

**Complete Course Grid and Syllabus**  
**Diploma in Petroleum Engineering**

**From Academic Year 2020-2021**



Course Grid for Diploma in Petroleum Engineering  
Assam Energy Institute, Sivasagar  
Rajiv Gandhi Institute of Petroleum Technology, Jais, Amethi

**Course: Diploma in Petroleum Engineering**

**Total Number of Credits: 359**

| <b>SEMESTER I</b>   |                                      |           |          |          |                |
|---------------------|--------------------------------------|-----------|----------|----------|----------------|
| <b>Subject Code</b> | <b>Subject</b>                       | <b>L</b>  | <b>T</b> | <b>P</b> | <b>Credits</b> |
| <b>IS101</b>        | Mathematics-I                        | 3         | 1        | 0        | 11             |
| <b>IS102</b>        | Physics-I                            | 3         | 1        | 0        | 11             |
| <b>IS103</b>        | Chemistry-I                          | 2         | 1        | 0        | 8              |
| <b>IE101</b>        | Engineering Thermodynamics           | 3         | 1        | 0        | 11             |
| <b>IE102</b>        | Fundamentals of Computer Engineering | 2         | 0        | 2        | 8              |
| <b>EP101</b>        | Engineering Drawing                  | 0         | 0        | 3        | 3              |
| <b>EP102</b>        | Engineering Workshop Practices-I     | 0         | 0        | 3        | 3              |
| <b>IS102L</b>       | Physics Lab                          | 0         | 0        | 2        | 2              |
| <b>TOTAL</b>        |                                      | <b>57</b> |          |          |                |
| <b>HU101</b>        | Universal Human Values               | 1         | 1        | 0        | <b>5</b>       |
| <b>LM101</b>        | Communication Skills*                | 2         | 0        | 1        | <b>7</b>       |

\*For selective students with less proficiency in English

| <b>SEMESTER II</b>  |   |           |          |          |                |
|---------------------|---|-----------|----------|----------|----------------|
| <b>Subject Code</b> | <b>Subject</b>                          | <b>L</b>  | <b>T</b> | <b>P</b> | <b>Credits</b> |
| <b>IS104</b>        | Mathematics-II                          | 3         | 1        | 0        | 11             |
| <b>IS105</b>        | Physics-II                              | 3         | 1        | 0        | 11             |
| <b>IS106</b>        | Chemistry-II                            | 3         | 0        | 0        | 9              |
| <b>IE103</b>        | Fundamentals of Mechanical Engineering  | 2         | 0        | 0        | 6              |
| <b>IE104</b>        | Fluid Mechanics & Fluid Flow Operations | 3         | 1        | 0        | 11             |
| <b>IE105</b>        | Computer Programming                    | 2         | 0        | 2        | 8              |
| <b>IS106L</b>       | Chemistry Lab                           | 0         | 0        | 2        | 2              |
| <b>TOTAL</b>        |   | <b>58</b> |          |          |                |
| <b>HU 102</b>       | Community Internship                    | 1         | 1        | 0        | <b>5</b>       |

| <b>SEMESTER III</b> |  |          |           |          |                |
|---------------------|--|----------|-----------|----------|----------------|
| <b>Subject Code</b> | <b>Subject</b>                                       | <b>L</b> | <b>T</b>  | <b>P</b> | <b>Credits</b> |
| <b>DC201</b>        | Basics of Geological Science                         | 3        | 0         | 0        | 9              |
| <b>IE201</b>        | Materials Science                                    | 3        | 0         | 0        | 9              |
| <b>DC202</b>        | Heat Transfer  | 3        | 0         | 0        | 9              |
| <b>IE202</b>        | Fundamentals of Electrical & Electronics Engineering | 3        | 1         | 2        | 13             |
| <b>DC203</b>        | Fluid Particle Mechanics & Mechanical Operations     | 2        | 0         | 0        | 6              |
| <b>DC204</b>        | Chemical Engineering Thermodynamics                  | 2        | 1         | 0        | 8              |
| <b>DC203L</b>       | Unit Operation Lab-I                                 | 0        | 0         | 2        | 2              |
| <b>DC201L</b>       | Geology Lab  | 0        | 0         | 2        | 2              |
| <b>TOTAL</b>        |  |          | <b>58</b> |          |                |

