GURU KASHI UNIVERSITY

Bachelor of Technology in Petroleum Engineering

Single Major (Appendix-III)

Session: 2025-26

Faculty of Engineering & Technology

Graduate Attributes of the Programme: -

Type of learning outcomes	**The Learning Outcomes Descriptors**
Graduates should be able to demonstrate the acquisition of:	
Learning outcomes that are specific to disciplinary/interdisciplinary areas of learning	A strong grasp of the chosen discipline(s), their connections to related fields, and awareness of current and emerging trends in a multidisciplinary context.
	Extensive procedural knowledge for professional tasks, self-employment, entrepreneurship, and innovative organizational strategies.
	Skills in the chosen specialization, including practical abilities for both routine and non-routine tasks in a broad multidisciplinary context.
	Ability to apply learned competencies in new contexts to solve problems, rather than just replicating curriculum content.
Generic learning outcomes	Complex problem-solving: Graduates should demonstrate the ability to solve problems in both familiar and unfamiliar contexts and apply their learning to real-life situations.
	Critical thinking: Graduates should analyze and evaluate knowledge, policies, and evidence, identify assumptions, spot logical flaws, and synthesize data to draw valid conclusions.
	Creativity: Graduates should be able to approach tasks diversely, solve complex problems, innovate, and generate creative solutions in unfamiliar contexts.
	Communication Skills: Graduates should be able to listen, read analytically, and present complex information clearly; express ideas effectively in writing and speaking; share views confidently; construct logical arguments using technical language; and communicate respectfully with sensitivity to gender and minority groups.
	Analytical reasoning: Graduates should evaluate evidence, identify logical flaws, synthesize data from various sources, draw valid conclusions, and address opposing viewpoints with evidence.
	Research skills: Graduates should demonstrate strong observation and inquiry, design research proposals, formulate research questions and hypotheses, test them using data, develop appropriate methodologies,

	use analytical tools, plan and report experiments, and understand and practice research ethics.
	Coordinating/collaborating: Graduates should work effectively with diverse teams, facilitate cooperation, and contribute efficiently to a common goal.
	Leadership qualities: Graduates should be able to set direction, formulate an inspiring vision, build and motivate a team, and use management skills to guide others toward goals.
	'Learning how to learn' skills: Graduates should be able to acquire new knowledge and skills for lifelong learning, adapt to changing work demands, work independently, identify resources for further learning, and develop a lifelong learning attitude.
	Digital literacy: Graduates should be able to use ICT in learning and work, access and evaluate information, and use software for data analysis.
	Multicultural competence: Graduates should understand diverse values and beliefs, engage respectfully in multicultural settings, and lead diverse teams to achieve common goals.
	Value inculcation: Graduates should embrace ethical and humanistic values, practice responsible global citizenship, address ethical issues from multiple perspectives, follow ethical practices, promote sustainability, and act with integrity and objectivity in all work.
	Autonomy, responsibility, and accountability: Graduates should apply knowledge independently, manage projects, and demonstrate responsibility and accountability in work and learning, ensuring safety and security.
	Environmental awareness and action: Graduates should apply knowledge and skills to mitigate environmental degradation, manage waste, conserve biodiversity, and promote sustainable development.
	Community engagement and service: Graduates should be able to actively participate in services and activities that promote societal well-being.
	Empathy: Graduates should be able to understand and relate to the perspectives and emotions of others.

Programme Learning outcomes: An Undergraduate Certificate is awarded to students who have demonstrated the achievement of the outcomes located at level 4.5:

Element of the Descriptor	**Programme learning outcomes relating to Undergraduate Certificate**
Knowledge and understanding	The graduates should be able to master multidisciplinary knowledge, recognize interconnections among learning areas, and acquire procedural skills for effective task performance.
General, technical and professional skills required to perform and accomplish tasks	The graduates should be able to apply cognitive and technical skills to perform multidisciplinary tasks, critically analyze diverse information, and select appropriate methods to enhance problem-solving.
Application of knowledge and skills	The graduates should be able to demonstrate the ability to solve problems in your field, integrate operational, technical, and theoretical knowledge with cognitive and practical skills to choose appropriate methods and tools.
Generic learning outcomes	The graduates should to excel in your field, communicate effectively, engage in self-directed learning, analyze data critically, and make informed, responsible decisions.
Constitutional, humanistic, ethical, and moral values	Uphold constitutional, ethical, and moral values in practice, and effectively articulate related arguments within your field
Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset	Develop essential knowledge and skills for effective job performance in your field, while taking responsibility for individual tasks and contributing to group outcomes.
Credit requirements	55
Entry requirements	A candidate who has passed Senior Secondary Certificate Examination (Class XII level) of the Board of School Education, Punjab; or any other examination recognized as equivalent thereto with minimum passing marks in aggregate, shall be eligible to join First Semester of the Undergraduate (UG) Programme.

Program Structure

SEMESTER: 1st									
Course Code	**Course Title**	**Type of Courses**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BPE1100	Engineering Mathematics–I	Core Course	3	1	0	4	30	70	100
BPE1101	Engineering Chemistry	Core Course	3	0	0	3	30	70	100
BPE1102	Engineering Chemistry Lab	Core Course	0	0	2	1	30	70	100
BPE1103	Communication Skills-I	Ability Enhancement Course	2	0	0	2	30	70	100
BPE1104	Overview of Petroleum Engineering & Technology	Minor Course	3	1	0	4	30	70	100
BPE1105	Principle of Economics	Multidisciplinary Course	3	0	0	3	30	70	100
VAC0001	Environment Education	Value Added Course	2	0	0	2	30	70	100
BPE1106	Manufacturing Practices	Skill Enhancement Course	0	0	6	3	30	70	100
BPE1107	Entrepreneurship Setup & Launch	Skill Enhancement Course	0	0	4	2	30	70	100
Total			**16**	**2**	**12**	**24**	**270**	**630**	**900**

SEMESTER: 2nd									
Course Code	**Course Title**	**Type of Courses**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BPE2150	Engineering Mathematics-II	Core Course	3	1	0	4	30	70	100
BPE2151	Engineering Physics	Core Course	3	0	0	3	30	70	100
BPE2152	Engineering Physics Lab	Core Course	0	0	2	1	30	70	100
BPE2153	Material Science	Minor Course	3	1	0	4	30	70	100
BPE2154	Engineering Graphics & Drawing	DSEC	4	0	0	4	30	70	100
BPE2155	Computer Proficiency	Skill Enhancement Course	2	0	0	2	30	70	100
BPE2156	Computer Proficiency Lab	Skill Enhancement Course	0	0	2	1	30	70	100
BPE2157	Indian Constitution	Multidisciplinary Course	3	0	0	3	30	70	100
VAC0002	Human Values and Professional Ethics	Value Added Course	2	0	0	2	30	70	100
BPE2158	Communication Skills-II	Ability Enhancement Course	2	0	0	2	30	70	100
BPE2159	Entrepreneurship & Marketing Basics	Skill Enhancement Course	0	0	4	2	30	70	100
Total			**22**	**2**	**8**	**28**	**330**	**770**	**1100**

Programme learning outcomes: An Undergraduate Diploma is awarded to students who have demonstrated the achievement of the outcomes located at level 5:

Element of the Descriptor	**Programme learning outcomes relating to Undergraduate Diploma**
Knowledge and understanding	The graduates should be able to develop a broad multidisciplinary theoretical and technical knowledge base, gain in-depth understanding of a specific area, and acquire procedural skills for performing specialized tasks within your program.
Skills required to perform and accomplish tasks	Graduates should to acquire cognitive and technical skills to perform complex tasks and analyze diverse information to generate effective solutions.
Application of knowledge and skills	Graduates should be able to apply specialized knowledge and practical skills to collect and analyze data, selecting appropriate methods and tools to solve field-specific problems.
Generic learning outcomes	The graduates should be able to demonstrate the ability to: •Analyze and communicate complex information effectively to diverse audiences while pursuing self-directed learning to enhance their knowledge and skills. •Evaluate critically theories and practices, make informed decisions, and take responsibility for solving unpredictable problems in their field.
Constitutional, humanistic, ethical, and moral values	The graduates should demonstrate the willingness and ability to: • Embrace the constitutional, humanistic, ethical, and moral values, and practice these values in life, and take a position regarding these values, • Formulate arguments in support of actions to address issues relating the ethical and moral issues relating to the programme of learning , including environmental and sustainable development issues, from multiple perspectives.

Employability and job-ready skills, and entrepreneurship skills and capabilities/qualities and mindset	The graduates should be able to demonstrate the acquisition of knowledge and essential skills set that are necessary to: • Take full responsibility for their tasks and outputs, both individually and as team members, while exercising self-management within their work and study contexts. • Supervise routine work of others, contributing to the evaluation and improvement of activities.
Credit requirements	105
Entry requirements	A student can re-enter into second year of a programme if she/he has taken an exit option after first year (UG Certificate).

SEMESTER: 3rd									
Course Code	**Course Title**	**Type of Courses**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BPE3200	Material and Energy Balance	Core Course	3	1	0	4	30	70	100
BPE3201	Heat Transfer	Core Course	3	0	0	3	30	70	100
BPE3202	Heat Transfer Lab	Core Course	0	0	2	1	30	70	100
BPE3203	Petroleum Exploration	DSEC	3	1	0	4	30	70	100
BPE3204	Basic Electrical & Electronics Engineering	Minor Course	3	0	0	3	30	70	100
BPE3205	Basic Electrical & Electronics Engineering Lab	Minor Course	0	0	2	1	30	70	100
BPE3206	Sustainable Development	Multidisciplinary Course	3	0	0	3	30	70	100
IKS0006	Indian Health Sciences	Indian Knowledge System	2	0	0	2	30	70	100
BPE3208	Professional Communication	Ability Enhancement Course	2	0	0	2	30	70	100
BPE3211	Operations and Scale	Skill Enhancement Course	0	0	4	2	30	70	100
Skill Enhancement Course (Any one of the following)									
BPE3207	Engineering and Solid Mechanics	Skill Enhancement Course	2	1	0	3	30	70	100
BPE3209	Disaster Risk Reduction and Management: Skills for Safety and Resilience		2	0	2				
BPE3210	Basics of Cyber Security		3	0	0				
***Total**			**21**	**3**	**8**	**28**	**330**	**770**	**1100**

SEMESTER: 4th									
Course Code	**Course Title**	**Type of Courses**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BPE4250	Drilling Technology	Core Course	3	1	0	4	30	70	100
BPE4251	Mass Transfer	Core Course	2	1	0	3	30	70	100
BPE4252	Mass Transfer Lab	Core Course	0	0	2	1	30	70	100
BPE4253	Elements of Reservoir Engineering	Core Course	3	1	0	4	30	70	100
BPE4254	Fluid Mechanics and Hydraulic Machines	Vocational Course	2	1	0	3	30	70	100
BPE4255	Fluid Mechanics and Hydraulic Machines Lab	Vocational Course	0	0	2	1	30	70	100
BPE4256	Report Writing	Ability Enhancement Course	2	0	0	2	30	70	100
IKS0009	Indian Agriculture	Indian Knowledge System	2	0	0	2	30	70	100
BPE4260	Organic Growth	Skill Enhancement Course	0	0	4	2	30	70	100
Discipline Elective-I (Any one of the following)									
BPE4257	Thermodynamics	Discipline Elective	3	1	0	4	30	70	100
BPE4258	Advanced Reservoir Engineering								
BPE4259	Drilling Fluids and Cements								
Total			**17**	**5**	**8**	**26**	**300**	**700**	**1000**

Programme learning outcomes: The Bachelor's degree is awarded to students who have demonstrated the achievement of the outcomes located at level 5.5:

Element of the Descriptor	**Programme learning outcomes relating to Bachelor of Vocational**
Knowledge and understanding	The graduates should be able to demonstrate the comprehensive multidisciplinary knowledge with specialized depth in their field, stay informed on emerging developments, and acquire procedural skills for professional tasks.
General, technical and professional skills required to perform and accomplish tasks	Graduates should be able to develop cognitive and technical skills to perform complex tasks, evaluate intricate ideas, and generate solutions to specific problems within their program.
Application of knowledge and skills	Graduates should be able to apply specialized knowledge and skills to gather and analyze data, assess problem-solving approaches, and employ appropriate strategies to generate effective solutions.
Generic learning outcomes	The graduates should be able to demonstrate the ability to: • Analyze and communicate complex information effectively, present study findings clearly, and engage in self-directed learning to adapt to evolving workplace demands. • Evaluate critically evidence, make informed decisions, and exercise sound judgment to generate solutions for field-specific and real-life problems.
Constitutional, humanistic, ethical, and moral values	Graduates should be able to uphold constitutional, humanistic, ethical, and moral values, identify and address ethical issues in their field, and adhere to ethical research practices, avoiding misconduct such as fabrication, falsification.
Employability and job-ready skills, and entrepreneurship skills and capabilities/qual	The graduates should be able to demonstrate the acquisition of: • Acquire essential knowledge and skills for professional roles in their chosen field, including entrepreneurship abilities for self-employment and business management.

ities and mindset	• Capable of supervising others, managing tasks in unpredictable environments, and taking full responsibility for individual and group outcomes.
Credit requirements	157
Entry requirements	A student can re-enter into third year of a programme if she/he has taken an exit option after second year (UG Diploma).

