussion: Listening; Leadership and Summing Up, Interview Skills: Preparation and Performance.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

- *Agarwal R. A. (2015). Modern Approach to Verbal & Non Verbal Reasoning. S. Chand Publication.*
- *Sijwali, B S. Analytical and Logical reasoning. S. Chand Publication.*
- *Agarwal R. (2015). Quantitative aptitude for Competitive examination. S. Chand Publication.*
- *Sijwali, B. Analytical and Logical reasoning for CAT and other management entrance test.*
- *Wentz, Frederick H. (2012). Soft Skills Training: A Workbook to Develop Skills for Employment. Amazon Digital Services.*
- *Butterfield and Jeff (2011). Soft Skills for Everyone. Cengage Learning India*

Course Title: PROCESS CONTROL LABORATORY
Course Code: BPE721

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. 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.

Course Title: DISASTER PREPAREDNESS & PLANNING
Course Code: OEC064

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. 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 and Understand the use of emergency management system to tackle the problems.
3. Discuss the role of media, various agencies and organizations for effective disaster management.
4. Design early warning system and understand the utilization of advanced technologies in disaster management.

Course Content

UNIT I **15 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 **10 Hours**

Disaster Mitigation and Preparedness: 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Readings:

- *www.http//ndma.gov.in*
- *http://www.ndmindia.nic.in*
- *Kaur, N & Goyal, A. (2014). Disaster Management. PBS Publication Jalandhar.*
- *Iyengar. (2006). Natural Hazards in the Urban Habitat. C.B.R.I., Tata McGraw Hill.*
- *Jon Ingleton. (1992). Natural Disaster Management. Tudor Rose, Leicester.*
- *Singh, B.K. (2008). Handbook of disaster management: Techniques & Guidelines. Rajat Publications.*
- *Singh, R.B. (2006). Disaster Management. Rawat Publications*
- *ESCAP: Asian and the Pacific Report on Natural Hazards and Natural Disaster Reduction.*

Course Title: OIL & WELL TESTING
Course Code: BPE810

L	T	P	Credits
3	1	0	4

Total hours 60

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the testing of drill stem and wire line.
2. Classify the various testing methods of fluid and well.
3. Selection of appropriate well testing methods and interpret tests data.
4.Analyze data and assess strengths and limitations of well test interpretation.

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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *C.S. Mathews and D.G. Russel. (2001). Pressure buildup and flow tests in wells, Vol-1. SPE.*
- *John Lee, Robert A. Wattenbarger. (2000). Gas Reservoir Engineering, Vol-5. SPE.*
- *Robert C. Earlougher. (2005). Advances in Well Testing, Vol-5. SPE*

Webo-graphy:

1. Lec 17: Well Testing and Performance-II - YouTube
2. Well test analysis | PDF (slideshare.net)

Course Title: HEALTH, SAFETY AND ENVIRONMENT MANAGEMENT IN PETROLEUM OPERATIONS	L	T	P	Credits
Course Code: BPE803	3	1	0	4

Total hours 60

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

1. Interpret the health, safety and environmental management to oil and gas sector.
2. Apply the safety measures in oil and gas sector.
3. To equip students with necessary engineering skills such as solving engineering problems in pollution control methodologies in process.
4. Evaluate the pollution control methodologies in process industries

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 shutdown 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings

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

Webo-graphy:

1. NPTEL :: Ocean Engineering - Health, Safety and Environmental Management in Petroleum and Offshore Engineering
2. Introduction to oil & gas health safety environment | PPT (slideshare.net)
3. HEALT & SAFETY IN THE OIL & GAS INDUSTRY | PPT (slideshare.net)

Course Title: NON-CONVENTIONAL ENERGY RESOURCES
Course Code: OEC102

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Understand the generation of electricity from various Non-Conventional sources of energy.
2. Estimate the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
3. Understand the concepts involved in wind energy conversion system by studying its components, types and performance.
4. Acquire knowledge about ocean energy and the operational methods of their utilization.

Course Content

UNIT I **15 Hours**

Introduction: Renewable and non-renewable energy sources, their availability and growth in India: energy consumption as a measure of Nation, s Development: strategy for meeting the future energy requirements.

Solar Energy: Solar radiations-beam and diffused radiations; earth sun angles, attenuation and measurement of solar radiations; Optical properties of materials and selective surfaces.

UNIT II **10 Hours**

Solar Energy Equipment: Principles, introduction to different types of collectors, flat plate, cylindrical and parabolic collectors; Solar energy storage systems-their types, characteristics and capacity; solar ponds. Application of solar energy in water, space and process heating, solar refrigerant and air conditioning; water desalination and water pumping; Solar thermal power generation; solar cells and batteries.

Wind Energy: Principle of wind energy conservation; basic components of wind energy conversion systems; wind mill components, various types and their constructional features; wind data and site selection considerations.