| <b>SEMESTER IV</b>  |   |          |           |          |                |
|---------------------|---|----------|-----------|----------|----------------|
| <b>Subject Code</b> | <b>Subject</b>                                | <b>L</b> | <b>T</b>  | <b>P</b> | <b>Credits</b> |
| <b>DC 205</b>       | Reservoir Engineering                         | 3        | 1         | 0        | 11             |
| <b>DC 206</b>       | Well Logging: Instrumentation and Operations  | 3        | 0         | 0        | 9              |
| <b>DC 207</b>       | Petroleum Refinery Operations                 | 3        | 0         | 0        | 9              |
| <b>DC 208</b>       | Production Operations                         | 3        | 0         | 0        | 9              |
| <b>DC 209</b>       | Drilling Technology: Equipment and Operations | 3        | 0         | 0        | 9              |
| <b>DC210</b>        | Petroleum Exploration and Prospecting         | 2        | 0         | 0        | 6              |
| <b>DC211L</b>       | Petroleum Engineering Lab-I                   | 0        | 0         | 2        | 2              |
| <b>DP301</b>        | Project                                       | 0        | 0         | 5        | 5              |
| <b>TOTAL</b>        |   |          | <b>60</b> |          |                |
| <b>DP 302</b>       | Industrial training                           | 0        | 0         | 5        | 5              |
|                     |   |          |           |          |                |

| <b>SEMESTER V</b>   |                                       |           |          |          |                |
|---------------------|---------------------------------------|-----------|----------|----------|----------------|
| <b>Subject Code</b> | <b>Subject</b>                        | <b>L</b>  | <b>T</b> | <b>P</b> | <b>Credits</b> |
| <b>DC301</b>        | Directional Drilling and Well Control | 3         | 0        | 0        | 9              |
| <b>DC302</b>        | Basic Well Testing                    | 3         | 0        | 0        | 9              |
| <b>DC303</b>        | Work over and Well Stimulation        | 3         | 0        | 0        | 9              |
| <b>DC304</b>        | Fire Safety & Hazard                  | 2         | 0        | 0        | 6              |
| <b>LM301</b>        | Engineering Economics                 | 2         | 1        | 0        | 8              |
| <b>HU301</b>        | Humanities                            | 2         | 0        | 0        | 6              |
| <b>DC305L</b>       | Petroleum Engineering Lab-II          | 0         | 0        | 2        | 2              |
| <b>DP303</b>        | Project                               | 0         | 0        | 10       | 10             |
| <b>TOTAL</b>        |                                       | <b>59</b> |          |          |                |
| <b>SEMESTER VI</b>  |                                       |           |          |          |                |
| <b>Subject Code</b> | <b>Subject</b>                        | <b>L</b>  | <b>T</b> | <b>P</b> | <b>Credits</b> |
| <b>DC305</b>        | Industrial Pollution & Control        | 2         | 0        | 0        | 6              |
| <b>DC306</b>        | Enhanced Oil Recovery                 | 3         | 0        | 0        | 9              |
| <b>DC307</b>        | Pipeline Transportation of Oil & Gas  | 2         | 0        | 0        | 6              |
| <b>DC308</b>        | Offshore Oil & Gas Operations         | 2         | 0        | 0        | 6              |
| <b>DE301</b>        | Departmental Elective                 | 3         | 0        | 0        | 9              |
| <b>OE301</b>        | Open Elective                         | 3         | 0        | 0        | 9              |
| <b>DC306L</b>       | Enhanced Oil Recovery Lab             | 0         | 0        | 2/2      | 1              |
| <b>DC305L</b>       | Industrial Pollution & Control Lab    | 0         | 0        | 2/2      | 1              |
| <b>DP304</b>        | Project                               | 0         | 0        | 10       | 10             |
| <b>TOTAL</b>        |                                       | <b>57</b> |          |          |                |

**Department Elective:**

|        |                                    |
|--------|------------------------------------|
| DE 301 | Reservoir Modelling& Simulation    |
|        | Unconventional Oil & Gas Resources |
|        | City Gas Distribution              |

| <b>Cat.</b> | <b>Diploma in Petroleum Engineering</b>   | <b>Min</b> |
|-------------|---|------------|
| HU          | Humanities and Social Science   | 16         |
| IS          | Basic Science   | 65         |
| IE          | Institute Requirement Engineering   | 66         |
| EP          | Engineering Drawing (Manual and Computer Aided),<br>Manufacturing Practices and Practice course of Department | 6          |
| LM          | Language & Management   | 8          |
| DC          | Department/Programme Core   | 150        |
| DE          | Department/Programme Elective   | 9          |
| OE          | Open Elective   | 9          |
| DP          | Project/ Industrial visit/ Training   | 30         |
|             | <b>Total</b>  | <b>359</b> |

## **Syllabus**

## Semester I

| Subject Code | Subject Name  | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|---------------|---------------------------|---|---|---------------|
|              |               |                           |   |   |               |
| IS101        | Mathematics-I | 3                         | 1 | 0 | 11            |

### **Unit-I: Complex Numbers:**

Definition of Complex numbers; Real and imaginary parts of a Complex number; Polar and Cartesian form of a complex number and its conversion from one form to other; Conjugate of a complex number; Modulus and amplitude of a complex number; Addition, Subtraction, Multiplication and Division of complex numbers. De-Moivre's theorem and its application.