SEMESTER: 5th									
Course Code	**Course Title**	**Type of Courses**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BPE5300	Engineering Mathematics-III	Core Course	3	1	0	4	30	70	100
BPE5301	Petroleum Refining Engineering	Core Course	3	0	0	3	30	70	100
BPE5302	Petroleum Refining Engineering Lab	Core Course	0	0	2	1	30	70	100
BPE5303	Chemical Reaction Engineering	Core Course	3	0	0	3	30	70	100
BPE5304	Chemical Reaction Engineering Lab	Core Course	0	0	2	1	30	70	100
BPE5305	Offshore Drilling and Production Practices	Core Course	4	0	0	4	30	70	100
BPE5306	Mechanical Operations	Vocational Course	3	0	0	3	30	70	100
BPE5307	Mechanical Operations Lab	Vocational Course	0	0	2	1	30	70	100
BPE5314	AI Automation & Finance	Skill Enhancement Course	0	0	4	2	30	70	100
Discipline Elective-II (Any one of the following)									
BPE5308	Petrochemical Technology	Discipline Elective	3	1	0	4	30	70	100
BPE5309	Multicomponent Distillation								
BPE5310	Directional Drilling								
Discipline Elective-III (Any one of the following)									
BPE5311	Waste To Energy	Discipline Elective	3	1	0	4	30	70	100
BPE5312	Non-Conventional Energy Resources								
BPE5313	Machine Learning in Petroleum Operations								
Total			**22**	**3**	**10**	**30**	**330**	**770**	**1100**

SEMESTER: 6th									
Course Code	**Course Title**	**Type of Courses**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BPE6350	Petroleum Production Operations	Core Course	3	1	0	4	30	70	100
BPE6351	Petroleum Formation Evaluation	Core Course	3	1	0	4	30	70	100
BPE6352	Optimization Techniques and Process Integration	Core Course	3	1	0	4	30	70	100
BPE6353	Process Instrumentation and Control	Vocational Course	3	0	0	3	30	70	100
BPE6354	Process Instrumentation and Control Lab	Vocational Course	0	0	2	1	30	70	100
Discipline Elective-IV (Any one of the following)									
BPE6355	Oil and Gas Transportation System	Discipline Elective	3	1	0	4	30	70	100
BPE6356	Pipeline Engineering								
BPE6357	Corrosion Technology								
Discipline Elective-V (Any one of the following)									
BPE6358	Natural Gas Engineering	Discipline Elective	3	1	0	4	30	70	100
BPE6359	Artificial Intelligence in Petroleum Engineering								
BPE6360	Plant Utilities								
Total			**18**	**5**	**2**	**24**	**210**	**490**	**700**

Programme learning outcomes: The Bachelor's degree is awarded to students who have demonstrated the achievement of the outcomes located at level 6:

Element of the Descriptor	**Programme learning outcomes relating to Bachelor Degree**
Knowledge and understanding	The graduates should be able to demonstrate the comprehensive multidisciplinary knowledge with specialized depth in their field, stay informed on emerging developments, and acquire procedural skills for professional tasks.
General, technical and professional skills required to perform and accomplish tasks	Graduates should be able to develop cognitive and technical skills to perform complex tasks, evaluate intricate ideas, and generate solutions to specific problems within their program.
Application of knowledge and skills	Graduates should be able to apply specialized knowledge and skills to gather and analyze data, assess problem-solving approaches, and employ appropriate strategies to generate effective solutions.
Generic learning Outcomes	The graduates should be able to demonstrate the ability to: • Analyze and communicate complex information effectively, present study findings clearly, and engage in self-directed learning to adapt to evolving workplace demands. • Evaluate critically evidence, make informed decisions, and exercise sound judgment to generate solutions for field-specific and real-life problems.
Constitutional, humanistic, ethical, and moral values	Graduates should be able to uphold constitutional, humanistic, ethical, and moral values, identify and address ethical issues in their field, and adhere to ethical research practices, avoiding misconduct such as fabrication, falsification.
Employability and job-ready skills, and entrepreneurship skills and capabilities/qual	The graduates should be able to demonstrate the acquisition of: • Acquire essential knowledge and skills for professional roles in their chosen field, including entrepreneurship abilities for self-employment and business management.

ities and mindset	• Capable of supervising others, managing tasks in unpredictable environments, and taking full responsibility for individual and group outcomes.
Credit requirements	197
Entry requirements	A student can re-enter into third year of a programme if she/he has taken an exit option after third year (B.Voc).

SEMESTER: 7th									
Course Code	**Course Title**	**Type of Courses**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BPE7400	Oil and Gas Well Testing	Core Course	4	0	0	4	30	70	100
BPE7401	Health, Safety & Environment Management in Petroleum Operations	Core Course	4	0	0	4	30	70	100
BPE7402	Enhanced Oil Recovery	Core Course	4	0	0	4	30	70	100
BPE7403	Chemical Process Industries	Minor Course	4	0	0	4	30	70	100
BPE7404	Process Equipment Design	Minor Course	4	0	0	4	30	70	100
Discipline Elective-VI (Any one of the following)									
BPE7405	Recent Advances in Hydrocarbons	Discipline Elective	3	1	0	4	30	70	100
BPE7406	Project Management								
BPE7407	Cyber Security in Petroleum Industry								
BPE7408	Oil and gas Marketing & Resource Management								
Total			**23**	**1**	**0**	**24**	**180**	**420**	**600**

SEMESTER: 8th									
Course Code	**Course Title**	**Type of Courses**	**L**	**T**	**P**	**No. of Credits**	**Int.**	**Ext.**	**Total Marks**
BPE8450	Internship	Skill Based	0	0	0	20	30	70	100
Total			**0**	**0**	**0**	**20**	**30**	**70**	**100**
Grand Total			**139**	**21**	**48**	**204**	**1980**	**4620**	**6600**

SEMESTER: I

Course Title: ENGINEERING MATHEMATICS–I	L	T	P	Cr.
Course Code: BPE1100	3	1	0	4

Total hours: 60

Course 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: ENGINEERING CHEMISTRY	L	T	P	Cr.
Course Code: BPE1101	3	0	0	3

Total hours: 45

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

1. Rationalize periodic properties such as ionization potential, electro-negativity, Oxidation states and electro-negativity.
2. Demonstrate Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and Nano particles,
3. Distinguish the ranges of Vibrational and rotational spectroscopy of diatomic molecules, Applications, Nuclear magnetic resonance and magnetic resonance imaging
4. Demonstrate organic reactions involving addition, substitution, elimination

Course Content

UNIT1 **12 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,

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 II **11 Hours**

Atomic and molecular structure: De Broglie hypothesis and Heisenberg uncertainty principle, Schrodinger equation, Particle in a box solution. Valence Bond theory, its postulates and limitations, Molecular orbital theory and its application for diatomic molecules and plots of the multicenter orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene, Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties.

UNIT III **12 Hours**

Spectroscopic techniques and applications: Principles of spectroscopy and selection rules, electronic spectroscopy, Vibrational and rotational spectroscopy of diatomic molecules, Nuclear magnetic resonance and

magnetic resonance imaging, surface characterization techniques, Fluorescence and its applications.
Ionic, Dipolar and Vander Waals interactions, Equations of state of real gases and Critical phenomena.
Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. The Nernst equation and applications.

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 CHEMISTRY LAB	L	T	P	Cr.
Course Code: BPE1102	0	0	2	1

Total hours: 30

Course 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: COMMUNICATION SKILLS-I	L	T	P	Cr.
Course Code: BPE1103	2	0	0	2

Total Hours: 30

Course 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 **8 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 **7 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: OVERVIEW OF PETROLEUM ENGINEERING AND TECHNOLOGY	L	T	P	Cr.
Course Code: BPE1104	3	1	0	4

Total Hours: 60

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

1. Understand the basics of petroleum production technology and crude processing techniques.
2. Understand the role of drilling fluid and cementing in upstream process.
3. Analyze the change in the crude oil behaviour from reservoir to storage in refinery system and different parameters for upgradation of refining products.
4. Apply the knowledge in identifying types and sources of pollution in petroleum industry and evaluate the role of chemistry in mitigating environmental and safety aspects in petroleum industries.

Course Content

UNIT I **16 Hours**

Petroleum upstream process: Introduction to Crude oil and Natural gases. Composition and properties of Crude oil and Natural Gas. Upstream process - survey, exploration, and drilling. Well stimulation/completion and fracking. Drilling fluid/mud types and uses. Cementing and casing in drilling process. Enhanced Oil Recovery. Concept of gathering, transportation and storage of crude oil and natural gases.

UNIT II **16 Hours**

Petroleum downstream process: Crude pre-treatment processes. Refining of crude oil. Fractional distillation and product profiling. Cracking processes – thermal and catalytic cracking. Process parameters and feed stock quality. Reforming, isomerization etc. and other catalytic upgradation of refining products. Olefins and aromatics. Benzene, Toluene, Xylene (BTX) products.

UNIT III **18 Hours**

Environmental pollution related to petroleum processes: Types of pollution arising from petroleum process. Ground water pollution arising from: – the escape of petroleum, chemicals or fluids, or the cross contamination of aquifers, due to inadequate well design or well failure. Surface water and Soil contamination from spills or leaks from storage tanks holding potential pollutants, drilling muds bit etc. Air pollution such as methane and other

harmful gases emission, venting, flaring, accidents etc. Prevention strategies and pollution control.

UNIT IV **10 Hours**

Challenges and broader economic and environmental impacts. Major international hydrocarbon reserves. Petroleum Economics and drivers in global scale.

Transaction Modes

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

Suggested Readings

- *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.*

Course Title: PRINCIPLE OF ECONOMICS	L	T	P	Cr.
Course Code: BPE1105	3	0	0	3

Total Hours: 45

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

1. Understand the core micro and macroeconomic concepts, theories, models, principles, tools, and techniques
2. Understanding the role of market and prices in influencing key economic activities
3. Develop the skills to interpret, analyze the economic concepts and variables through diagrams, tables and graphs
4. Relate the key economic principles to real life situations, especially in the context of development challenges which would help students to make informed decisions

Course Content

Unit I: 8 Hours

Basic concepts of Economics - Understanding the philosophy o of economics - Nature of economics: Is economics a science or an art? - Definitional pluralities and distinctions such as micro-versus macro, theories versus models - A brief history of ideas in economics - Techniques of economic analysis: theories, models and tools.

Unit II: 10 Hours

Demand, Supply, Elasticities, and Market Efficiency - The economic problem of scarcity, choice, and opportunity cost - Demand, supply, and market equilibrium - Demand and supply applications - Consumer surplus and producer's surplus - Market efficiency and their applications - Elasticity: its various forms and estimation methods, elasticity, and total revenue - Elasticity applications in the field of energy and environment - Utility, Preferences and Choice - Budget constraints, determination of optimal choices using indifference curve analysis and its applications - Behavioral economics as an alternative framework of consumer choice.

Unit III: 12 Hours

Production and Cost - Production Theory - Production function and different forms - Short-run and long-run production function, Isoquants, MRTS - Total, average, and marginal products Economies of scale and scope - Theory of cost - Short-run and long run costs, cost minimization - Total, average and marginal costs - Applications of production and costs theory.

Unit IV: 15 Hours

Market structure and regulation - Market equilibrium and price determination under different market structure - Perfect and Imperfect market structure, welfare costs of monopoly - Market structure, efficiency, and regulation - Regulation of public monopolies - Application in case of infrastructure industries such as energy and water.

National Income Accounting - Measuring national income, output, and employment – different approaches - Determination of aggregate output, price level and interest rate – classical, Keynesian, and modern theories and approaches - GDP estimation in India.

Transaction Modes

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

Suggested Readings

- *Karl Case, Ray Fair, and Sharon Oster. (2017). Principles of Economics, 12th Edition. Pearson Education.*
- *Mankiw, N. Gregory. (2006). Principles of Economics, 4th edition. South-Western College Publications.*
- *Stiglitz, J.E. and C.E. Walsh. (2002). Principles of Economics, 3rd Edition. W.W. Norton & Company.*
- *R. Dornbusch, S. Fischer, and R. Startz. (2012). Macro Economics, 10th Edition, Tata McGraw Hill.*
- *Olivier Blanchard. (2009). Macroeconomics, 5th edition. Pearson Education.*

Course Title: ENVIRONMENT EDUCATION	L	T	P	Cr.
Course Code: VAC0001	2	0	0	2

Total Hours: 30

Course Learning Outcomes: After completing all the units, students will learn:

1. Grasp the concept of Environmental Science, its components, types of natural resources, their distribution, and usage, with a focus on India.
2. Discuss the factors impacting biodiversity loss and ecosystem degradation in India and the world.
3. An overview of Contemporary Environmental Issues i.e National and Global efforts to address climate change adaptation and mitigation.
4. To understand environmental laws for monitoring pollution.
5. Principles guiding human responsibility toward the environment.
6. Toxic chemicals and analytical methods for monitoring environmental pollutants.