UNIT III **10 Hours**

Direct Energy Conversion Systems: i) Magneto Hydrodynamic (MHD) Generators; Operating principle, types and working of different MHD system –their relative merits; MHD materials and production of magnetic fields ii) Thermo-Electric Generators; Thermo-electric effects and materials; thermoelectric devices and types of thermo-electric generators; thermo-

electric refrigeration iii) Thermionic Generators; Thermionic emission and materials; working principle of thermionic convertors iv) Fuel Cell; Thermodynamic aspect; types, components and working of fuel cell. Performance, applications and economic aspects of above mentioned direct energy conversion systems.

Bio-Mass: Concept of bio-mass conversion, photo-synthesis and bio-gasification; bio gas generators and plants, their types constructional features and functioning; fuel properties of bio gas and community bio gas plants.

UNIT IV **10 Hours**

Geothermal: Sources of geothermal energy types, constructional features and associated prime movers.

Tidal and Wave: Basic principles and components of tidal and wave energy plants; single basin and double basin tidal power plants; conversion devices, Advantages/disadvantages and applications of above mentioned energy systems.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Prakash, J. & Garg, H. P. (2017). Solar Energy Fundamentals and Applications (1st Edition). McGraw-Hill.*
- *Sukhatme, S. P. (1984). Principles of thermal collection & storage. McGraw-Hill.*
- *Chang, D. B. (2013). Solar Engineering of Thermal Process Energy conversion. Prentice Hall.*

Professional Elective Courses

Course Title: EXPLORATION METHODS
Course Code: BPE901

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, Data correction and reduction. Anomaly interpretation. Response for different type of geological structures, 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Course Title: OIL AND GAS TRANSPORTATION SYSTEM
Course Code: BPE902

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 and 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, catholic protection principle and design.

UNIT IV **10 Hours**

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

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Course Title: DIRECTIONAL DRILLING
Course Code: BPE903

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. Ability to check the profile of the progressive well and to correct the deflected well path
3. Acquire knowledge of well monitoring without interrupting the drilling progress
4. 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 III **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 IV **10 Hours**

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

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Schlumberger. (2013). Introduction to Directional Drilling. Schlumberger.*

- *Neal J.A. (1985). Drilling Engineering - A complete well planning approach. Penn Well Publishing Company.*
- *Rabia, H. (2017). Well Engineering and Construction. Entrac Consulting.*

Course Title: ADVANCED RESERVOIR ENGINEERING
Course Code: BPE904

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Solve petroleum engineering problems by integrating different types of data used in the oil industry.
2. Identify, formulate, and solve petroleum engineering problems using real world engineering tools.
3. Recognize the main terminology, concepts, and techniques that apply to reservoir engineering founded on a theory based understanding of mathematics and the natural and physical sciences.
4. Develop a field development plan.

Course Content

UNIT I **15 Hours**

Reservoir drive mechanisms: solution gas drive, gas cap drive, natural water drive, compaction drive and pore compressibility.

UNIT II **10 Hours**

Water flooding: microscopic efficiency of immiscible displacement, macroscopic displacement efficiency of linear water flood, fractional flow and frontal advancement, immiscible displacement in two dimensions, displacement pattern and sweep efficiency, water flood design, role of reservoir geology in the design and operation of water floods, introduction to EOR.

UNIT III **10 Hours**

Radial steady state and transient flow, linearization of equations for small and constant compressibility; well in flow equation; steady state and pseudo steady state solutions.

UNIT IV **10 Hours**

Natural water influx, application of water influx theory in history matching, steam soaking.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

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

Course Title: PIPELINE ENGINEERING
Course Code: BPE905

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 and 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 cathodic protection 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Readings:

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

Course Title: OIL & GAS MARKETING AND RESOURCE MANAGEMENT
Course Code: BPE906

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Interpret the structure of oil and gas industry
2. Analyze the marketing in oil and gas sector
3. Acquire knowledge about the International & National Institutions of Oil & Gas
4. Acquire knowledge of oil & gas sector in an integrated manner.

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, Liquefied 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, and 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Werner, S. (2016). Managing Human Resources in the Oil & Gas. Penn Well Corp.*
- *Colombano, A. (2017). Petroleum Refining & Marketing. Alberto Colombano and Alfonso Colombano.*

Webo-graphy:

1. Oil marketing companies | PPT (slideshare.net)
2. Oil & gas sector presentation | PPT (slideshare.net)

Course Title: RECENT ADVANCES IN HYDROCARBONS
Course Code: BPE907

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: On successful completion of this course, the students would be able to:
1. Overview of NGH and classification of NGH.
2. Acquire knowledge about Hydrate formation by using different methods.
3. Interpret the completions and driving of CBM reservoirs.
4. Evaluate the hydro fracturing job for coal seams

Course Content

UNIT-I **15 Hours**

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

UNIT-II **10 Hours**

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

UNIT-III **10 Hours**

Coal bed methane: Well Construction: Drilling-Cementing. Formation Evaluations, Logging: Borehole Environment-Tool measurement response in coal-wire line log evaluation of CBM Wells-Gas-In-Place calculations-Recovery Factor-Drainage area calculations-Coal permeability/Cleating-Natural fracturing and stress orientation-Mechanical rock properties in CBM evaluation. Completions: Open hole Completions-Open hole cavitation process, Cased hole completions, Multi zone entry in cased hole.