### **Unit-II: Partial fractions:**

Definition of polynomial proper fraction & improper fractions and definition of partial fractions; To resolve proper fraction into partial fraction with denominator containing non-repeated linear factors, repeated linear factors and irreducible non-repeated quadratic factors; To resolve improper fraction into partial fraction.

### **Unit-III: Permutations and Combinations:**

Fundamental principle of counting; Fundamental principle of multiplication, Fundamental principle of addition; Factorial notation; Permutations; Combinations; Practical problems on permutations and combinations.

### **Unit-IV: Binomial theorem:**

Binomial theorem (without proof) for positive integral index ; General and middle term in Binomial expansion; Binomial theorem for any rational number (without proof); Simple applications

### **Unit-V: Trigonometry:**

Concept of angle; Measurement of angle in degree, grades and radians and their conversions; Trigonometric ratios; Sum, difference formulae and their applications ( Without proof); Product formula (Transformation of Product to Sum and Differences and vice versa); Trigonometric Ratios of multiple angle, sub-multiple angles (2A,3A,A/2); Graph of  $\sin x$ ,  $\cos x$ ,  $\tan x$ ,  $\operatorname{cosec} x$ ,  $\sec x$  and  $\cot x$ .

### **Unit-VI: Differential Calculus**

Definition of function; Concept of limits; Four standard limits

$\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}$ ,  $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ ,  $\lim_{x \rightarrow 0} \frac{a^x - 1}{x}$  and  $\lim_{x \rightarrow 0} (1 + x)^{1/x}$  . Differentiation by definition of

$x^n$ ,  $\sin x$ ,  $\cos x$ ,  $e^x$  and  $\log_a x$  . Differentiation of sum, product and quotient of functions;

Differentiation of function of a function; Differentiation of trigonometric and inverse trigonometric functions; Logarithmic differentiation; Exponential functions.

**TEXT BOOKS:-**

1. B.S. Grewal, Higher Engineering Mathematics, Khana Publishers, New Delhi, 40<sup>th</sup> Edition,2007.
2. Murray R. Spiegel, Robert E. Moyer, College Algebra, Tata McGraw Hill, New Delhi, 2<sup>nd</sup> Edition,2000.

**REFERENCE BOOKS:-**

1. G. B. Thomas, R.L. Finey, Calculus and Analytical Geometry, Addison Wesley, 9<sup>th</sup> Edition,1995
2. Frank Ayers, Elliot Mendelson, Calculus, McGraw Hill, New York, 4<sup>th</sup> Edition.



| Subject Code | Subject Name | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------|---------------------------|---|---|---------------|
|              |              |                           |   |   |               |
| IS102        | Physics-I    | 3                         | 1 | 0 | 11            |

### **Unit 1: Physical world, Units and Measurements**

Physical quantities; fundamental and derived, Units and systems of units (FPS, CGS and SI units).

Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis.

Measurements: Need, measuring instruments, least count, types of measurement (direct, indirect), Errors in measurements (systematic and random), absolute error, relative error, error propagation, error estimation and significant figures.

### **Unit 2: Force and Motion**

Scalar and Vector quantities – examples, representation of vector, types of vectors. Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product, Resolution of a Vector and its application to inclined plane and lawn roller.

Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun, rockets, Impulse and its applications.

Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical), Centripetal and Centrifugal forces with live examples, Expression and applications such as banking of roads and bending of cyclist.

### **Unit 3: Work, Power and Energy**

Work: Concept and units, examples of zero work, positive work and negative work.

Friction: concept, types, laws of limiting friction, coefficient of friction, reducing friction and its engineering applications, Work done in moving an object on horizontal and inclined plane for rough and plane surfaces and related applications.

Energy and its units, kinetic energy, gravitational potential energy with examples and derivations, mechanical energy, conservation of mechanical energy for freely falling bodies, transformation of energy (examples).

Power and its units, power and work relationship, calculation of power (numerical problems).

### **Unit 4: Rotational Motion**

Translational and rotational motions with examples, Definition of torque and angular momentum and their examples, Conservation of angular momentum (quantitative) and its applications.

Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid); (Formulae only).

### **Unit 5: Properties of Matter**

Elasticity: definition of stress and strain, moduli of elasticity, Hooke's law, significance of stress-strain curve.

Pressure: definition, units, atmospheric pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications.