Course Content

Unit-I: Human – Environment Interaction, Natural Resources, and Sustainable Development **6 Hours**

The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. Environmental Ethics and emergence of environmentalism: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and Rio Summit. Natural resources: Definition and Classification. Microbes as a resource; Status and challenges. Environmental impact of over-exploitation, issues and challenges; Water scarcity and Conflicts over water. Mineral resources and their exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. Energy resources: Sources and their classification. Implications of energy use on the environment. Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs.

Unit-II: Biodiversity Conservation and Environmental Issues **6 Hours**

Biodiversity as a natural resource; Levels and types. Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat

categories. Major ecosystem types in India, their services, classification, significance and characteristics of forests, wetlands, grasslands, agriculture, coastal and marine; Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. Major conservation policies: in-situ and ex-situ approaches; National and International Instruments for biodiversity conservation; the role of traditional knowledge, community-based conservation; Gender and conservation. Environmental issues and scales: micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. Pollution: Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste; transboundary air pollution; acid rain; smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. Global change: Ozone layer depletion; Natural Disasters – Natural and Man-made (Anthropogenic).

Unit-III: Environmental Pollution, Health, Climate Change: Impacts, Adaptation and Mitigation **8 Hours**

Definition of pollution; Point and non-point sources. Air pollution: sources, Impacts, Primary and Secondary pollutants; Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide; Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; National Ambient Air Quality Standards. Water pollution: Sources; River, lake and marine pollution, groundwater pollution, impacts; Water quality parameters and standards. Soil pollution: sources and pollutants. Solid and hazardous waste, its impacts. Noise pollution: Definition, Unit of measurement, sources, noise standards; adverse impacts. Thermal and Radioactive pollution: Sources and impacts. Climate change: natural variations in climate due to greenhouse gas emission- past, present & future. Structure of atmosphere. Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent. Impacts, vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests, natural ecosystems, animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change. Mitigation of climate change: Synergies between adaptation and mitigation measures; Green House Gas

(GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.

Unit-IV: Environment Management, Treaties and Legislation **10 Hours**
Introduction to environmental laws and regulation: Article 48A, Article 51A (g) and other environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001 Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis Environmental audit and impact assessment; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Ecomark scheme. Bilateral and multilateral agreements on international co-operation of instruments; conventions and protocols; binding and nonbinding measures; Conference of the Parties (COP) Major International Environmental Agreements:- Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention, Minamata Convention, United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions Major Indian Environmental Legislations: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards; Waste management rules; Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone; Production and consumption of Ozone Depleting substances, Green Tribunal; Some landmark Supreme Court judgements Major International organisations and initiatives: United Nations Environment Programme

(UNEP), International Union for Conservation of Nature (IUCN),World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.

Suggested Readings: -

- *Chahal, M. K. (2024). Environmental Science and Hazards Management (Ecology and Risk Management), ISBN:978-93-6440-586-7.*
- *Baskar, S. and Baskar, R. (2009). Natural Disasters (Earth's Processes & Geological Hazards), ISBN: 978-81-7806-168-9.*
- *Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/*
- *Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.*
- *Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.*
- *Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238.*
- *William P.Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA)*
- *Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/ standards/*
- *Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.*
- *Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/ convention-V-16-CURVE-web.pdf*

Webo-graphy:

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

Course Title: MANUFACTURING PRACTICES	L	T	P	Cr.
Course Code: BPE1106	0	0	6	3

Total Hours: 90

Course 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 **19 Hours**

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

UNIT II **19 Hours**

Fitting operations & power tools, Electrical & Electronics, Carpentry.

UNIT III **18 Hours**

Plastic moulding, glass cutting, Metal casting.

UNIT IV **19 Hours**

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

Workshop Practice:

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 hours + gas welding 4 hours)
6. Plastic moulding & Glass cutting – 6 hours

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

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*. Dhanpat Rai & Sons.
- Jain, R.K. (2010*). Production Technology. Khanna* Publishers.
- Singh, S. (2003). *Manufacturing Practice*. S.K. Kataria & Sons.

Course Title: ENTREPRENEURSHIP SETUP & LAUNCH	L	T	P	Cr.
Course Code: BPE1107	0	0	4	2

Total Hours: 30

Introduction:
This semester lays the foundation for the learner to understand what entrepreneurship is, beyond just starting a business. It introduces key ideas like problem-solving, value creation, and self-awareness. The learner will begin exploring basic business concepts while discovering their own interests and strengths.

Learners Objective:
1. Understand the core concepts of entrepreneurship through relatable, real-life examples.
2. Begin to see themselves as problem-solvers and creators.
3. Learn about business paths and choose one to try based on interest or local fit.
4. Launch a micro-hustle (online or offline) to earn their first income.
5. Build confidence and self-belief by doing.

Outcome: By the end of this semester, learners will start a simple business activity, earn their first income, and build belief in their ability to do business.

Guiding Principles/Approach:
This syllabus is built on principles of **experiential learning, growth mindset development**, and **identity-first learning**. Drawing from learning science and behavior design, the course shifts students from passive learning to *active doing*, where they try out small business activities in real contexts. The design helps students not just learn entrepreneurship, but begin to see themselves as entrepreneurs. Emphasis is placed on *small wins, peer collaboration, and locally relevant opportunities* to ensure learning feels achievable and connected to their realities. The curriculum focuses on conceptual understanding without heavy theory, combining *practical action, reflection, and collaboration*. By making progress visible and success feel possible, it plants the seeds of self-reliance, initiative, and long-term motivation.

Semester Syllabus:
Format: 12 weeks, 4 hours/week | 2 credits
Revenue Target: ₹10,000

Week	Learning Goal	Measurable Outcome
1	Understand what entrepreneurship is and who can be an entrepreneur	Students define entrepreneurship in their own words and list 2 entrepreneurs from their local area or community
2	Connect personal identity to entrepreneurship (strengths, interests, struggles)	Students create a “value map” showing how a skill/interest/problem from their life could become a business opportunity

3	Learn about 5 business paths: content creation, dropshipping, cloud kitchen/food business, gig economy and local services	Students explore 1–2 examples from each domain and share one they're most curious to try and why
4	Choose a path and generate a basic business idea	Students write down a clear offer (what, for whom, why) and one way to reach their customer
5	Take first real action: message, post, pitch, or sell	Students reach out to or serve 1 real potential customer and record what happened
6	Reflect on first attempt and share with peers	Students share their result, a challenge faced, and one idea to improve next time
7	Improve and try again: aim for first ₹100	Students apply a change, try again, and aim to make their first ₹100 or get meaningful response
8	Learn how to identify and understand your target customer	Students talk to 2 potential customers or observe them and list 3 insights about their needs
9	Learn how to serve your target audience better	Students improve one part of their offer (product, delivery, messaging, or interaction) based on customer feedback or need
10	Explore core entrepreneurial values (resilience, honesty, effort)	Students reflect on 1 value they're building and show it in a business task or peer story
11	Focus on earning and staying consistent	Students complete a second earning task and track their consistency (e.g., same product or message for 3 days)
12	Reflect on earnings, grit, and how to keep going	Students record total earnings, one resilience moment, and one support system or habit they'll continue with

Weekly Component:

Component	Duration	Description
Learning Module	~1.5 hrs	- Introduces key concepts in a simple and engaging way - Includes, examples, and 1–2 interactive discussions or quizzes
Action Lab	~2 hrs	- Hands-on task on the weekly concept - Includes step-by-step guidance, templates, and worksheets - Ends with a submission (e.g., video, reflection, or proof of action)
Resources	Self-paced	- Supplementary videos, short readings, real-life stories, and tools to deepen understanding at their own pace

Evaluation Criteria

Evaluation Component	Description	Weightage
Weekly Task Completion	Timely submission of weekly tasks including reflections, activities, quizzes etc.	40%
Target Completion	Performance-based evaluation on hitting **revenue or profit targets** (e.g., generating ₹10,000 revenue)	30%
Final Project	A comprehensive project based on the semester's theme	30%

SEMESTER: II

Course Title: ENGINEERING MATHEMATICS–II	L	T	P	Cr.
Course Code: BPE2150	3	1	0	4

Total hours: 60

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

1. Demonstrate the methods of forming and solving Ordinary differential equations and Solve linear differential equations with constant and variable coefficients
2. Apply the concept of differential equation and classifies the differential equations with respect to their order and linearity.
3. Calculate 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 Mode

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

Suggested Readings:

- *Thomes, G.B.and Finney, R. L. (2010). Calculus and Analytic Geometry. Pearson Education.*
- *Kreyszig, E. (1998). Advanced Engineering Mathematics. John Wiley and sons.*
- *Grewal, B.S. (1965). Higher Engineering Mathematics; Khanna Publishers, New Delhi.*
- *Babu Ram (2009). Advance Engineering Mathematics. Pearson Education.*
- *Richard Courant and Fritz John (2012). Introduction to Calculus and Analysis. Springer Publication.*
- *Harold M. Edwards (2013) Advanced Calculus: A Differential Forms Approach, Birkhauser.*

Course Title: ENGINEERING PHYSICS	L	T	P	Cr.
Course Code: BPE2151	3	0	0	3

Total hours: 45

Course 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 **12 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 **13 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 **10 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 **10 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, Fraunhoffer 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 PHYSICS LAB	L	T	P	Cr.
Course Code: BPE2152	0	0	2	1

Total hours: 30

Course 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

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/study 7-8 experiments from the syllabus.

Course Title: MATERIAL SCIENCE	L	T	P	Cr.
Course Code: BPE2153	3	1	0	4

Total Hours: 60

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

1. Appreciate the necessity of engineering materials, Smart Sensors and its applications in various fields.
2. Identify possible cause of failure due to fatigue and Creep.
3. Demonstrate the knowledge of nucleation, Crystal growth, Solid solution and Phase diagrams.
4. Appreciate the significance and applications of Various heat treatment processes and explain classification and fabrication processes of composite materials.

Course Content

UNIT I **15 Hours**

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

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

UNIT II **15 Hours**

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

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

UNIT III **15 Hours**

Solidification and phase diagram: Mechanism of solidification, Homogenous and Heterogeneous nucleation. Cristal Growth, Cast metal

strictures, Phase diagram. Solid solutions, Substitution and Interstitial solid solution, Humerothary rule, Intermediate phase, construction of equilibrium diagram involving complete and partial solubility, lever rule, Gibb's phase rule.

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

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

UNIT IV **15 Hours**

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

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

Transaction Modes

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

Suggested Readings

- *W. D. Callister, Jr. (2014). Materials Science and Engineering- An Introduction to Materials Science and Engineering, 2nd Edition, Wiley India (P) Ltd.*
- *J. F. Shackelford. (1992). Introduction to Materials Science for Engineers. Mc-Millan Publishing Co., N. Y.*
- *Avner S H. (2017). Introduction to Physical Metallurgy, 2nd Edition, McGraw Hill Education.*
- *Autar K. Kaw. (2005). Mechanics of Composite Materials, Second Edition. CRC Press.*
- *M. V. Gandhi and B. So Thompson. (1992). Smart Materials and Structures. Chapman & Hall.*
- *Shackleford. & M. K. Muralidhara. (2007). Materials Science. Pearson Publication.*
- *Dr. V.D. Kodgire & S. V. Kodgire. (2015). Material Science & Metallurgy for Engineers. Everest Publication.*

- *A. K. Bhargava, & C.P. Sharma. (2015). Mechanical Behavior & Testing of Materials. PHI Learning Private Ltd.*

Course Title: ENGINEERING GRAPHICS & DRAWING	L	T	P	Cr.
Course Code: BPE2154	4	0	0	4

Total hours: 60

Course 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 **22 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 **22 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 **24 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 **22 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: COMPUTER PROFICIENCY	L	T	P	Cr.
Course Code: BPE2155	2	0	0	2

Total hours: 30

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

1. Develop the ability to analyze and solve AI-related problems using intelligent agents, search strategies, optimization techniques, and decision-making frameworks, preparing for real-world applications in diverse fields
2. Acquire practical knowledge and skills in PC maintenance, security, and troubleshooting, including software updates, hardware cleaning, file management, and resolving basic technical issues to ensure efficient computer performance.
3. Develop foundational knowledge of computer networks, internet applications, web security, and troubleshooting, along with practical skills in using web browsers, search engines, and online collaboration tools.
4. Understand the latest trends in IECT, e-Governance, cloud and mobile computing, digital signatures, and their applications in governance and project management, ensuring a comprehensive foundation for modern digital systems.

Course Content

UNIT I **5 Hours**

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games.

UNIT II **10 Hours**

PC Maintenance, Security & Troubleshooting: Computer Maintenance and Security: Overview of Computer Maintenance and Security, Inbuilt PC Security, tools, Securing documents, Antivirus, Upgrading Operating System and Application software. security; Cleaning the monitor, keyboard, CPU; Deleting unnecessary programs and files: Disk cleanup, deleting toolbars; defrag hard drive; Computer maintenance programs: Ccleaner, myDefrag,

Spinrite etc.; Basic troubleshooting: restart computer, checking cables, uninstalling a software, start windows in safe mode etc.; Windows installation and upgrades, CPUs and motherboards, Memory systems, Expansion cards, Data storage devices, Ports, connectors, and cables, Printers and scanners, Display devices, Portable computers and devices, Networking, Security, Maintaining the PC environment.