UNIT-IV **10 Hours**

Hydraulic fracturing of coal seams: Need for fracturing Coals-Unique problems in fracturing Coals-Types of fracturing fluids for coal-In Situ Conditions-Visual observation of fractures. Water production and disposal: Water production rates from methane Wells-Chemical content,

Environmental Regulations-Water disposal Techniques-Economics of coal bed methane recovery.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *John J. C. (2003). Natural Gas Hydrates: A Guide for Engineers. Gulf Professional Publisher.*
- *Dendy E.S., KohC. (2007). Clathrate Hydrates of Natural Gases, 3rd Edition. CRC Press.*
- *Mavor, M., Nelson C. R. (2011). Coal Bed Reservoir Gas –in Place Analysis. Nelson, Gas Research Institute.*
- *Saulsberry. J. L. & Paul, S.A. (1996). Guide to Coal Bed Methane Reservoir Engineering. Gas Research Institute.*

Webo-graphy:

1. NPTEL :: Chemical Engineering - NOC: Hydrogen Energy: Production, Storage, Transportation and Safety
2. (PDF) Recent advancements in hydrocarbon bioremediation and future challenges: a review (researchgate.net)

Course Title: CORROSION TECHNOLOGY
Course Code: BPE908

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Illustrate the basic concept of corrosion mechanism and forms of corrosion
2. Analyze the concept of corrosion testing
3. Interpret the concept of the modern theory of corrosion
4. Illustrate the basic mechanism and procedure of corrosion testing and prevention.

Course Content

UNIT I **10 Hours**

Corrosion fundamentals: Corrosion in oil Industry, Cost of corrosion in the industry, Corrosivity of hydrocarbon fluids: Water-oil emulsion and multiphase flow regime, Wettability of metal surface. Corrosivity of aqueous phase in hydrocarbon fluids; Sulphur and H_2S in hydrocarbon fluids; Influence of oil chemistry on the corrosivity of the aqueous phase. Pipeline corrosion; Kinetics of electrochemical surface reactions; Cathodic reduction reactions; Anodic dissolution reactions; Transport of species; Transport from the bulk solution to the steel surface; Transport through the porous surface scales. Corrosion products; Kinetics of corrosion products precipitation and corrosion products growth;

UNIT II **15 Hours**

Modes of internal corrosion attack: Uniform corrosion; Localized corrosion; Pitting corrosion; Erosion corrosion; Galvanic corrosion; Intergranular corrosion; Stress corrosion cracking; Hydrogen damage; hydrogen embrittlement; Hydrogen-induced cracking; Formation of hydride. Pipeline flow Corrosivity: Effect of water wetting; Effect of multiphase flow regime; Effect of multiphase velocity; Effect of water phase characteristics; Significance of salinity; Significance of CO_2 pressure; Significance of H_2S; Significance of O_2; Significance of pH; Effect of temperature. Materials selection: Significance of alloying composition; Significance of steel microstructure.

UNIT III **10 Hours**

Experimental setups, methods, and standards: Multiphase flow loop; Autoclave; Horizontal rotating cylinder; High velocity rig; Glass cell; Goniometer/Tensiometer; Moisture content measurements; Slow strain rate test. Corrosivity and corrosion rate determination: Weight loss

measurements; Potentiodynamic polarization and polarization resistance; Electrochemical impedance spectroscopy; Potentiostatic polarization.

UNIT IV **10 Hours**

Pipeline Corrosion control; Environment control- Gas-phase contaminants and degasification; Water presence and dehydration/dewatering; Pipe cleaning; Pigging; Internal coating/liner; Chemical treatment and corrosion inhibitors: Corrosion control by industrial inhibitors, Application methods; Influence of operating conditions; Solubility, partitioning, and compatibility. Biocides

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Readings

- *Bansal, P. & Goyal, A. (2020). Engineering Chemistry. Laxmi Publications.*
- *Papavinasam, S. (2013). Corrosion control in oil and gas industry. Elsevier.*
- *Cicek, Volkan. (2000). Corrosion in Petroleum Industry. Industrial Solutions.*

Webo-graphy:

1. https://nptel.ac.in/courses/113108051
2. Corrosion/Environmental Degradation/Surface Engineering - Course (nptel.ac.in)
3. Surface Engineering For Corrosion And Wear Resistance Application - Course (nptel.ac.in)
4. Mod-01 Lec-01 Introduction, Basic definition of corrosion - YouTube

Course Title: ARTIFICIAL INTELLIGENCE IN PETROLEUM ENGINEERING
Course Code: BPE909

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Identify the AI based problems
2. Apply techniques to solve the AI problems
3. Discuss on Neural Networks
4. Understand the components of IoT infrastructure and its applications.