Surface tension: concept, units, cohesive and adhesive forces, angle of contact, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension.

Viscosity and coefficient of viscosity: Terminal velocity, Stoke's law and effect of temperature on viscosity, application in hydraulic systems.

Hydrodynamics: Fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem (only formula and numerical) and its applications.

### **Unit 6: Heat and Thermometry**

Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), specific heats, scales of temperature and their relationship, Types of Thermometer (Mercury thermometer, Bimetallic thermometer, Platinum resistance thermometer, Pyrometer) and their uses.

Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them, Co-efficient of thermal conductivity, engineering applications.

### **TEXT BOOKS:-**

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi

### **REFERENCE BOOKS:-**

1. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi.
2. Concepts in Physics by HC Verma, Vol. I & II, BhartiBhawan Ltd. New Delhi
3. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi
4. Engineering Physics by DK Bhattacharya&PoonamTandan; Oxford University Press, New Delhi.
5. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P) Ltd., New Delhi
6. Practical Physics by C. L. Arora, S. Chand Publication.
7. E-books/e-tools/ learning physics software/websites etc.

| Subject Code | Subject Name | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------|---------------------------|---|---|---------------|
|              |              | 2                         | 1 | 0 |               |
| IS 103       | Chemistry-I  | 2                         | 1 | 0 | 8             |

### **Unit – 1: States of matter**

States of matter, Gas laws, Ideal gas equation, Gas constant, Dalton's law of partial pressure, Graham's law of diffusion, Avogadro's hypothesis and its applications, Mole concept and problems, Standard solution, normal solution and molar solution, concentration terms-normality, molarity, gm/l, ppm, normality equation, acid-base titration.

### **Unit – 2: Chemical equation**

Chemical equation-definition, qualitative and quantitative significance, limitations, balancing by partial and ion-electron method, electronic concept of oxidation and reduction, Stoichiometric calculations.

### **Unit – 3: Acids, bases and salts**

Acids, bases and salts, Theories of acids and bases- Arrhenius, Bronsted-Lowry, Lewis theory, Strong acids and strong bases, conjugate acid-base pair, classification of salts, hydrolysis of salts and its effect.

### **Unit – 4: Atomic structure**

Atomic structure: Rutherford's Model, Bohr's Model, Atomic spectra, Dual nature of electron, uncertainty principle, Quantum number, Aufbau principle, Hund's rule, Pauli's exclusion principle, electronic configuration.

### **Unit – 5: Modern Periodic table**

Modern Periodic table, Periodic properties, size of atoms (atomic and ionic radii), Ionization energies, electron affinity, electro-negativity, Basic Concepts of s,p,d and f- block Elements.

### **Unit – 6: Chemical bonding**

Chemical bonding: electronic theory of valency, Ionic, covalent and co-ordinate covalent bonds, characteristics of ionic and covalent compounds, Hydrogen bonding.

### **Unit-7: Chemical equilibrium**

Chemical equilibrium: Law of mass action, equilibrium constant, factors effecting equilibrium, Le-Chatellier's principle and its applications, ionic equilibrium, pH value, dissociation of acids and bases, common ion effect, buffer solution, solubility product and its applications.

### **Unit-8: Electrolysis**

Electrolysis: Laws of electrolysis, problems, Industrial application of electrolysis (extraction and purification of metals, electroplating and galvanization).

### **Unit-9: Catalysis**

Catalysis: Definition, type of catalyst, industrial applications of catalysis in manufacture of  $\text{NH}_3$ ,  $\text{H}_2\text{SO}_4$  by contact process, cracking.

### **Unit-10: Water**

Water: Causes of hardness of water, removal of hardness by permutite process, de-ionisation of water, effect of water in boiler preparation of boiler-feed water, preparation of Municipal water with block-diagram, Estimation of hardness of water

**SUGGESTED READINGS:**

**TEXTBOOKS:**

1. NCERT Text book (Class XI and XII)
2. Engg. Chem, B. K. Sharma
3. A Text Book Of Engineering Chemistry, SashiChawla
4. Engineering Chemistry, Jain and Jain
5. Applied Chemistry, Dr. Raman Rani Mittal

**REFERENCE BOOKS:**

1. Physical Chemistry: Peter Atkins, Julio De. Paula
2. Concise Inorganic Chemistry: J. D. Lee

| Subject Code | Subject Name               | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|----------------------------|---------------------------|---|---|---------------|
|              |                            |                           |   |   |               |
| IE101        | Engineering Thermodynamics | 3                         | 1 | 0 | 11            |

### Unit-I: Basic concepts and definition

Scope of Thermodynamics, Macroscopic and Microscopic approaches; Definition of Fixed mass (closed systems) and Control volume (open system), Properties (extensive and Intensive), State and its representation on a property diagram, Process and its representation, Cyclic process (or cycle) and its representation, Carnot Cycle, Otto Cycle, Diesel Cycle, Dual Cycle, Rankine Cycle, Brayton Cycle, Characteristics of properties (point and path function); Reversible and Irreversible processes; Thermal, mechanical and Chemical equilibrium, Thermodynamic equilibrium, Zeroth Law of Thermodynamics and temperature, Measurement of temperature and calibration of Thermometers, the ideal gas temperature scale, Measurement of pressure, Bourdon pressure gage and manometers, gage and absolute pressure.