UNIT III **10 Hours**

Basic of Computer Networks: LAN, WAN, Wi-Fi, Broadband, Bluetooth; Internet: Concept of Internet, Applications of Internet, Connecting to the Internet, Troubleshooting; WWW, TCP/IP, DNS, Search Engine; Key web browser features, Brief about switch, router, gateway; Various applications of Internet: e-mail, information gathering, retailing etc.; Methods of connecting to the Internet: Dial up, ISDN and broadband; Brief introduction to Internet addressing, Internet protocols (TCP/IP, FTP and HTTP); Define and understand the terms: Internet Service Provider (ISP), Uniform Resource Locator (URL), hyperlink; Internet protocols (TCP/IP, FTP and HTTP); Define and understand the terms: Internet Service Provider (ISP), Uniform Resource Locator (URL), hyperlink; Know how to identify a secure web site:https, lock symbol; Security Considerations: Know about security threats from web sites like: viruses, worms, Trojan horses, spyware.

Using Favorites Folder, Downloading Web Pages, Printing Web Pages, Understanding URL, Set the web browser Home Page/Start page; Bookmark a web page, Delete a bookmark, Publishing on the Web, Downloading Web Pages, Printing Web Pages; Complete a web-based form using: text boxes, drop-down menus, list boxes, check boxes, radio buttons; Understanding benefits of Search Engines and Popular Search Engines (Google, Alta Vista, Excite); Commerce on Internet, Impact of Internet on Society.

Overview of use of search engines and e-mail messages; Instant Messaging and Collaboration: Using Instant messaging, Instant messaging providers, Use of Social Networking Sites viz. Facebook, Twitter etc.; Introduction to the concepts of IPv4 and IPv6 networks; Network troubleshooting.

UNIT IV **5 Hours**

Latest trends in IECT & e-Governance: Applications of IECT: e-governance, Multimedia and Entertainment; Project Management using IT tools & related applications; Introduction to Cloud Computing: What is cloud computing, Properties & Characteristics, Service models, Deployment models; Concepts of: IaaS (Infrastructure as a Service), PaaS (Platform as a Service), SaaS (Software as a service), DaaS (Desktop as a Service); Introduction to Mobile Computing, its components and characteristics; Digital signature: definition as per ITA 2000, how digital signature works; role of certifying authorities: Digital Certificates and their uses, Certifying

Authority regulation in India, Obtaining a trial version of a Digital Certificate; legal aspect covering digital signatures in India; how to use digital signatures on electronic documents. Legal aspects covering digital signatures in India.

e-Governance: Definition of e-Governance, Pillars of e-Governance, Infrastructure for e-Governance, Mission Mode Projects (At least 5), Familiarization with terminology like change management, processing engineering, Govt. Processing engineering and Governance, e-Governance project life cycle, electronically delivery of services, messaging system and case study of any 5 public utility portal related with the Department (especially, public grievance redressal system, RTI, Vigilance, Department working and financial inclusion, linkage with Aadhar etc.)

Transaction Modes

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

Suggested Readings

- *Stuart Russell and Peter Norvig. (2020). Artificial Intelligence: A Modern Approach. PHI.*
- *David L. Poole and Alan K. Mackworth. (2017). Artificial Intelligence: Foundations of Computational Agents. Cambridge University Press.*
- *Scott Mueller. (2015). Upgrading and Repairing PCs. QUE.*
- *Behrouz A. Forouzan. (2017). Data Communications and Networking. McGraw Hill.*
- *Thomas Erl et al. (2013). Cloud Computing: Concepts, Technology & Architecture. Pearson Education.*
- *Darrell M. West. (2005). Digital Governance: Leveraging Digital Technology for Governance, Growth and Inclusion. Princeton University Press.*
- *C.S.R. Prabhu. (2006). e-Governance: Concepts and Case Studies. PHI.*

Course Title: COMPUTER PROFICIENCY LAB	L	T	P	Cr.
Course Code: BPE2156	0	0	2	1

Total Hours: 30

Course 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. Use 3D effects on prescribed presentation
4. Applications of MS-Office MS-Word, MS-Excel, MS-PowerPoint.
5. Create web pages using different tags.
6. Web Browser and E-Mail
7. Conversion of a word documents into PDF/ Image conversion using image file format.
8. Computer Hardware.

Course Title: INDIAN CONSTITUTION	L	T	P	Cr.
Course Code: BPE2157	3	0	0	3

Total hours: 45

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

1. Identify and explore the basic features and modalities about Indian constitution.
2. Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
3. Differentiate different aspects of Indian Legal System and its related bodies.
5. Discover and apply different laws and regulations related to engineering practices.
6. Correlate role of engineers with different organizations and governance models.

Course Content

Unit I **10 Hours**

Introduction and Basic Information about Indian Constitution: Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Unit II **12 Hours**

Union Executive and State Executive: Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister,

Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Unit III **12 Hours**

Introduction and Basic Information about Legal System: The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

Unit IV **11 Hours**

Intellectual Property Laws and Regulation to Information: Intellectual Property Laws: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

Transaction Mode

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

Suggested Readings:

- *Basu, D.D. (2001). Introduction to the Constitution on India. Prentice Hall.*
- *Charles E. Haries, Michael S Pritchard and Michael J. Robins "Engineering Ethics" Thompson Asia, 2003-08-05.*
- *Pylee, M.V. (2002). An Introduction to Constitution of India. Vikas Publishing.*
- *Govindarajan, M., Natarajan, S. & Senthil kumar, V.S. (2004). Engineering Ethics. Prentice Hall of India Pvt. Ltd. New Delhi.*
- *Sharma, B.K. (2011). Introduction to the Constitution of India. PHI Learning Pvt. Ltd., New Delhi.*
- *Latest Publications of Indian Institute of Human Rights, New Delhi.*

Course Title: HUMAN VALUES AND PROFESSIONAL ETHICS	L	T	P	Cr.
Course Code: VAC0002	2	0	0	2

Total Hours: 30

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

1. Understand the essence of Indian ethos, cultural values and ethical principles derived from scriptures, integrating self-exploration with scientific inquiry.
2. Analyze human values, self-awareness and ethical decision-making by distinguishing between perspectives, ideologies and universal moral principles.
3. Evaluate constitutional values, global responsibilities and the role of ethics in citizenship while promoting inclusivity and social welfare.
4. Develop essential life skills, stress management techniques and holistic well-being through mindfulness, self-discipline and personality development.

Course Content

Unit-I Introduction to Indian Ethos **7 Hours**

Meaning of ethos and cultural essence of India, Scriptures as the base of the Indian Knowledge System (IKS), Integrating the two methodologies: interiorization process for self-exploration and exterior scientifc pursuit for the prosperity of world, The Law of Karma and Nishkama Karma (The Law of action and selfless action), Practical: Five hours of Yoga practice per week, Ethics through Music and Indian Poetry, Community Engagement

Unit-II Human Values and Ethics **8 Hours**

Knowing the Self and the universal values that we stand for. This is self-enquiry & self-discovery, Background conversations and deep listening, recognizing the assumptions that we make, the biases we have and the implications for ethical action. Self-identity: distinguishing and embracing oneself (and others) four profiles (inner potential, social, professional, personality), Distinguish ideology, perspectives beliefs from embodying values. Practical: Self-discovery, self-enquiry and Mindfulness, Yama & Niyama of Ashthang Yoga

Unit-III Constitutional Values, Global Responsibility & Skills for Youth **7 Hours**

Values embedded in the Preamble of the Indian Constitution, Integration of Human Rights and duties. Principles and responsibilities: as citizens of India, towards global environment, Loksangraha and Vasudhaiva Kutumbakam, Conscious Full Spectrum Response model. Distinguishing judgement from discernment, Practical: Development of concentration among students through music, fine arts, mathematics, sports, yoga and mindfulness

Unit-IV Integrated Personality and Well-being **8 Hours**

The three gunas (qualities of sattva—purity and harmony, rajas —activity and passion, tamas —darkness and chaos), the four antah-karanas (inner instruments) and panch kosha (five sheaths), Stress management, Oneness, non-duality and equanimity, Physical, mental, social and spiritual well-being. Practical: Talks on importance of the Ayurvedic concept of well-being and nutrition, sports activities.

Suggested Readings:

- *Mahadevan, B., Bhat, V.R. and Nagendra, P.R.N. 2022. Introduction to Indian Knowledge System. Delhi: PHI.*
- *Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.*
- *Kashyap, Subhash C. 2019. Constitution of India. A handbook for students. New Delhi: National Book Trust.*
- *Dr. Awadesh Pradhan, Mahamana ke Vichara". (B.H.U., Vanarasi 2007)*
- *Harold Koontz & Heinz Weihrich, Essentials of Management, Tata McGraw Hill.*
- *Lama, D. 2012. Beyond Religion: Ethics for a Whole World. India: Harper Collins.*
- *Shrimad Bhagavad-Gita (Part of the Mahabharata). 1994. Gorakhpur: Gita Press. Swami Harshananda. 2000. The Birds' Eye View of the Vedas. Bangalore: Ramakrishna Math.*
- *Fontaine, D. K., Rushton, C. H. and Sharma, M. 2013. Cultivating Compassion and Empathy. In: M. Plews-Ogan and G. Beyt (Eds.), Wisdom Leadership in academic Health Science Centers- Leading Positive Change. London: Radcliffe Publishing.*
- *Blanchard, Kenneth and Peale, Norman Vincent. 1988. The Power of Ethical Management. New York: William Morrow and Company, Inc.*
- *Gandhi, Mohandas Karamchand. 1971. Pathway to God compiled by MS Deshpande. Ahmedabad: Navajivan Mudranalaya, Navjivan Trust.*
- *Gardner, H. 2006. Five Minds for the Future. Boston: Harvard Business School Press.*

- *Rodriguez, S. and Juvva, S. 2018. Embodying Universal Values and Ethical Leadership in Higher Education: Creating Change Agents for Social Transformation. In B. Chatterjee, A. Banerji and P. Arya (Eds.). Resolution to Resolve: Sustainability Practices in Industry and Education. New Delhi: Bloomsbury [ISBN: 978-938-74-7168-9].*
- *Sharma, M. 2017. Radical Transformational Leadership: Strategic Action for Change Agents. Berkeley, US: North Atlantic Books.*

Webo-graphy:

- https://www.holy-bhagavad-gita.org/
- https://iksindia.org/
- NPTEL Course: Exploring Human Values: Visions of Happiness and Perfect Society
- https://ebooks.inflibnet.ac.in/hrmp01/

Course Title: COMMUNICATION SKILLS-II	L	T	P	Cr.
Course Code: BPE2158	2	0	0	2

Total hours: 30

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

1. Start conversations, respond appropriately, use visuals, and build vocabulary with various tools like synonyms and idioms.
2. Develop techniques for skimming, scanning, guessing meanings, and critical reading and master professional writing formats like resumes, emails, and technical reports.
3. Strengthen oral and written presentation skills with seminars, posters, and assignments.
4. Improve group dynamics, body language, and prepare with mock interviews.

Course Content

Unit I **5 Hours**

Fundamentals of Inter-Personal Communication and Building Vocabulary:

Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.

Unit II **10 Hours**

Reading Comprehension: General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effective googling.

Writing Skills: Structure and presentation of different types of writing – letter writing/Resume writing/ e-correspondence/Technical report writing/ – planning for writing – improving one's writing

Unit III **8 Hours**

Presentation Skills: Oral presentations (individual and group) through JAM sessions/seminars/PPTs and written presentations through posters/projects/reports/ emails/assignments etc.

Unit IV **7 Hours**

Group Discussion and Interview Skills: Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

Transaction Mode

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

Suggested Readings:

- *M Asharaf Rizvi. (2022). Effective Technical Communication. McGraw Hill Education (India) Pvt. Ltd.*
- *Stephen Bailey. (2018). Academic Writing: A Handbook for International Students. Routledge.*
- *Shiv K. Kumar and Hemalatha Nagarajan. (2007). Learn Correct English – A Book of Grammar, Usage and Composition. Pearson.*
- *Aruna Koneru. (2016). Professional Communication. McGraw Hill Education (India) Pvt. Ltd.*
- *Meenakshi Raman & Sangeeta Sharma. (2009). Technical Communication. Oxford University Press.*
- *Paul V. Anderson. (2007). Technical Communication. Cengage Learning pvt. Ltd. New Delhi.*
- *English Vocabulary in Use series, Cambridge University Press 2008.*
- *David A. McMurrey & Joanne Buckley. (2012). Handbook for Technical Communication. Cengage Learning.*
- *Leena Sen. (2009). Communication Skills. PHI Learning Pvt Ltd.*
- *Colm Downes. (2008). Job Hunting. Cambridge University Press.*
- *Aysha Vishwamohan. (2009). English for Technical Communication for Engineering Students. Tata McGraw Hill.*

Course Title: ENTREPRENEURSHIP MARKETING BASICS	L	T	P	Cr.
Course Code: BPE2159	0	0	4	2

Total hours: 30

Introduction

This semester helps learners understand marketing as a practical life skill - not just "advertising." It teaches them how to communicate value, attract the right customers, and grow something small into something sustainable. Learners explore the basics of customer psychology, messaging, content creation, and simple sales strategies. Through hands-on activities, they will practice real marketing techniques for their micro-hustle or a simulated business idea, learning how to get attention, build trust, and generate sales.