Course Content

UNIT I **10 Hours**

Introduction to Artificial Intelligence: AI Problems, Intelligent Agents, Problem Formulation, Basic Problem Solving Methods. Searching: Search strategies, Uniformed Search Strategies, State-Space Search, Bi-Directional Search, BFS, DFS, Heuristic Search Strategies, Local Search Algorithms.

UNIT II **10 Hours**

Introduction to Neural Networks: Characteristics of Neural Networks, Historical Development of Neural Networks Principles, Artificial Neural Networks, Terminology, Models of Neuron, Topology, Basic Learning Laws, Basic Functional Units.

UNIT III **15 Hours**

Introduction to Data Science: Data, types of data, data quality, issues, data architecture, data quality issues, data architecture. Big Data, big data architecture, big data technologies, requirements. Statistics related to data sciences, clustering, and regression analysis.

UNIT IV **10 Hours**

Introduction to IoT: Basics, Physical and Logical Designs, Elements of IoT - Basic Architecture of an IoT. Application Sensors & Actuators, Edge Networking (WSN), Gatew Domain- Specificific IoTs - Home Automation, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Life Style Max.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Russell, S.J. & Norvig, P. (2001). Artificial Intelligence: A Modern Approach. Pearson Education.*
- *Night, K & Rich, E. (2002). Artificial Intelligence (SIE). McGraw Hill.*
- *Patterson, W. (2010). Introduction to AI and ES. Pearson Education.*
- *Luger G & Sttubblefield, W. A. (2010). Artificial Intelligence. Addison-Wesley Longman.*
- *Nilson, N.J. (2010). Principles of Artificial Intelligence. Narosa Publishing House.*

Webo-graphy:

1. https://www.slideshare.net/sparkcognition/oil-and-gas-webinar
2.https://www.slideshare.net/RamezMaher/artificial-intelligence-applications-in-petroleum-engineering-part-i

Course Title: MULTICOMPONENT DISTILLATION
Course Code: BPE910

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Comprehend the key component of distillation process
2. Calculate number of theoretical and actual stages required for multi component distillation by using various methods.
3. Analyze how to break azeotrope using azeotropic and extractive distillation.
4. Illustrate various design options energy conservation in distillation column.

Course content

UNIT I **5 Hours**

Selection of Key Component: Light and heavy key component, Split key and adjacent key, Distribution of key and non-key components
Sequencing of Distillation Column: Concept, Selection criteria with industrial examples

UNIT II **15 Hours**

Selection of Operating Pressure: Determination of operating pressure for the various industrial distillation columns, Criteria for vacuum distillation, Advantages &Disadvantages of vacuum distillation, Determination of vapor-liquid Equilibrium data 06 11 4 Methods for Finding Theoretical Stages: Short cut methods: Fenskey-Underwood-Gilliland's method, Rigorous methods: Lewis-Metheson method, Theile-Geddes method, Equation tearing procedures using tridiagonal matrix algorithm

UNIT III **15 Hours**

Azeotropic and Extractive Distillation: Concept and Working principle, Industrial examples, Determination of number of theoretical stages for azeotropic and extractive distillation, advantage and disadvantage over each other.
Tower Diameter and Pressure Drop: Criteria of selection between tray tower and packed tower, various types of packing, Selection of tray type, Determination of tower diameter and pressure drop, Tray Efficiency and HETP.

UNIT IV **10 Hours**

Multi component Batch Distillation: Design of multicomponent batch distillation with and without rectification

Energy Saving in Distillation: Optimum design of system, Use of high efficiency trays, Heat integration, advanced process control, thermally coupled distillation column, Use of heat pumps, efficient operation of distillation column, Replace the distillation partially or completely with new separation techniques

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- Thakore, S. B., Bhatt. B. I. (2007). *Introduction to Process Engineering & Design.* McGraw Hill.
- Deshpande, P. B. (1985). *Distillation dynamics and control.* Instrument society of America.
- Perry. (2000). *Perry's chemical engineer's handbook.* McGraw Hill.
- Kister, H. Z. (1992). *Distillation design.* McGraw-Hill.
- Henley, E. J, Seader, J. D. (2010). *Equilibrium-stage separation operation in chemical engineering.* John Wiley.