### Unit-II: Ideal Gases

Ideal gases and their P-V-T relations, Gas mixtures. Work Transfer (definition and calculation), Different modes of work, Displacement Work for various process, Heat Transfer; Modes of heat transfer, Basic laws in conduction, convection and radiation, combined modes of heat transfer with examples.

### Unit-III: First Law of Thermodynamics

Formal

statement (using cyclic processes), First law for processes of fixed masses (closed systems) and introduction of internal energy as a thermodynamics property, Introduction of enthalpy as a thermodynamic property; Definition of specific heats and their use in calculation of internal energy and enthalpy with emphasis on ideal gases.

Application of First Law to control volumes; Nozzle, Diffuser, Compressor, Turbine, Throttling device, Heat Exchanger. (only steady flow need be considered)

### Unit- IV: Second Law of Thermodynamics

Kelvin- Planck and Clausius statements of Second Law, Reversible and irreversible engines and their efficiency, Entropy concepts and the principle of entropy increase.

### Unit- V: Properties of Pure Substances

P-V, P-T, T-S, H-S diagram for steam, different types of steam, Introduction to steam tables with respect to specific volume, pressure, temperature, enthalpy and entropy.

### Unit-VII: Application of thermodynamics

Air compressors, steam power plant, Refrigerators and Heat pump, I.C. Engines (Brief description of different components of above mentioned systems and working principles with Schematic diagram only)

**TEXT BOOK(S):**

1. Engineering Thermodynamics by P.K.Nag, Publisher:TMH
2. Basic Engineering Thermodynamics by Rayner Joel, PearsonEducation

**REFERENCE BOOK(S):**

1. Engineering Thermodynamics by Van Wylen and Sontang, JohnWiley
2. Engineering Thermodynamics by M.Achuthan, Publisher:PHI
3. Applied Thermodynamics by Eastop and McConkey, Publisher:Pearson
4. Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher.PHI
5. Engineering Thermodynamics by Russel and Adebiyi, publisher,Oxford
6. Steam Tables in SI Units by Ramalingam,Scitech.

| Subject Code | Subject Name                         | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------------------------------|---------------------------|---|---|---------------|
|              |                                      |                           |   |   |               |
| IE102        | Fundamentals of Computer Engineering | 2                         | 0 | 2 | 8             |

#### **UNIT 1:**

Basic Internet skills: Understanding browser, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals.

General understanding of various computer hardware components – CPU, Memory, Display, Keyboard, Mouse, HDD and other Peripheral Devices.

#### **UNIT 2:**

OS Installation (Linux and MS Windows), Unix Shell and Commands, vi editor.

#### **UNIT 3:**

HTML4, CSS, making basic personal webpage.

#### **UNIT 4:**

Office Tools: OpenOffice Writer, OpenOffice Spreadsheet (Calc), OpenOffice Impress.

#### **UNIT 5: Information security best practices.**

Class lectures will only introduce the topic or demonstrate the tool, actual learning will take place in the Lab by practicing regularly.

#### **SUGGESTED LAB WORK:**

This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. This course is all about some theory and a lot of practice.

#### **RECOMMENDED BOOKS:-**

- 1) R.S. Salaria, Computer Fundamentals, Khanna Publishing House.
- 2) Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House.
- 3) Online Resources, Linux man pages, Wikipedia.
- 4) Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by MokhtarEbrahim, Andrew Mallett.

| Subject Code | Subject Name        | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|---------------------|---------------------------|---|---|---------------|
|              |                     |                           |   |   |               |
| EP101        | Engineering Drawing | 0                         | 0 | 3 | 3             |

### **1. Introduction to Engineering Drawing**

1.1 Introduction to drawing instruments, materials, layout and sizes of drawing sheets and drawing boards.

1.2 Different types of lines in Engineering drawing as per BIS specifications

1.3 Practice of vertical, horizontal and inclined lines, geometrical figures such as triangles, rectangles, circles, ellipses and curves, hexagonal, pentagon with the help of drawing instruments.