Learners Objective

→ Understand the core concepts of marketing using simple, relatable real-world examples.
→ Learn how customers think, choose, and buy—and how businesses influence decisions ethically.
→ Identify and define a target customer clearly instead of "selling to everyone."
→ Create clear messaging: what they sell, who it helps, and why it matters.
→ Use basic marketing channels (offline + online) to attract customers.
→ Run a simple marketing campaign and measure what worked.
→ Build confidence in selling, promoting, and talking about their product/service.

Outcome

By the end of this semester, learners will be able to market a product/service using basic strategies, attract real customers, and improve their results through feedback and experimentation.

Guiding Principles/Approach

This syllabus is built on action-based learning, clarity-first communication, and customer-first thinking. Learners don't just study marketing - they practice it in real situations through small experiments and repeated improvement. The course is designed to feel approachable and practical: learners create simple content, test messaging, talk to real people, and observe what influences decisions. Instead of heavy theory, students build marketing skills through doing: customer discovery, storytelling, channel experiments, and reflection. The curriculum emphasizes confidence-

building, ethical marketing, and communication as a leadership skill. By helping learners see results quickly (even small wins like one customer or one inquiry), the program builds motivation, creativity, and real-world business readiness.

Curriculum

1. Recap Milestone
   Recap and Introduction
2. Milestone 13: Marketing Fundamentals
   Learn marketing fundamentals to scale your business
3. Milestone 14: WhatsApp Community Marketing
   Build and activate your WhatsApp community
4. Milestone 15: Generating Content for Marketing using AI
   Use AI to generate content for marketing
5. Milestone 16: Social Media Marketing
   Plan your social media marketing strategy
6. Milestone 17: Trust-led Marketing
   Generate leads and turn them into sales
7. Milestone 18: Viral/Trend Marketing
   Make your brand go viral
8. Milestone 19: BTL/Offline Marketing
   Drive revenue through offline/BTL marketing
9. Milestone 20: Collaboration and Affiliate Marketing
   Grow through collaboration and affiliate marketing
10. Milestone 21: Advertising Marketing (Meta)
    Run your first ad on Instagram
11. Milestone 22: Psychological Marketing
    Use Psychological Triggers to Increase Sales
12. Milestone 23: Data-Driven Marketing
    Use Data-Driven Marketing to Grow Faster
13. Milestone 24: Closure and Next Step
    Plan your next growth phase

SEMESTER: III

Course Title: MATERIAL AND ENERGY BALANCE	L	T	P	Cr.
Course Code: BPE3200	3	1	0	4

Total hours: 60

Course 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 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 **15 Hours**

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

UNIT III **20 Hours**

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

UNIT IV **15 Hours**

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

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.*

Webo-graphy:

- https://archive.nptel.ac.in/courses/102/106/102106069/
- https://onlinecourses.nptel.ac.in/noc20_bt07/preview
- https://nptel.ac.in/courses/102106069
- https://archive.nptel.ac.in/courses/103/105/103105209/

Course Title: HEAT TRANSFER	L	T	P	Cr.
Course Code: BPE3201	3	0	0	3

Total hours: 45

Course 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. Illustrate the heat transfer processes involved in heat exchangers.
4. Classify evaporators and interpret the mechanism.

Course Content

UNIT I **10 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. Modelling 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 III **15 Hours**

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

UNIT IV **10 Hours**

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

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.*
- *Kreith, F., Manglik, R.M., & Bohn, M.S. (2010). Principles of Heat Transfer. Brooks Cole Thomson Learning Publication, 7th Edition.*
- *Incopera, F.P., DeWitt, D.P., Bergman, T.L., & Lavine, A.S. (2011). Fundamentals of Heat and Mass Transfer. John Wiley, 7th Edition.*
- *Geankopolis, C J. (2004). Transport Processes and Separation Process Principles. Prentice Hall of India, 4th Edition (Eastern Economy Edition).*
- *Coulson, J. M. & Richardson, J. F. (1999). Chemical Engineering, Volume 1. Pergamon Press.*

Webo-graphy:

- NPTEL :: Chemical Engineering - NOC:Heat Transfer
- NPTEL : NOC:Heat Transfer (Chemical Engineering) (digimat.in)
- Heat Transfer - Course (nptel.ac.in)
- Heat transfer | PPT (slideshare.net)
- Lectures on Heat Transfer - Introduction - Applications - Fundamentals - Governing Laws | PPT (slideshare.net)

Course Title: HEAT TRANSFER LAB	L	T	P	Cr.
Course Code: BPE3202	0	0	2	1

Total hours 30

Course 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. Operate equipment based upon processes involving gas absorption, drying of solids, adsorption, distillation, liquid-liquid extraction and leaching

Course Content

List of Experiments

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

Webo-graphy:

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

Course Title: PETROLEUM EXPLORATION	L	T	P	Cr.
Course Code: BPE3203	3	1	0	4

Total hours: 60

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

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

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 II **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 III **15 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.

UNIT IV **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.

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

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.*
- *6.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.*

Webo-graphy:

- Petroleum Exploration - (oil-gasportal.com)
- (PDF) An Introduction to Petroleum Exploration Methods (researchgate.net)
- Petroleum exploration - AAPG Wiki

Course Title: BASIC ELECTRICAL & ELECTRONIC ENGINEERING	L	T	P	Cr.
Course Code: BPE3204	3	0	0	3

Total hours: 45

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

1. Calculate and measure basic electrical quantities and parameters.
2. Use different electrical machines by making connections.
3. Use electrical safety devices in electrical circuit
4. Use relevant diode in different electronic circuits.
5. Use BJT and FET in various electronic circuits.
6. Use various types of sensors and transducers.

Course Content

UNIT I **8 Hours**

ELECTRICAL CIRCUITS

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law – Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT II **12 Hours**

ELECTRICAL MACHINES

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT III **15 Hours**

ANALOG ELECTRONICS

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode – Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters

DIGITAL ELECTRONICS

Review of number systems, binary codes, error detection and correction codes, Combinational logic – representation of logic functions-SOP and POS forms, K-map representations – minimization using K maps (Simple Problems only).

UNIT IV **10 Hours**

MEASUREMENTS AND INSTRUMENTATION

Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO-Block diagram- Data acquisition.

Transaction Mode

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

Suggested Readings:

- *N.Mittle. (1990). Basic Electrical Engineering. Tata McGraw Hill.*
- *A.K. Sawhney. (2004). A Course in Electrical & Electronic Measurements & Instrumentation. Dhanpat Rai and Co.*
- *Jacob Millman and Christos C-Halkias. (2010). Electronic Devices and Circuits. Tata McGraw Hill*
- *Edminister J.A. (2015). Theory and problems of Electric Circuits" Schaum's Outline Series. McGraw Hill.*
- *Hyatt W.H and Kemmerlay J.E. (2015). Engineering Circuit Analysis. McGraw Hill Internatinal Editions.*
- *D. P. Kothari and I. J. Nagrath. (2004). Electric machines. Tata McGraw Hill.*
- *Millman and Halkias. (2004). Integrated Electronics. Tata McGraw Hill.*

Course Title: BASIC ELECTRICAL & ELECTRONIC ENGINEERING LAB	L	T	P	Cr.
Course Code: BPE3205	0	0	2	1

Total hours: 30

Course 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

Electrical

1. Verification of ohms and Kirchhoff's Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self-excited DC Generator
4. Load test on Single-phase Transformer
5. Load Test on Induction Motor

Electronics

6. Experiment on Transistor based application circuits (Inverting and non-inverting amplifier or switching circuits)
7. Experiments on Operational Amplifier-based Inverting and non-inverting amplifier.
8. Experiments on ADC.
9. Experiments on 555 timer
10. Measurements
11. Study on function of DSO.
12. Measurement of Amplitude, Frequency, Time, Phase
13. Measurement using DSO.

Course Title: SUSTAINABLE DEVELOPMENT	L	T	P	Cr.
Course Code: BPE3206	3	0	0	3

Total hours: 45

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

1. Elucidate the basics of sustainable development, sustainable engineering and its role in engineering
2. Application of Sustainable Engineering Concepts and Principles in Engineering
3. Apply the Principle, and methodology of Life Cycle Assessment Tool to engineering systems
4. Understand integration methods of sustainability to Engineering Design

Course Content

Unit-I **10 Hours**

Sustainable Development and Role of Engineers: Introduction, Why and What is Sustainable Development, THE SDFs, Paris Agreement and Role of Engineering, Sustainable Development and the Engineering Profession, Key attributes of the Graduate Engineering Sustainable Engineering Concepts: Key concepts – Factor 4 and Factor 10: Goals of sustainability, System Thinking, Life Cycle Thinking and Circular Economy

Unit-II **15 Hours**

Sustainable Engineering and Concepts, Principles and Frame Work: Green Economy and Low Carbon Economy, Eco Efficiency, Triple bottom Line, Guiding principles of sustainable engineering, Frameworks for sustainable Engineering. Tools for sustainability Assessment: Environmental Management System, Environmental Auditing, Cleaner Production Assessment, Environmental Impact Assessment, Strategic Environmental Assessment Life Cycle Management

Unit-III **10 Hours**

Fundamentals of Life Cycle Assessment Why and What is LCA, LCA Goal and Scope, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and presentation of Results, Iterative Nature of LCA, Methodological Choices, LCI Databases and LCA Software's, Strength and Limitations of LCA.

Unit-IV **10 Hours**

Environmental Life Cycle Costing, Social Life Cycle Assessment, and Life Cycle Sustainability Assessment: Introduction, Environmental Life Cycle Costing, Social Life Cycle Assessment, Life Cycle Sustainability, LCA Applications in Engineering: Environmental Product Declarations and Product Category Rules, Carbon and Water Foot Printing, Energy systems, Buildings and the Built Environment, Chemical and Chemical Production Food and Agriculture Introduction to Environmental Economics

Transactional Mode

Seminars, Group discussion, Team teaching, Focused group discussion, Assignments, Project-based learning, Simulations, reflection and Self-assessment.

Suggested Readings

- *Franco, I.B. and Tracey, J. (2019), "Community capacity-building for sustainable development: Effectively striving towards achieving local community sustainability targets", International Journal of Sustainability in Higher Education, Vol. 20 No. 4, pp. 691-725*
- *Our Common Journey: A Transition Toward Sustainability. National Academy Press, Washington D.C. Soubbotina, T. P. 2004.*
- *Elliott, Jennifer. (2012). An Introduction to Sustainable Development. 4th Ed. Routledge, London.*
- *Rogers, Peter P., Kazi F. Jalal, and John A. Boyd. (2012). An introduction to sustainable development. Taylor Francis.*
- *Sachs, J. D. (2015). The Age of Sustainable Development. Columbia University Press, New York.*
- *Soubbotina, Tatyana P. (2004). Beyond Economic Growth: An Introduction to Sustainable Development. WBI learning resources series. Washington DC; World Bank.*
- *Kerr, Julie. (2017). Introduction to energy and climate: Developing a sustainable environment. CRC Press.*
- *Saito, Osamu. (2020). Sharing Ecosystem Services. Springer Singapore.*
- *Nhamo, Godwell, and Vuyo Mjimba. (2020). Sustainable Development Goals and institutions of higher education. Springer.*

Course Title: Indian Health Sciences	L	T	P	Cr.
Course Code: IKS0006	2	0	0	2

Total Hours: 30

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

1. Understand knowledge of India's traditional health systems.
2. Critically analyse India's healthcare policies.
3. Understand the patterns, causes, and effects of diseases in India and strategies for prevention and control.
4. Learn about nutrition, sanitation, mental health, and lifestyle diseases like diabetes and cardiovascular disorders, along with preventive healthcare measures.

Course Content

Unit I: **7 Hours**

Introduction, Vedic foundations of Ayurveda. Ayurveda is concerned both with maintenance of good health and treatment of diseases.

Unit II: **8 Hours**

Basic concepts of Ayurveda. The three Gunas and Three Doshas, Pancha-mahabhuta and Sapta-dhatu.
The importance of Agni (digestion). Six Rasas and their relation to Doshas. Ayurvedic view of the cause of diseases.

Unit III: **8 Hours**

Dinacharya or daily regimen for the maintenance of good health. Ritucharya or seasonal regimen. Important Texts of Ayurveda. Selected extracts from *Astāngahrdaya* (selections from *Sūtrasthāna*)
and *Suśruta-Samhitā* (sections on plastic surgery, cataract surgery and anal fistula). The large pharmacopeia of Ayurveda.

Unit IV: **7 Hours**

Charaka and Sushruta on the qualities of a Vaidya. The whole world is a teacher of the good Vaidya.
Charaka's description of a hospital. Hospitals in ancient and medieval India.

Transactional Mode

Seminars, Group discussion, Team teaching, Focused group discussion, Assignments, Project-based learning, Simulations, reflection and Self-assessment.