Webo-graphy:

1. Mod-05 Lec-13 Multicomponent Distillation - YouTube
2. Introduction to multicomponent distillation | PPT (slideshare.net)

Course Title: CHEMICAL TECHNOLOGY
Course Code: BPE911

L	T	P	Credits
3	0	0	3

Total hours 45

Learning Outcomes: After completion of this course, the learner will be able to:

1. Know about Extraction of oils, Hydrogenation of oils.
2. Acquire knowledge about paper and cement.
3. Acquire knowledge about manufacture of Soda ash by Solvay process and modified Solvay process.

4.Understand polymerization and their properties, applications and production technologies.

Course Content

UNIT I **10 Hours**

Oils and Fats: Introduction, Extraction of oils, Hydrogenation of oils.
Sugar: Introduction, Juice extraction, defecation, 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Waddams, A. L. (1969). Chemicals from Petroleum (4th Edition). Gulf Publishing Company.*
- *Lewis, F. H. & Matar, S. (1981). From Hydrocarbon to Petrochemicals. Gulf Publishing Co.*
- *Rao, B.K.B. (2004). A Text on Petrochemicals (2nd Edition). Khanna Publishers.*
- *Mall, I.D. (2007). Petrochemical Process Technology. Macmillan India Limited.*
- *Shreeve, T.A. (2017). Chemical process Technology (5th Edition). McGraw Hill Publication.*
- *Dryden. (2005). Outlines of Chemical Technology. East west press publication.*

Webo-graphy:

1. NPTEL :: Chemical Engineering - Chemical Technology - I
2. CHEMICAL Technology PPT | PPT (slideshare.net)

Course Title: INDUSTRIAL POLLUTION ABATEMENT
Course Code: BPE912

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 pollutants.
3. Knowledge and application of methods to remove water pollutants.
4. Knowledge and application of solid waste management methods.
5. Knowledge of 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.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Goyal, A. (2000). Environmental Studies. Notion Press.*
- *Perkins H. C. (1974). Air Pollution. McGraw Hill.*
- *Liptak B.G., Liu D. H. F. (1999). Environmental Engineers Handbook, 2nd Ed. CRC Press.*
- *Willisamson S. J. (1973). Fundamentals of Air Pollution. Addison Wesley Co.*
- *Nemerow N. L. (1971). Liquid Wastes of Industry: Theory, Practices and Treatment. Addison Wesley Co.*
- *Rao, C. S. (2006). Environmental Pollution Control Engineering, 2nd Edition. New Age International Pvt. Ltd.*
- *Metcalf and Eddy. (2008). Waste-Water Engineering, 4th Edition. Tata McGraw Hill.*
- *Mahajan S. P. (2008). Pollution Control in Process Industries. Tata McGraw Hill.*
- *Sincero, A. P., Sincero, G.A. (1999). Environmental Engineering. Prentice Hall of India.*

Course Title: PLANT UTILITIES
Course Code: BPE913

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Select Various Methods For Water Softening And Purification.
2. Explain Different Types of Steam Generators and Compressors along with their components.
3. Select Refrigeration For Various Applications.
4. Apply concepts of energy efficiency and green chemistry for conservation of utilities.

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 numerical 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 **15 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 hexameter phosphate, sodium triphosphate etc.

Types of cooling towers-induced draught, forced draught.

UNIT IV **10 Hours**

Utility Equipment

- Boilers: Coal fired, oil fired, Babcox, water tubes and fire tube - Cochran, Lancashire,
- Compressors: Centrifuge, reciprocating
- Blowers: Centrifuge, reciprocating

- Refrigeration, absorption, compression and vapor compression.

Transaction Mode
Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

- *Ludvig. E. (2001). Applied Process Design for Chemical and Petrochemical Plants. Gulf Publishing.*
- *Smith McCabe, (1995). Unit Operation of Chemical Engineering. McGraw Hill.*
- *Timmerhaus. P. (2000). Plant Economics. McGraw Hill.*

Webo-graphy:
1. https://onlinecourses.nptel.ac.in/noc22_ch24/preview
2. https://archive.nptel.ac.in/courses/103/107/103107211/
3. http://digimat.in/nptel/courses/video/103107211/L17.html
4. https://archive.nptel.ac.in/content/syllabus_pdf/103107211.pdf

Course Title: POLYMER TECHNOLOGY
Course Code: BPE914

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

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 & specialty polymers.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:

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

Course Title: PETROLEUM ENGINEERING SYSTEM DESIGN

Course Code: BPE915

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Identify different designing aspects of a drilling rig.
2. Learn an insight into the casing integrity aspects.
3. Select and design the surface separation equipment.
4. Select, design, operate artificial lifts and its components.

Course Content

UNIT I **15 Hours**

Selection and Design of Drilling Rig: Environmental Load, Power System, and Operating System (Hoisting, Rotary, Circulating System); Selection and Design of Drill String and casing design.