1.4 Free hand and instrumental lettering (Alphabet and numerals) – upper case (Capital Letter), single stroke, vertical and inclined at 75 degree, series of 5,8,12 mm of free hand and instrumental lettering of height 25 to 35 mm in the ratio of 7:4

### **2. Dimensioning Technique**

2.1 Necessity of dimensioning, method and principles of dimensioning (mainly theoretical instructions)

2.2 Dimensioning of overall sizes, circles, threaded holes, chamfered surfaces, angles, tapered surfaces, holes, equally spaced on P.C.D., counter sunk holes, counter bored holes, cylindrical parts, narrow spaces and gaps, radii, curves and arches

### **3. Scales**

3.1 Scales –their needs and importance (theoretical instructions), type of scales, definition of R.F. and length of scale

3.2 Drawing of plain and diagonal scales

### **4. Orthographic Projections**

4.1 Theory of orthographic projections (Elaborate theoretical instructions)

4.2 Projection of Points in different quadrant

4.3 Projection of Straight Line (1st and 3rd angle)

4.3.1. Line parallel to both the planes

4.3.2. Line perpendicular to any one of the reference plane

4.3.3. Line inclined to any one of the reference plane.

4.4 Projection of Plane – Different lamina like square, rectangular, triangular and circle inclined to one plane, parallel and perpendicular to another plane in 1st angle only

4.5 Three views of orthographic projection of different objects. (At least one sheet in 3rd angle)

4.6 Identification of surfaces

### **5 Projection of Solid**

5.1. Definition and salient features of Solid

5.2. Types of Solid (Polyhedron and Solid of revolution)

5.3 To make projections, sources, Top view, Front view and Side view of various types of Solid.



## **6. Sections**

6.1 Importance and salient features

6.2 Drawing of full section, half section, partial or broken out sections, Offset sections, revolved sections and removed sections.

6.3 Conventional sectional representation of various materials, conventional breaks for shafts, pipes, rectangular, square, angle, channel, rolled sections

6.4 Orthographic sectional views of different objects.

## **7. Isometric Views**

7.1 Fundamentals of isometric projections and isometric scale.

7.2 Isometric views of combination of regular solids like cylinder, cone, cube and prism.

## **RECOMMENDED BOOKS:-**

1. A Text Book of Engineering Drawing by Surjit Singh; Dhanpat Rai & Co., Delhi

2. Engineering Drawing by PS Gill; SK Kataria & Sons, New Delhi

3. Elementary Engineering Drawing in First Angle Projection by ND Bhatt; Charotar Publishing House Pvt. Ltd., Anand

4. Engineering Drawing I & II by JS Layall; Eagle Parkashan, Jalandhar

5. Engineering Drawing I by DK Goel, GBD Publication.

| Subject Code | Subject Name                     | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|----------------------------------|---------------------------|---|---|---------------|
|              |                                  |                           |   |   |               |
| EP102        | Engineering Workshop Practices I | 0                         | 0 | 3 | 3             |

### **Unit 1**

#### **Fitting Shop:**

Introduction and practice of various fitting processes: Use of hand tools in fitting, preparing a male and female joint of M.S.

### **Unit 2**

#### **Welding Shop:**

Introduction and practice of various Welding processes: Electric Arc welding Practice and Gas welding, TIG, MIG, Gas Cutting and application. Joints such as a Lap joint, a T-joint or a Butt joint are to be prepared.

### **Unit 3**

#### **Machine Shop:**

Introduction and practice of various Machining processes: Plain and Stepped cylindrical turning, grooving, knurling and Thread-cutting of a job in lathe.

#### **TEXT BOOK(S):**

1. Elements of Workshop Technology, Vol. I and II by Hajrachoudhary, Khanna Publishers

#### **REFERENCE(S):**

1. Workshop Technology by WAJ Chapman, VivaBooks
2. Workshop Manual by Kannaiah / Narayana, Scitech

| Subject Code | Subject Name | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------|---------------------------|---|---|---------------|
|              |              |                           |   |   |               |
| IS102L       | Physics Lab  | 0                         | 0 | 2 | 2             |

**List of Practicals:**

*(To be performed a minimum of 10 practicals)*

1. To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object.
2. To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge.
3. To determine radius of curvature of a convex and a concave mirror/surface using a spherometer.
4. To verify triangle and parallelogram law of forces.
5. To find the co-efficient of friction between wood and glass using a horizontal board.
6. To determine force constant of a spring using Hook's Law.
7. To verify law of conservation of mechanical energy (PE to KE).
8. To find the moment of inertia of a flywheel.
9. To find the viscosity of a given liquid (Glycerin) by Stoke's law.
10. To find the coefficient of linear expansion of the material of a rod.
11. To determine atmospheric pressure at a place using Fortin's barometer.
12. To measure room temperature and temperature of a hot bath using mercury thermometer and convert it into different scales.