Suggested Readings

- *Park's Textbook of Preventive and Social Medicine – K. Park.*
- *Ayurveda: The Science of Self-Healing – Dr. Vasant Lad.*
- *Health Sector in India: A Policy Perspective – P. K. Pandey.*
- *Essential Readings in Health Policy and Law – Joel B. Teitelbaum & Sara E. Wilensky.*

Course Title: ENGINEERING AND SOLID MECHANICS	L	T	P	Cr.
Course Code: BPE3207	2	1	0	3

Total hours: 45

Course 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 Readings:

- *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 Ltd.*

Webo-graphy:

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

Course Title: PROFESSIONAL COMMUNICATION	L	T	P	Cr.
Course Code: BPE3208	2	0	0	2

Total hours: 30

Course Learning Outcomes: After completion of this course, student will be able to:

1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately.
3. Communicate confidently in various contexts and different cultures.
4. Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Course Content

UNIT I **10 Hours**

Introduction to Soft Skills– Hard skills & soft skills – employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs.

Self-Introduction-organizing the material – Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice - presenting the visuals effectively – 5 minute presentations.

UNIT II **10 Hours**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics – brainstorming the topic — questioning and clarifying -GD strategies- activities to improve GD skills.

UNIT III **5 Hours**

Interview etiquette – dress code – body language – attending job interviews-telephone/skype interview – one to one interview & panel interview – FAQs related to job interviews.

UNIT IV **5 Hours**

Recognizing differences between groups and teams- managing time – managing stress – networking professionally – respecting social protocols-understanding career management – developing a long-term career plan – making career changes.

Transaction Mode

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

Suggested Readings:

- *Butterfield. (2015). Jeff Soft Skills for Everyone. Cengage Learning: New Delhi.*
- *E. Suresh Kumar et al. (2015). Communication for Professional Success. Orient Blackswan: Hyderabad.*
- *Interact English Lab Manual for Undergraduate Students. Orient Black Swan: Hyderabad, 2016.*
- *Raman, Meenakshi and Sharma. S. (2014). Professional Communication. Oxford University Press: Oxford.*
- *S. Hariharanetal. Soft Skills. (2010). MJP Publishers: Chennai.*

SEMESTER: IV

Course Title: DRILLING TECHNOLOGY	L	T	P	Cr.
Course Code: BPE4250	3	1	0	4

Total hours: 60

Course 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 **15 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 **15 Hours**

Drill Bits: Classification and design criteria of drag, rotary, roller, diamond and PDC bits.

Coring: Different methods of core drilling.

UNIT IV **15 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:

- NPTEL :: Mining Engineering - NOC:Drilling and Blasting Technology
- Drilling Technology - an overview | ScienceDirect Topics
- Drilling Rig Technologies (oil-gasportal.com)

Course Title: MASS TRANSFER	L	T	P	Cr.
Course Code: BPE4251	2	1	0	3

Total hours: 45

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

1. Apply the principles of mass transfer.
2. Interpret the concept of mass transfer coefficients in designing of co-current, counter-current & continuous-contact columns.
2. Acquire knowledge about extraction and leaching mass transfer operations.
3. Interpret the processes involving gas absorption, drying of solids, humidification operations

Course Content

UNIT I **10 Hours**

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

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

UNIT II **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.

UNIT III **10 Hours**

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

UNIT IV **15 Hours**

Other Mass Transfer Operations:

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

Transaction Mode

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

Suggested Readings:

- *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.*
- *Backhurst, J.R., Harker, J.H., Coulson, J.F., & Richardson, J.M., (1999). Chemical Engineering- Volume 1(3rd Edition). Butterworth Heinemann.*
- *Skelland, A.H.P. (1985). Diffusional Mass Transfer. Kreiger Publishing Co.*
- *McCabe, W.L., Smith, J.C., & Harriot, P. (2005). Module Operations of Chemical Engineering (7th Edition). McGraw Hill.*

Webo-graphy:

- https://archive.nptel.ac.in/courses/103/103/103103145/
- Lecture Notes On Mass Transfer | PDF | Diffusion | Mass Transfer (scribd.com)
- Mass transfer process in chemical technologies - online presentation (ppt-online.org)

Course Title: MASS TRANSFER LAB	L	T	P	Cr.
Course Code: BPE4252	0	0	2	1

Total hours: 30

Course 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.

Course Content

List of Experiments

- 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.
- Determination of liquid hold up in a packed column.
- To find the mass transfer coefficient for the vaporization of organic vapor to air.
- To verify the Rayleigh's equation for batch distillation.
- To find the height equivalent to a theoretical plate and height of a transfer unit for the packed distillation column under total reflux.
- To find the yield of crystals using batch crystallizer
- To find the efficiency of rotary drier using a granular solid
- To find the efficiency of a distillation column.
- To study the adsorption characteristics and plot adsorption isotherm.
- To find the yield of a natural oil by leaching from biomass.
- To study liquid-liquid extraction in a packed column.
- To determine mass transfer coefficient from a wetted wall column.

Webo-graphy:

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

Course Title: ELEMENTS OF RESERVOIR ENGINEERING	L	T	P	Cr.
Course Code: BPE4253	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.
5. Understand the principle of fluid flow in the porous media, linear, radial and spherical flow, steady and unsteady state flow.

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. 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. Springer.*

Course Title: FLUID MECHANICS AND HYDRAULIC MACHINES	L	T	P	Cr.
Course Code: BPE4254	2	1	0	3

Total hours: 45

Course 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 **5 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 **12 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 **13 Hours**

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

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

UNIT IV **15 Hours**

Flow Measurement:

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

In open channels- Notches, Weirs

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

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). McGraw 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.*

Webo-graphy:

- Fluid Flow Operations - Course (nptel.ac.in)
- (870) Mod-01 Lec-01 Introduction and Fundamental Concepts - I - YouTube
- NPTEL :: Chemical Engineering - NOC:Fluid Flow Operations

Course Title: FLUID MECHANICS AND HYDRAULIC MACHINES LAB	L	T	P	Cr.
Course Code: BPE4255	0	0	2	1

Total hours: 30

Course Learning Outcomes: After completion of this course, the learner will be able to measure various properties of fluids and characterize the performance of fluid machinery.

Course Content

List of Experiments

1. Measurement of Coefficient of Discharge of given Orifice and Venturimeters.
2. Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe.
3. Determination of the performance characteristics of a centrifugal pump.
4. Determination of the performance characteristics of Pelton Wheel.
5. Determination of the performance characteristics of a Francis Turbine.
6. Determination of the performance characteristics of a Kaplan Turbine.

Course Title: REPORT WRITING	L	T	P	Cr.
Course Code: BPE4256	2	0	0	2

Total hours: 30

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

1. Explain the basic related to writing the reports.
2. Understanding the concepts related to formatting and structuring the report.
3. To comprehend the concept of proofreading, proposals and practice.

Course Content

UNIT I **10 Hours**

Introduction: An introduction to writing technical reports, technical sentences formation, using transitions to join sentences, Using tenses for technical writing.

Planning and Structuring: Planning the report, identifying reader(s), Voice, Formatting and structuring the report, Sections of a seminar/technical report, Minutes of meeting writing.

UNIT II **12 Hours**

Drafting report and design issues: The use of drafts, Illustrations and graphics.

Final edits: Grammar, spelling, readability and writing in plain English: Writing in plain English, Jargon and final layout issues, Spelling, punctuation and Grammar, Padding, Paragraphs, Ambiguity.

UNIT III **13 Hours**

Proofreading and summaries: Proofreading, summaries, Activities on summaries. Presenting final reports: Printed presentation, Verbal presentation skills, Introduction to proposals and practice.

Using word processor: Adding a Table of Contents, Updating the Table of Contents, Deleting the Table of Contents, Adding an Index, Creating an Outline, Adding Comments, Tracking Changes, Viewing Changes, Additions, and Comments, Accepting and Rejecting Changes

UNIT IV **10 Hours**

Using word processor: Working with Footnotes and Endnotes, Inserting citations and Bibliography, Comparing Documents, Combining Documents, Mark documents final and make them read only., Password protect Microsoft Word documents., Using Macros.

Nature of Intellectual Property: Patents, Designs, Trade and Copyright.

Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property.

Transaction Mode

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

Suggested Readings:

- *Meenakshi R and Sangeeta S. (2008). Technical Communication- Principles & Practice. Oxford.*
- *B.N. Basu. (2008). Technical writing. PHI learning.*
- *Alok J, Pravin S.R. Bhatia, A.M. Sheikh. (2006). Professional Communication Skills. S Chand.*
- *Andrea J Rutherford. (2001). Basic Communication Skills for technology. Pearson.*
- *T. Ramappa. (2008). Intellectual Property Rights Under WTO, S. Chand Publishers.*
- *R. P. Merges, P. S. Menell, Mark A. Lemley. (1997). Intellectual Property in New Technological Age.*

Webo-graphy:

- https://www.udemy.com/course/reportwriting/
- https://www.udemy.com/course/professional-business-english-and-technical-report-writing/
- https://www.udemy.com/course/betterbusinesswriting/

Course Title: Indian Agriculture	L	T	P	Cr.
Course Code: IKS0009	2	0	0	2

Total Hours: 30

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

1. Understand the significance of agriculture and irrigation in ancient Indian texts.
2. Analyze historical accounts of Indian agriculture by Greek historians and travelers.
3. Explore ancient water management systems and advanced agricultural technologies.
4. Assess agricultural productivity in medieval and early modern India through historical reports.

Course Content

Unit-I **7 Hours**

Introduction, the significance of agriculture and irrigation as emphasised in the Ramayana, Mahabharata and other texts.

Unit-II **7 Hours**

Mention of Indian agriculture by the Greek historians and later travellers. Significance of agriculture and irrigation for the kings of Indian tradition.

Unit-III **8 Hours**

Major water-bodies of the ancient times. The Ery system of south India. Excellence of Indian agricultural technologies as observed by more recent European observers.

Unit-IV **8 Hours**

Productivity of Indian agriculture in medieval Thanjavur and eighteenth-century Allahabad, Chengalpattu, etc. Indian attitude towards agriculture, based on Walker and later reports.

Transactional Mode

Seminars, Group discussion, Team teaching, Focused group discussion, Assignments, Project-based learning, Simulations, reflection and Self-assessment

Suggested Readings

- *Srivastava, Vinod Chandra. History of Agriculture in India, up to c. 1200 AD. Vol. 5. Concept Publishing Company, 2008.*

- *Buckley, Robert Burton. The Irrigation Works of India. E. & FN Spon, 1905.*
- *Sunil Kumar. Agriculture in Ancient India. Shivalik Prakashan.*
- *Saxena, R. C., S.L. Choudhary, and Y.L. Nene. Textbook on Ancient History of Indian Agriculture. Munshiram Manoharlal Publishers.*

Course Title: THERMODYNAMICS	L	T	P	Cr.
Course Code: BPE4257	3	1	0	4

Total hours: 60

Course 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 **15 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 **15 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 **15 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:

- NPTEL :: Chemical Engineering - NOC:Chemical Engineering Thermodynamics
- Mod-01 Lec-01 Thermodynamics and the Chemical Industry - YouTube
- NPTEL :: Chemical Engineering - NOC:Advanced Thermodynamics
- Thermodynamics | PPT (slideshare.net)

Course Title: ADVANCED RESERVOIR ENGINEERING	L	T	P	Cr.
Course Code: BPE4258	3	1	0	4

Total hours: 60

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

1. Describe the behavior of reservoir fluids in porous media using fundamental mathematical expressions.
2. Cover various methods for improving oil recovery, including water flooding and other advanced techniques.
3. Gain hands-on experience with reservoir simulation and dynamic modeling.
4. Apply material balance equations to analyze reservoir performance.

Course Content

UNIT I **15 Hours**

Introduction to reservoir and reservoir engineering. Petroleum reservoir type, drive mechanism, geometry, flow system and pattern, Single phase and multiphase fluid flow in different state (steady and unsteady) and different system (linear, radial, spherical) considering compressible, slightly compressible and incompressible fluid, Diffusivity equation and its application for reservoir flow system**.**

UNIT II **15 Hours**

Reservoir Data: type and acquisition. Bottom hole operation for pressure and temperature measurement, Reservoir fluid data: sampling, PVT studies and PVT parameters. Reservoir rock and fluid data: Core study, well log information, Transient well testing and interpretation information. Classification of flow system in porous media.

UNIT III **15 Hours**

Reservoir engineering principles and activities, Volumetric evaluation of petroleum reserves, Material balance equation and its application, Water Influx calculation, Decline curve analyses method and its application. Reservoir performance analysis by volumetric, material balance and decline curve methods with few case studies.

UNIT IV **15 Hours**

Reservoir Engineering activities and management, Reservoir performance analysis and monitoring, Preparation of development schemes, Concept of

water flooding, IOR/EOR and workover jobs for reservoir management, Concept of reservoir simulation.

Transaction Mode

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

Suggested Readings:

- *L. P. Dake (1998). Fundamentals of Reservoir Engineering. Elsevier, 17th Edition.*
- *B. C. Craft & M. F. Hawkins Applied Petroleum Reservoir Engineering. Prentice Hall.*
- *H. C. Worldwide Practical Petroleum Reservoir Engineering Methods. Penn Well Publishing Company.*
- *4 Ahmed, T. & Paul D. (2005). Advance Reservoir Engineering Professional Publishing, Elsevier.*
- *C. R. Smith, G. W. Tracy, R. L. Farrar. (1992). Applied Reservoir Engineering*

Course Title: DRILLING FLUIDS AND CEMENTS	L	T	P	Cr.
Course Code: BPE4259	3	1	0	4

Total hours: 60

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

1. Understand well planning procedure and functioning of rig components.
2. Evaluate the drilling mud, casing and cementing procedure
3. Evaluate the drill bit for effective selection.
4. Summarize the mechanism of well cementing and design procedure and calculate cement slurry, surface power and other requirements.