UNIT II **10 Hours**

Directional Well Planning; Directional Tools; Well Path Correction; Directional Well Profile Selection and Design; Directional Well Surveying Methods and Data Analysis; Well Economics; Cased and Perforated Well Performance: Total Perforation Skin.

UNIT III **10 Hours**

Separation System: Classifications, Working and Applications; Specification of Optimum Separation Process; Design of 2 – Phase and 3 – Phase Horizontal and Vertical Separators, sizing of separators. Surface and Sub-Surface Sucker Rod Pumping System: Working Principle, Application Considerations; Design of sucker-rod pumping production system: Theoretical Analysis of Rod Motion, Effective Plunger Stroke Length, Polished Rod Load Calculations, Counterbalance, Torque on the Gearbox, Prime Mover Pump Requirements; Dynagraph Analysis and its Applications.

UNIT IV **10 Hours**

Gas Lift System: Classifications, Working Principle and Application Considerations; Design of gas-lift production system for continuous and intermittent gas-lift systems: Point of Gas Injection, Injection Rate, Valve Mechanics, Spacing of Valves, Injection Gas Breakthrough, Fluid Recovery per Cycle for Intermittent Gas Lift Operations and Maximum Daily Production.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Michael G, Curtis H. (1995). Well Performance. Norwegian university of science and technology.*
- *Kermit, E. and H. Dale (1977). The Technology of Artificial Lift Methods. PennWell Company.*
- *H. Dale. (2003). Production optimization. OGCI and Petro skills publications.*
- *Adam T. (1986). Applied Drilling Engineering. SPE.*

Course Title: PYTHON FOR OIL AND GAS
Course Code: BPE916

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Understand the Python programming environment and data.
2. Work with strings, lists and tuples and apply various operators.
3. Apply loops and execute conditionals and logical operators.
4. Work with data files, dictionaries, iterations, functions, and classes.

Course Content

UNIT I **10 Hours**

Installing and Understanding Python Environment, Python Libraries, Data Types and Variables.

UNIT II **10 Hours**

Operators and Operands, Statements and Expressions, Strings, Lists, Tuples.

UNIT III **10 Hours**

Working with for Loop, Boolean Expressions, Logical Operators, Conditional Execution.

UNIT IV **15 Hours**

Sequence Mutation and Accumulation Patterns, Working with Data Files, Dictionaries and Dictionary Accumulation. Iteration and Advanced Functions, Basic Sorting's, Python Classes and Inheritance.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Lutz, M. (2010). Programming Python, 4th Edition. O'Reilly Media.*
- *Brian, K. and David, M. (2013) Python Cookbook: Recipes for Mastering Python. O'Reilly Media.*

Course Title: MACHINE LEARNING IN PETROLEUM OPERATIONS
Course Code: BPE917

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Understand the basics of machine learning.
2. Understand and apply regression and clustering methods.
3. Understand and apply Bayesian and K-Nearest Neighbours methods.
4. Understand and apply classification methods and dimensionality reduction techniques.

Course Content

UNIT I **15 Hours**

Overview of machine learning: Unsupervised, Supervised, Reinforcement, machine learning problems, components of learning, types of learning. Aspects of developing a learning system: training data, concept representation, function approximation.

UNIT II **10 Hours**

Regression: Univariate Linear Regression and Multivariate Regression. Clustering: Distance measures, Different clustering methods (Distance, Density, Hierarchical), Iterative distance- based clustering, dealing with continuous, categorical values in K-Means.

UNIT III **10 Hours**

Classification: Bayesian Learning (Bayes theorem, Bayes Optimal Classifier, Naïve Bayes classifier), K-Nearest Neighbors.

UNIT IV **10 Hours**

Support Vector Machines, Decision Trees, Boosted Trees, Random Forest, CART, Gradient boosting.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Mitchell, T. (2013). Machine Learning. McGraw Hill.*
- *Alpaydin, E. (2013). Introduction to Machine Learning. Springer*
- *Marsland, S. (2014). Machine Learning: An Algorithmic Perspective. CRC Press.*

Course Title: CYBER SECURITY IN PETROLEUM INDUSTRY

Course Code: BPE918

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Interpret the cyber threat landscape, both in terms of recent developing issues and those issues which persist over time.
2. Illustrate the roles and effects of governments, commercial and other organizations, citizens and criminals in cyber security affairs.
3. Illustrate general values and policies that can be functional to systems to make them more vigorous to attack.
4. Analyze key factors in cyber security from different corrective views including computer science, management.

Course Content

UNIT I **15 Hours**

Overview of Cyber Security, Cyber Threats & Crime, Cyber Espionage, Internet Governance, Challenges and Constraints, necessity for a Comprehensive Cyber Security Policy, necessity for a Nodal Authority, necessity for an International convention on Cyberspace.