**TEXT / REFERENCE BOOKS:-**

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi.
2. Comprehensive Practical Physics, Vol, I & II, JN Jaiswal, Laxmi Publications (P)Ltd.
3. Practical Physics by C. L. Arora, S. Chand Publication.
4. E-books/e-tools/ learning physics software/YouTube videos/websites etc.

| Subject Code | Subject Name           | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|------------------------|---------------------------|---|---|---------------|
|              |                        | 1                         | 1 | 0 |               |
| HU 101       | Universal Human Values | 1                         | 1 | 0 | 5             |

### **Unit I: Motivation and Objectives of Human Values Course**

Introduction to the objectives of the course. Content and process of the course including mode of conduct. Daily life as lab for the course. Activities in the course.

### **Unit II: Purpose of Education**

How human being has a need for Knowledge, what should be the content of knowledge, how the content should be discussed in education. Complimentarily of skills and values, how the current education system falls short.

### **Unit III: Peers Pressure, Social Pressure**

In various dimensions of life, how do these things work. What is the way out? In the context of education, peer pressure etc.

### **Unit IV: Concept of Competition and Excellence**

How competition leads to degradation of self and relationships. How excellence is the basic need of a human being. What is excellence?

### **Unit V: Time Management**

How does one deal with myriads of activities in college? Focus of the mind.

### **Unit VI: Concept of Preconditioning**

How preconditioning affects our thinking, behavior, work, relationships, society and nature. How do we develop pre-conditioning? What are the various sources of preconditioning? How do we evaluate our Preconditioning? How do we come out of it?

### **Unit VII: Concept of Natural Acceptance in Human Being**

What is natural acceptance? How can the concept of natural acceptance be used to evaluate our preconditioning. Universal nature of natural acceptance. Are anger, jealousy, hatred natural? How do we feel when we experience them? Which feelings are natural for a human being and which are not?

### **Unit VIII: Understanding Relationships**

Are relationships important? What is the role of relationships in our life? If relationships are important then why they are important? If they are important then why it is the case that we are not discussing them? What are the notions/conditions and factors which stop us to explore more into relationships. Relationships in family and extended family. Dealing with anger, Basic expectations in relationships. Seven types of relations, Gratitude as a universal value in relationships, Nine universal values in human relationships, Trust as the founding value, Concept of acceptance, Unconditional acceptance in relationships, Our preconditioning affecting our relationships, Our relationships with subordinate staff, with people of opposite gender, caste, class, race, How relationships have the power to force a person to change his preconditioning.

### **Unit IX: Concept of prosperity Material goods**

What role others have played in making material goods available to me: Identifying from one's own life.

### **Unit X: Idea of Society**

What is a society? What constitutes a society? What systems are needed for a society to work? What is the purpose of society and various systems which are working in it? How understanding of Human Nature is important in order to understand the purpose of Society and various social systems? And what happens when this understanding is lacking?

### **Unit XI: Balance in nature**

Balance which already exists in nature, How human beings are disturbing the balance. Resource depletion and pollution, our own role in wastage of electricity, water and in use of plastics, Waste management, Issues like global warming, animal extinction

### **SUGGESTED READINGS:**

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3. On Education - J Krishnamurthy
4. Siddhartha - Hermann Hesse
5. Old Path White Clouds -ThichNhatHanh
6. Diaries of Anne Frank - Anne Frank
7. Life and Philosophy of Swami Vivekananda
8. Swami Vivekananda on Himself
9. Small is Beautiful - E. F Schumacher
10. Slow is Beautiful - Cecile Andrews
11. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi
12. Rediscovering India - by Dharampal
13. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
14. India Wins Freedom -Maulana Abdul Kalam Azad
15. Autobiography of a Yogi – by Paramhansa Yogananda
16. Gandhi and Question of Science – Sahasrabudhe

| Subject Code | Subject Name         | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|----------------------|---------------------------|---|---|---------------|
|              |                      | L                         | T | P |               |
| LM 101       | Communication Skills | 2                         | 0 | 1 | 7             |

### **Chapter 1: Parts of Speech**

Recognition and review of Nouns, Pronouns, Verbs, Adverbs, Adjectives, Prepositions, Conjunctions, Interjections, Knowledge of Subject, Object and Compliment of the Verb, Verbals – Infinitival, Gerund and Preposition

### **Chapter 2: Prepositions of time and place**

Contextual teaching of prepositions of time - on, in, at, since, for, ago, before, to, past, to, from, till/until, by Prepositions of place: in, at, on, by, next to, beside, near, between, behind, in front of, under, below, over, above, across, through, to, into, towards, onto, from