Course Content

UNIT I **15 Hours**

Well Planning -Well Planning and Well design: Objective, Input data, Drilling programme preparation, Type of well, Prospect, GTO, Introduction to wellbore pressures.

UNIT II **15 Hours**

Rig Components -Introduction to drilling Technology: Rotary / top drive drilling, Types of onshore/offshore rigs, Introduction to hardware system (Land Rig), power generation system, Hoisting, Rotary and Drilling Fluid circulation system, mud pumps, Rig selection criteria. Horsepower calculations for draw-works and rotary. Advantages and disadvantages of top drive system.

UNIT III **15 Hours**

Drilling Fluids-Introduction, functions, types, compositions, properties of mud, Field test, Rheology, Additives and contamination, Selection of drilling fluids and mud, Conditioning equipment, Mud calculations, Hydrostatic pressure, Volume, Weight related calculations during drilling and tripping
Drilling Bit- Introduction, Bit Types, Design Factors, IADC classification of bit, Bit selection, factors affecting rate of penetration

UNIT IV **15 Hours**

Casing Functions, Casing policy and design – Pore pressure, Fracture gradient prediction, Casing seat / depth selection, Casing design criteria, Burst, Tension, Collapse, Bi-axial loading etc., combination string, Leak off test.

Cementing Functions, classification of cement, Cement additives, Methods of cementation, Equipment and accessories,
Directional Drilling tools. Directional survey.

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

Suggested Readings:

- *Hussain R. (1986). Oil Well Drilling Engineering, Principles & Practice. Graham & Trotman.*
- *Robert F. Mitchell H and Stefan Z. Miska. (2011). Fundamentals of Drilling Engineering, SPE Text Book Series.*
- *Adam T. Bourgoyne, Keith K. and Martin E. Chenevert, Jr. F. S. Young. (1987). Applied Drilling Engineering, SPE Textbook Series.*
- *Mc Ray, A.Cole Frank W. (1981). Basic Drilling Engineering. New India Publication*
- *Azar, J.J. and Samuel G.R. (2007). Drilling Engineering. Pennwel.*
- *Larry W. Lake. (2007). Petroleum Engineering Handbook-Volume-II (Drilling Engineering)*
- *Walter Francis R. (2007). Composition and Properties of Oil Well Drilling Fluids. Gulf Publishing Company.*

Webo-graphy:
- Lecture 1 - Fundamentals of Drilling Fluids | PDF | Drilling Rig | Oil Well (scribd.com)
- Drilling fluids | PPT (slideshare.net)

SEMESTER: V

Course Title: ENGINEERING MATHEMATICS-III	L	T	P	Cr.
Course Code: BPE5300	3	1	0	4

Total hours: 60

Course 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. Apply numerical methods to find solution of algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations
4. Use various interpolation methods and finite difference concepts to find roots of polynomial equations using numerical analysis.

Course Content

UNIT I **15 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 **15 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 **15 Hours**

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

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

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: Faddeev Leverrier's Method, Power Method.

UNIT IV **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.

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, Mobile Teaching, Self-Learning, Collaborative Learning.

Suggested Readings:

- *Rohatgi, V.K., Saleh, A.K. Md. E. (2008). An Introduction to Probability and Statistics. Wiley.*
- *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.*
- *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:

- Probability and Statistics - Course (nptel.ac.in)

- Introduction to Operations Research - Course (nptel.ac.in)
- Operational reseachppt | PPT (slideshare.net)
- Numerical methods - Course (nptel.ac.in)
- numerical methods | PPT (slideshare.net)

Course Title: PETROLEUM REFINING ENGINEERING	L	T	P	Cr.
Course Code: BPE5301	3	0	0	3

Total hours: 45

Course 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 **15 Hours**

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

Testing of petroleum products:

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

UNIT III **10 Hours**

Separation Processes: Design and operation of topping and vacuum distillation units, Tube still furnaces, Solvent extraction processes for lube oil base stock and for aromatics from naphtha and kerosene steams, solvent dew axing.

UNIT IV **10 Hours**

Conversion Process: Thermal cracking, visbreaking 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:
- NPTEL :: Chemical Engineering - Petroleum Refinery Engineering
- Petroleum Technology - Course (nptel.ac.in)
- Petroleum Refining | PPT (slideshare.net)
- petroleum refinery and its product | PPT (slideshare.net)

Course Title: PETROLEUM REFINING ENGINEERING LAB	L	T	P	Cr.
Course Code: BPE5302	0	0	2	1

Total hours: 30

Course 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.

Couse Content

List of Experiments

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: CHEMICAL REACTION ENGINEERING	L	T	P	Cr.
Course Code: BPE5303	3	0	0	3

Total hours: 45

Course 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 **15 Hours**

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

UNIT II **15 Hours**

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

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

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

Reactor combinations of CSTR and PFR

UNIT III **10 Hours**

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

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

UNIT IV **10 Hours**

Non–Ideality: Basics of non-ideal flow, residence time distribution, States of segregation. Measurement and application of RTD, E-Age distribution

function & F-curve and inter-relationship between them, Conversion in non-ideal reactors.

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:

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

Course Title : CHEMICAL REACTION ENGINEERING LAB	L	T	P	Cr.
Course Code: BPE5304	0	0	2	1

Total hours: 30

Course Learning 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 of temperature dependence of rate constant using CSTR

List of Experiments

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

Course Title: OFFSHORE DRILLING AND PRODUCTION PRACTICES	L	T	P	Cr.
Course Code: BPE5305	4	0	0	4

Total hours 60

Course 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:

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

Course Title: MECHANICAL OPERATIONS	L	T	P	Cr.
Course Code: BPE5306	3	0	0	3

Total hours 45

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

1. Interpret 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. Find capacity and effectiveness of a screen and calculation of average size of particle.
4. 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 **10 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 **15 Hours**

Settling

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

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

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

Fluidization

Fluidization and fluidized bed, conditions for fluidization, Ergun equation and Kozeny-Carman equation, minimum fluidization velocity, types of fluidizations, 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.*
- *Perry, R.H. & Green, D. W. (2008). Chemical Engineers' Handbook (8th Edition). McGraw Hill.*

Webo-graphy:

- NPTEL :: Chemical Engineering - Mechanical Operations
- Mechanical Operations - Course (nptel.ac.in)
- Mechanical unit operations 19_09.pptx (slideshare.net)

Course Title: MECHANICAL OPERATIONS LAB	L	T	P	Cr.
Course Code: BPE5307	0	0	2	1

Total hours: 30

Course 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.

Course Content

List of Experiments

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:

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

Course Title: PETROCHEMICAL TECHNOLOGY	L	T	P	Cr.
Course Code: BPE5308	3	1	0	4

Total hours: 60

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

1. Outline the applications of hydrocarbons in various industries such as fertilizer, power generation, petrochemicals etc.
2. Illustrate polymerization and their properties, applications and production technologies.
3. Recognize the higher hydrocarbons and aromatics
4. Classify various 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. 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. Oxford & IBH Publishing Company*

Webo-graphy:

- NPTEL :: Chemical Engineering - Chemical Technology - I
- Presentation on Petrochemicals | PPT (slideshare.net)
- PPT - Petrochemical Technology (TKK-2130) PowerPoint Presentation, free download - ID:1979291 (slideserve.com)

Course Title: MULTICOMPONENT DISTILLATION	L	T	P	Cr.
Course Code: BPE5309	3	1	0	4

Total hours: 60

Course 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 **15 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 **15 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. Tata 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:
- Mod-05 Lec-13 Multicomponent Distillation - YouTube
- Introduction to multicomponent distillation | PPT (slideshare.net)

Course Title: DIRECTIONAL DRILLING	L	T	P	Cr.
Course Code: BPE5310	3	1	0	4

Total hours: 60

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

1. Interpret the directional coordinates and techniques
2. Analyze the three-dimensional geometry of directional well profiles
3. Ability to check the profile of the progressive well and to correct the deflected well path
4. Acquire knowledge of well monitoring without interrupting the drilling progress.

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 **15 Hours**

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

UNIT III **15 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.*
- *Neal J.A. (1985). Drilling Engineering - A complete well planning approach. Penn Well Publishing Company Tulsa Okhlama.*
- *Rabia, H. (2017). Well Engineering and Construction. Entrac Consulting.*

Webo-graphy:

- NPTEL : NOC:Drilling and Blasting Technology (Mining Engineering) (digimat.in)
- Mod-01 Lec-05 Drill ships and basics of drilling - YouTube

Course Title: WASTE TO ENERGY	L	T	P	Cr.
Course Code: BPE5311	3	1	0	4

Total hours: 60

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

1. Elaborate the fundamentals of energy conversion systems with a broad perspective that encompasses technical and environmental aspects.
2. Analyze energy conversion in thermochemical, biochemical, and chemical processes using range of traditional and alternative energy sources and presents assessments of their availability, sustainability, and evaluation of their potential role in solving the global energy crisis.
3. Explain the recent advancement and technological developments (carbonization, torrefaction, sub and supercritical water gasification, thermochemical conversion to ethanol, green diesel) in the field of conventional (coal) and non-conventional energy sources (biomass) with emphasis on engineering and design aspects and concept of integration of energy system.

Course Content

UNIT I **15 Hours**

Introduction: Introduction, major sources of energy: primary and secondary energy sources, energy scenario, prospects/need of alternate energy sources, common forms of energy, conventional and non-conventional energy sources; energy from biomass/coal; environmental aspects of energy utilisation-conventional energy resources and their importance.

Basics of feedstock: Concept of solid and liquid fuels, basic understanding of various properties of fuels solid fuels: heating value, ultimate analysis, proximate analysis, Liquid fuels: heating value, density, specific gravity, viscosity, flash point, ignition temp, pour point, ash composition.

UNIT II **15 Hours**

Energy from bio-based feedstock: Availability of the feedstock, compositional analysis and properties of feedstock, preparation of fuel pellets using bio-additives, carbonization, torrefaction (practice example).

Thermochemical conversion: Simultaneous bio-char and bio-oil production and their application, hydrothermal liquefaction of bio-based feedstocks, comparison of biomass with conventional fuels Gasification (practice example), upstream and downstream processing, comparison of

conventional gasification with sub-supercritical water gasification process, plasma gasification

UNIT III **15 Hours**

Biochemical conversion process: Anaerobic digestion in landfills, landfill gas and biogas, bioconversion into biogas, single/two-stage anaerobic digestion, wet and dry fermentation, integrated centralized co-digestion plant concept, comparison of biochemical and thermochemical routes, competitive production of alcohol, bioethanol production from edible sources and non-edible sources, process description, distillation, combined biogas and bioethanol production.

Chemical conversion processes: Biodiesel production, different types of feedstock, extraction process, mechanism of transesterification, fuel characteristics of biodiesel, green diesel synthesis from bio-based feedstocks and their applications.

UNIT IV **15 Hours**

Energy from coal: Origin and composition solid fuels; properties of coal; coal classification; properties and storage of coal; coal carbonization, gasification and liquefaction. Combustion process (biomass/coal): Combustion stoichiometry and combustion chemistry (practice example).

Integrated energy system: Concept of integration of conventional and non-conventional energy resources and systems.

Transaction Mode

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

Suggested Reading

- *Basu S. (2013). Biomass gasification, pyrolysis and torrefaction, 2nd Ed. Publisher AP.*
- *Sarkar S. (2010). Fuels and Combustion, Third Edition. CRC Press.*
- *Sukhatme S. P. & Nayak J. K. (2008). Solar Energy: Principles of thermal Collection and Storage, 3rd Ed. Tata McGraw-Hill Education Pvt. Ltd.*
- *Twidell, J. and Tony W. (2006). Renewable Energy Resources, 2nd Edition. Taylor & Francis.*
- *Khan B. H. (2009). Non-Conventional Energy Resources, 2nd Edition. Tata McGraw-Hill Education Pvt. Ltd.*

Course Title: NON-CONVENTIONAL ENERGY RESOURCES	L	T	P	Cr.
Course Code: BPE5312	3	1	0	4

Total hours 60

Course 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 **15 Hours**

Solar Energy Equipments: 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 **15 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 **15 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

- *B.H. Khan. (2017). Non-Conventional Energy Resources, 3rd Edition. McGraw Hill Education India Private Limited.*
- *Sobh Nath Singh. (2015). Non-Conventional Energy Resources. Pearson India.*
- *N.K. Bansal. (2015). Non-Conventional Energy Resources. Vikas Publishing House.*

Course Title: MACHINE LEARNING IN PETROLEUM OPERATIONS	L	T	P	Cr.
Course Code: BPE5313	3	1	0	4

Total hours 60

Course 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 **15 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 **15 Hours**

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

UNIT IV **15 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, 1st edition. McGraw Hill.*
- *Alpaydin E. (2013). Introduction to Machine Learning, 2nd edition. Springer.*
- *Marsland S. (2014). Machine Learning: An Algorithmic Perspective, 2nd*

edition. CRC Press.