Overview, vulnerabilities in software, Intrusion, Physical Theft, Abuse of Privileges, Malware infection, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness.

UNIT II **10 Hours**

Security Practices: Security Management, Security Policy, Risk Management, Information Classification Process, Security Procedures and Guidelines, Business Continuity and Disaster Recovery. Security Safeguards: Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Anti-Malware software.

UNIT III **10 Hours**

Intrusion detection and Prevention Techniques, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges, Network based Intrusion detection & Prevention Systems.

UNIT IV **10 Hours**

Security Laws & Standards: Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy. Cyber Forensic: Overview, Handling Preliminary Investigations, Controlling an Investigation**.**

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Krause, M & Tipton, H. (2004). Handbook of Information Security Management. CRC Press.*
- *Nelson, B. (2016). Computer Forensics and Investigations. Cengage Learning.*
- *Bishop, M. (2002). Computer Security Art and Science. Pearson/PHI.*

Webo-graphy:

1. Cyber Security and Privacy - Course (nptel.ac.in)
2. Introduction To Industry 4.0 And Industrial Internet Of Things - Course (nptel.ac.in)
3. Cybersecurity in Oil & Gas Company | PPT (slideshare.net)
4. Cybersecurity in Oil Gas Industry | PPT (slideshare.net)

Course Title: PROCESS MODELING AND SIMULATION
Course Code: BPE919

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Study the concept of mathematical modeling and its analysis.
2. Understand the various laws for solution of mathematical modeling.
3. Compose mathematical models of typical chemical engineering systems such as reactors, columns, heat exchangers etc.
4. Acquire knowledge about simulation of chemical engineering problems involving lesser number of equations and variables.

Course Content

UNIT I **15 Hours**

Introduction: Definition of mathematical model, lumped parameter models, distributed parameter models, uses of mathematical models, scope of coverage, principles of formulation.

UNIT II **10 Hours**

Fundamental laws

Continuity equations, energy equations, equation of motion, equations of state, equilibrium, chemical kinetics.

UNIT III **10 Hours**

Mathematical Models for Chemical Engineering Systems: Series of isothermal constant holdup CSTRs, CSTRs with variable holdups, Two heated tanks, Non-isothermal CSTR, Single component vaporizer, Batch reactor, Ideal binary distillation column, Batch distillation with holdup, pH systems, Lumped parameter model of gas absorber, Model foe heat exchanger, Model for interacting & non-interacting tanks, Model for biochemical reaction.

UNIT IV **10 Hours**

Simulation: Meaning of simulation, Simulation examples of isothermal CSTR, non-isothermal CSTR. Batch reactor.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Luyben, W. L. (1990). Process Modeling Simulation and Control for Chemical Engineers. McGraw Hill.*
- *Rose, L. M. (1974). The Application of Mathematical Modelling to Process Development and Design (1st Edition). Applied Science Publisher Limited.*
- *Bequette. (2003). Process Dynamics- Modelling, Analysis and Simulation. PHI.*
- *Rase, H.F. (1997). Chemical Reactor Design for Process Plants (Vol II, 1st Edition). John Wiley.*
- *Morton, D.M. (1986). Process Modelling (1st Edition). Longman Publisher.*

Course Title: MODERN SEPARATION PROCESSES
Course Code: BPE920

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Understand the industrial chemical processes and mechanism of separation.
2. Acquire knowledge about the membrane separation phenomena.
3. Study the adsorption process and its applications.
4. Acquire basic knowledge about the ion exchange process and its applications.

Course Content

UNIT I **15 Hours**

Industrial chemical processes, Mechanism of separation, separation power, selection of feasible separation processes. Membrane Materials, Membrane Modules, Transport in Membranes – Porous Membranes, Bulk Flow, Liquid Diffusion in Pores, Gas Diffusion, Nonporous Membranes, Solution-Diffusion for Liquid Mixtures, Solution-Diffusion for Gas Mixtures, Module Flow Patterns, Cascades, External Mass-Transfer Resistances, Concentration Polarization and Fouling.

UNIT II **10 Hours**

Dialysis and Electrodialysis, Reverse Osmosis, Gas Permeation, Pervaporation, Ultrafiltration, Microfiltration. Sorbents: Adsorbents, Ion Exchangers, Sorbents for Chromatography.

UNIT III **10 Hours**

Equilibrium Considerations: Pure Gas Adsorption, Liquid Adsorption, Ion Exchange Equilibria, Equilibria in Chromatography.

Kinetic and Transport Considerations: External Transport, Internal Transport, Mass Transfer in Ion Exchange and Chromatography.

UNIT IV **10 Hours**

Sorption Systems: Adsorption, Ion Exchange, Chromatography, Slurry Adsorption (Contact Filtration), Fixed-Bed Adsorption (Percolation), Thermal-Swing Adsorption, Pressure-Swing Adsorption, Continuous, Countercurrent Adsorption Systems, Simulated-Moving-Bed Systems, Ion-Exchange Cycle, Chromatographic Separations.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- Seader, J.D. & Henley, E.J. (2006). *Separation Processes Principles*. John Wiley.

- Rousseau, R.W. (1987). *Handbook of Separation Process Technology*. Wiley-Interscience.
- Strathmann, H. (2004). *Ion-Exchange Membrane Separation Processes*. Elsevier Science.

Course Title: OPTIMIZATION TECHNIQUES
Course Code: BPE921

L	T	P	Credits
3	0	0	3

Total hours 45

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

1. Study optimization problem and interpret the results of a model and present the insights.
2. Understand about the engineering applications of optimization.
3. Know about optimization of a given single variable, constrained and unconstrained problems using various optimization techniques.
4. Optimize a given multivariable, constrained and unconstrained problems using various optimization techniques and solve linear programming problem.

Course Content

UNIT I **15 Hours**

Introduction: Engineering application of optimization, Design variables, constraints, objective function, variable bounds, statement and formulation of an optimization problem, Examples of chemical engineering Optimization problems, Classification of optimization problems, different optimization algorithms.

Optimal Point: Local optimal point, global optimal point and inflection point.

UNIT II **10 Hours**

Single variable Optimization Techniques:

1. Optimality criterion.
2. Bracketing method (Bounding phase method).
3. Region elimination methods (Internal halving method, Fibonacci search method, Golden section search method).
4. Point estimation method (Successive quadratic estimation methods).
5. Gradient-based methods (Newton-Raphson method, Bisection method, Secant, Cubic search method.)

UNIT III **10 Hours**

Multivariable Optimization Techniques:

1. Optimality criterion – Hessian Matrix and its use in optimization
2. Unidirectional search method.
3. Direct search method (Evolutionary method, Hooke-Jeeves Pattern Search method, Powell's conjugate direction method)
4. Gradient-based methods (Steepest descent method, Newton's method, Marquardt's methods)

UNIT IV **10 Hours**

Constrained Optimization Algorithms: Kuhn - Tucker conditions and Transformation method (penalty function method), Direct search for constrained minimization (variable elimination method, complex search method).

Linear Programming: Linear programming problems, Degeneracy, Simplex method of linear programming, dual phase simplex method.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Deb, K. (2005). Optimization for Engineering, Design Algorithms and Examples. Prentice Hall of India.*
- *Edgar, T.I., Himmelblau, D.M., & Lasdon L.S. (2001). Optimization of Chemical Processes. McGraw Hill.*
- *Rao, S. S. (2009). Engineering Optimization Theory and Practice (4th Edition). John Wiley.*
- *Ray, W. H. and Szekely, J. (1973). Process Optimization with Applications to Metallurgy & Chemical Engineering. Wiley Interscience.*
- *Beveridge, S. G. and Schechter R. S. (1973). Optimization: Theory & Practice. McGraw Hill.*
- *Grewal, B.S. (1991). Numerical Methods in Engineering and Science. Khanna Publishers.*

Course Title: PROCESS PLANT DESIGN
Course Code: BPE922

L	T	P	Credits
3	0	0	3

Total hours 45

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

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

Course Content

UNIT I **15 Hours**

Mechanical Design of Process Equipment: Introduction, Classification of pressure vessels, pressure vessel codes and standards, Fundamental Principles and equations review.

Design Considerations: Design Pressure, Design Temperature, Materials of construction, Weld joint efficiency, corrosion allowance, Design loads

UNIT II **10 Hours**

Design of thin walled vessels under Internal Pressure: Cylindrical and spherical vessels.

Design of heads and closures – design of flat head, conical head, dished heads, hemispherical and elliptical heads.

UNIT III **10 Hours**

Design of thick walled vessels under Internal Pressure Design of Vessels subject to External Pressure: Cylindrical & spherical vessels, Stiffening rings, vessel heads.

UNIT IV **10 Hours**

Design of vessels under combined loading: Dead Weight, wind load.

Design of supports: Skirt support, lug support.

Transaction Mode

Lecture, e-Team Teaching, e-Tutoring, Dialogue, Self-Learning, Collaborative Learning.

Suggested Reading

- *Brownell, L. E. & Young, E. H. (1959). Process Equipment Design. Wiley Interscience.*
- *Bhattacharya, R. C. (1985). An Introduction to Chemical Equipment Design- Mechanical Aspects (1st Edition). CBS Publication.*
- *Mahajani V. V. & Umarji S. B. (2009). Joshi's Process Equipment Design (4th Edition). Macmillan Indian Ltd.*