SEMESTER: VI

Course Title: PETROLEUM PRODUCTION OPERATIONS	L	T	P	Cr.
Course Code: BPE6350	3	1	0	4

Total hours: 60

Course 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 **15 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 **15 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. Prentice hall Petroleum Engineering Series.*

Course Title: PETROLEUM FORMATION EVALUATION	L	T	P	Cr.
Course Code: BPE6351	3	1	0	4

Total hours: 60

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

1. Understand the fundamental principles governing the formation evaluation techniques and correlate their significances to petrophysical properties.
2. Compare various direct and indirect well logging tools and techniques.
3. Infer and validate the well log data for formation evaluation.
4. Interpret the formation in terms of rock and fluid characteristics and petrophysics.

Course Content

UNIT I **20 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 II **10 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

UNIT III **15 Hours**

Spontaneous Potential (SP) logs, principles and applications; Resistivity theory and Archie Equations, Modern Electrical Logging Tools, Estimation of fluid saturations; Effects of clays on log measurements.

UNIT IV **15 Hours**

Principles of sonic logging and applications; Cementing Quality monitoring; Permeability, relative permeability and Capillary pressures; Fluid Testing and Pressure logs; DST and formation interval tests; Image logs, NMR logs; Production Logging Tools.

Transaction Mode

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

Suggested Readings

- *Darling, T. (2005). Well Logging and Formation Evaluation. Gulf Pub.*
- *Lynch, E. J. (1971). Formation Evaluation. Harper International Publication*
- *Bassiouni, Z. (1994). Theory, Measurement, and Interpretation of Well Logs-Vol 4 - SPE Textbook Series*
- *Rider, M. (2004). The Geological Interpretation of Well Logs. Rider-French Consulting Ltd.*
- *Luthi, S. M. (2001). Geological Well Logs: Their use in reservoir modelling. Springer-Verlag.*

Webo-graphy:

- Petroleum Formation Evaluation - Course (nptel.ac.in)
- Crude oil Production System | PPT (slideshare.net)
- Petroleum production engineering | PDF (slideshare.net)

Course Title: OPTIMIZATION TECHNIQUES AND PROCESS INTEGRATION	L	T	P	Cr.
Course Code: BPE6352	3	1	0	4

Total hours: 60

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

1. Formulate the objective functions for constrained and unconstrained optimization problems.
2. Use different optimization strategies.
3. Solve problems using non-traditional optimization techniques.
4. Use of different optimization techniques for problem solving.

Course Content

UNIT I **15 Hours**

Introduction: Process optimization, Formulation of various process optimization problems and their classification, Basic concepts of optimization-convex and concave functions, Necessary and sufficient conditions for stationary points. Optimization of One Dimensional Functions: Unconstrained multivariable optimization direct search methods, Bracketing methods: Exhaustive search, Bounding phase, Region elimination methods- Interval halving, Fibonacci search, Golden section search, Point Estimation, Successive quadratic estimation methods.

UNIT II **15 Hours**

Indirect First Order and Second Order Methods: Gradient-based methods- Newton Raphson, Bisection, Secant, Cubic spline, Root-finding using optimization Techniques. Multivariable Optimization Algorithms: Optimality criteria, Unidirectional search, Direct search Methods- Evolutionary optimization, Simplex search, Powell's conjugate direction, Gradient-based methods- Cauchy's (steepest descent) method, Newton's method.

UNIT III **15 Hours**

Constrained Optimization Algorithms: Kuhn-Tucker conditions, Transformation methods, Penalty function method, Method of multipliers, Sensitivity analysis, Direct search for constraint Minimization-Variable elimination method, Complex search method, Successive linear and quadratic programming, Optimization of staged and discrete processes.

UNIT IV **15 Hours**

Non-traditional Optimization Techniques: Introduction to Simulated annealing, Genetic algorithms, Differential evolution.

Transaction Mode

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

Suggested Readings:

- *Edgar, T. F., Himmelblau, D. M. and Lasdo. (2004). L.S. Optimization of Chemical Processes. McGraw-Hill.*
- *Babu, B.V. (2004). Process Plant Simulation. Oxford University Press.*

Webo-graphy:

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

Course Title: PROCESS INSTRUMENTATION AND CONTROL	L	T	P	Cr.
Course Code: BPE6353	3	0	0	3

Total hours: 45

Course 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.
2. Interpret a given system for its frequency response and stability.
3. Analyze the process, identification and control strategies such as cascade, ratio and feed forward control.

Course Contents

UNIT I **15 Hours**

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

UNIT II **15 Hours**

Process Control Introduction: General Principles of process control, Time domain, Laplace domain and frequency domain, dynamic and control.

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

UNIT III **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:

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

Course Title: PROCESS INSTRUMENTATION AND CONTROL LAB	L	T	P	Cr.
Course Code: BPE6354	0	0	2	1

Total hours: 30

Course Learning 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
2. Acquire basic knowledge about types of control valves.
3. Study basics of non-ideal flow.

Couse Content

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: OIL AND GAS TRANSPORTATION SYSTEM	L	T	P	Cr.
Course Code: BPE6355	3	1	0	4

Total hours: 60

Course Learning 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 and corrosion characteristics.
4. Acquire knowledge about the distribution parameters of gas.

Course Content

UNIT I **15 Hours**

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

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

UNIT II **15 Hours**

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

UNIT III **15 Hours**

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

UNIT IV **15 Hours**

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

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: PIPELINE ENGINEERING	L	T	P	Cr.
Course Code: BPE6356	3	1	0	4

Total hours: 60

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 and know about hydrates, wax & scale - formation and prevention.
4. Acquire knowledge about city distribution network of oil / gas.

Course Content

UNIT I **15 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 **15 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 **15 Hours**

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

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

Suggested Readings:

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

Course Title: CORROSION TECHNOLOGY	L	T	P	Cr.
Course Code: BPE6357	3	1	0	4

Total hours: 60

Course 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 **15 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 H2S; Significance of O_2; Significance of pH; Effect of temperature. Materials selection: Significance of alloying composition; Significance of steel microstructure.

UNIT III **15 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 **15 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:

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

Course Title: NATURAL GAS ENGINEERING	L	T	P	Cr.
Course Code: BPE6358	3	1	0	4

Total hours: 60

Course 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 **15 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 **15 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 **15 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:

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

Course Title: ARTIFICIAL INTELLIGENCE IN PETROLEUM ENGINEERING	L	T	P	Cr.
Course Code: BPE6359	3	1	0	4

Total hours: 60

Course 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 identify the architecture of IoT and its applications.

Course Content

UNIT I **15 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 **15 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 **15 Hours**

Introduction to IoT: 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. (2021). Artificial Intelligence: A Modern Approach. Pearson Education.*
- *Night, K & Rich, E. (2017). Artificial Intelligence (SIE). McGraw Hill.*
- *Patterson, W. (2015). Introduction to AI and ES. Pearson Education.*
- *Luger G & Sttubblefield, W. A. (2009). Artificial Intelligence. Addison-Wesley Longman.*
- *Nilson, N.J. (1982). Principles of Artificial Intelligence. Narosa Publishing House.*

Webo-graphy:

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

Course Title: PLANT UTILITIES	L	T	P	Cr.
Course Code: BPE6360	3	1	0	4

Total hours: 60

Course 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 **20 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 **15 Hours**

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

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

UNIT III **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 hexameta phosphate, sodium triphosphate etc. Types of cooling towers-induced draught, forced draught.

UNIT IV **10 Hours**

Utility Equipment

- Boilers: Coalfired, oil fired, Babcox, water tubes and fire tube - Cochran, Lancashire,

- Compressors: Centrifuge, reciprocating
- Blowers: Centrifuge, reciprocating
- Refrigeration, absorption, compression and vapor compression.

Transaction Mode

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

Suggested Readings:

- *Ludvig.E. (2007). Applied Process Design for Chemical and Petrochemical Plants. Gulf Publishing, Houston, Texax.*
- *Warren L. McCabe, Julian C. Smith, and Peter Harriott. (2004). Unit Operation of Chemical Engineering. McGraw Hill Publication.*
- *Timmerhaus.P. (2003). Plant Economics. McGraw Hill Publication.*

Webo-graphy:

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

SEMESTER: VII

Course Title: OIL & WELL TESTING	L	T	P	Cr.
Course Code: BPE7400	4	0	0	4

Total hours: 60

Course 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:

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

Course Title: HEALTH, SAFETY AND ENVIRONMENT MANAGEMENT IN PETROLEUM OPERATIONS	L	T	P	Cr.
Course Code: BPE7401	4	0	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. 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. Wiley.*
- *Wise Global Trading Ltd. (2015). Introduction to Oil and Gas Operational Safety. Taylor & Francis.*

Webo-graphy:

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

Course Title: ENHANCED OIL RECOVERY	L	T	P	Cr.
Course Code: BPE7402	4	0	0	4

Total hours: 60

Course Learning 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 **15 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 **20 Hours**

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

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

Suggested Readings:

- *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: CHEMICAL PROCESS INDUSTRY	L	T	P	Cr.
Course Code: BPE7403	4	0	0	4

Total hours: 60

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

1. Know about oil, fat and sugar industries.
2. Acquire knowledge about pulp and paper, sulphuric acid and soda ash industries.
3. Acquire knowledge about glass, cement and fertilizer industries.
4. Know about types of polymer, industrial gases and pharmaceutical industries.

Course Content

UNIT I **15 Hours**

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

UNIT II **15 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 **15 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.

Pharmaceutical Industries: Introduction to Antibiotics, Hormones, and Vitamins, Biologicals, Steroid hormones.

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:

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

Course Title: PROCESS EQUIPMENT DESIGN	L	T	P	Cr.
Course Code: BPE7404	4	0	0	4

Total hours: 60

Course 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 **15 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 **15 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 **15 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.*

Course Title: RECENT ADVANCES IN HYDROCARBONS	L	T	P	Cr.
Course Code: BPE7405	3	1	0	4

Total hours: 60

Course 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- nButane- 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 **15 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 **15 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 **15 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:

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

Course Title: PROJECT MANAGEMENT	L	T	P	Cr.
Course Code: BPE7406	3	1	0	4

Total hours: 60

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

1. Prepare project plan by applying the concepts of project management and organize and manage the resources of projects.
2. Apply tools and techniques used in project management
3. Identify, analyze, quantify and mitigate risks
4. Evaluate the sources of finance.

Course Content

UNIT I **15 Hours**

Concepts of Project Management: Concepts of projects, characteristics of project, Phases of project life cycle, Tools and techniques for project management, Computer based project management.

Project planning and estimating: Feasibility report, Preparation of cost estimation, Evaluation of the project profitability.

UNIT II **15 Hours**

Organizing Human Resources and Contracting: Delegation, Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization, Contracts, Tendering and Selection of contractors

Tools and techniques of project management: Bar (GANTT) chart, Networks – PERT and CPM, Applications, Basic steps in PERT/CPM, Rules for drawing network diagram, Labelling, Time estimates, Critical Path Method, Project Evaluation and Review Technique (PERT).

UNIT III **15 Hours**

Performance measures in Project Management: Performance indicators, Performance Improvement, Project management and environment.

Risk Analysis: Sources, measures and perspectives on risk, sensitivity analysis, scenario analysis, breakeven analysis, Hiller model, simulation analysis, decision tree analysis, managing risk, project selection under risk.

UNIT IV **15 Hours**

Financing of Projects: Capital structure, menu of financing, equity capital, internal accruals, term loans, debentures, working capital advance, miscellaneous sources, raising of venture capital, raising capital in international markets.

Transaction Mode

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

Suggested Reading

- *Choudhry S. (2010). Project Management. Tata McGraw Hill.*
- *Prasanna Chandra. (2005). Projects: Planning, Analysis, Financing, Implementation, and Review, 5th edition. Tata McGraw Hill.*
- *N V R Naidu, G. Rajendra, T Krishna kumar. (2011). Operations Research. I K International Publishing house.*
- *S. D. Sharma. (2010). Operations Research and Engineering Management. Kedar Nath Ram Nath & Co.*
- *Harold Kerzner. (2002). Project management a system approach to planning scheduling and controlling. CBS Publisher.*
- *A management guide to PERT and CPM. (2002). WEIST and LEVY Eastern Economy of PH.*
- *T R Banga, N K Agarwal and S C Sharma. Industrial engineering and Management Sciences. Khanna Publishers.*

Course Title: CYBER SECURITY IN PETROLEUM INDUSTRY	L	T	P	Cr.
Course Code: BPE7407	3	1	0	4

Total hours: 60

Course 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 **15 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 **15 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 **15 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 LLC*
- *Nelson, B. (2016). Computer Forensics and Investigations. Cengage Learning. India Edition.*
- *Bishop M. (2002). Computer Security Art and Science. Pearson/PHI.*

Webo-graphy:

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

Course Title: OIL AND GAS MARKETING & RESOURCE MANAGEMENT	L	T	P	Cr.
Course Code: BPE7408	3	1	0	4

Total hours: 60

Course 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 **15 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 **15 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 **15 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. PennWell Corp.*
- *Colombano, A. (2017). Petroleum Refining & Marketing. Create Space Independent Publishing Platform.*

Webo-graphy:

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