### **Chapter 3: Clause, phrases and Relative Clauses**

Basic definitions of clauses and phrases, Focus on Relative Pronouns and their use in sentences as relative clauses

### **Chapter 4: Subject Verb Agreement**

Rules that guide the agreement of the subject to its verb

### **Chapter 5: Sentence types and Transformation of sentences**

Assertive sentences, Exclamatory sentences, Interrogative sentences, Negative sentences, Compound sentences, complex sentences, simple sentences, Degrees of Comparison

### **Chapter 6: Voice**

Change from Active Voice to Passive Voice and vice versa

### **Chapter 7: Punctuation**

Use of the comma, semi-colon, colon, apostrophe, exclamation mark, question mark and quotation marks

### **Chapter 8: Word formation**

Change of one part of speech to the other: from Verbs to Nouns, Nouns to Verbs, Adjectives to Nouns, Nouns to Adjectives, Verbs to adverbs, and Adverbs to Verbs

### **Chapter 9: Affixation**

Prefixes and Suffixes and new word formations

### **Chapter 10: Nominal Compounds**

Common nominal compound

### **Chapter 11: Paragraph Writing**

Descriptive Paragraph on various related topics.

### **SUGGESTED READINGS:**

1. Essential English Grammar with Answers by Raymond Murphy (Cambridge University Press)
2. English for Polytechnics by Dr Paporí Rani Barooah (Eastern Book House Publishers)
3. English Grammar by Annie Brinda (Cambridge University Press)

**Syllabus**  
**Semester II**

| Subject Code | Subject Name   | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|----------------|---------------------------|---|---|---------------|
|              |                |                           |   |   |               |
| IS104        | Mathematics-II | 3                         | 1 | 0 | 11            |

**Unit-I: Determinants and Matrices:**

Elementary properties of determinants up to 3rd order; Consistency of equations; Cramer's rule; Algebra of matrices; Inverse of a matrix; Matrix inverse method to solve a system of linear equations in 3 variables.

**Unit-II: Integral Calculus:**

Integration as inverse operation of differentiation; Simple integration by substitution, by parts and by partial fractions (for linear factors only); Use of formula  $\int_0^{\pi/2} \sin^n x dx$ ,  $\int_0^{\pi/2} \cos^n x dx$  &  $\int_0^{\pi/2} \sin^m x \cos^n x dx$

for solving problems where m and n are positive integers.

**Unit-III: Co-ordinate Geometry:**

Equation of straight line in various standard form (Without Proof); Intersection of two straight lines; Angle between two straight lines; Parallel lines and perpendicular lines; Perpendicular distance formula; Sections of a cone: Circle, Parabola, Ellipse and Hyperbola; General equation of a circle and its characteristics. ; Definition of conics (Parabola, Ellipse, Hyperbola) their standard equations (without proof). Problems

**Unit-IV: Vector Algebra:**

Definition, notation and rectangular resolution of a vector; Addition and subtraction of vectors; Scalar and vector products of 2 vectors; Simple problems related to work; moment and angular velocity.

**Unit-V: Differential Equations:**

Definition of differential equations; Order and degree of a differential equation; General and particular solution of a differential equation; Formation of differential equation whose general solution is given; Solution of first order and first degree differential equation by variable separation method; Solution of Linear differential equations of the forms:

(i)  $\frac{dy}{dx} + Py = Q$ ;  $P$  &  $Q$  are functions of  $x$  or constants

(ii)  $\frac{dx}{dy} + Px = Q$ ;  $P$  &  $Q$  are functions of  $y$  or constants



. MATLAB – Simple Introductions.

**TEXT BOOKS:-**

3. B.S. Grewal, Higher Engineering Mathematics, Khana Publishers, New Delhi, 40<sup>th</sup> Edition, 2007
4. Murray R. Spiegel, Robert E. Moyer, College Algebra, Tata McGraw Hill, New Delhi, 2<sup>nd</sup> Edition, 2000
5. Frank Ayers, Elliot Mendelson, Calculus, McGraw Hill, New York, 4<sup>th</sup> Edition

**REFERENCE BOOKS:-**

3. G. B. Thomas, R.L. Finey, Calculus and Analytical Geometry, Addison Wesley, 9<sup>th</sup> Edition, 1995
4. Murray R. Spiegel, Vector Analysis, McGraw-Hill Book Company, New York,
5. Richard Bronson, Differential Equations, Tata McGraw-Hill, New Delhi, 2<sup>nd</sup> Edition, 2004

| Subject Code | Subject Name | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------|---------------------------|---|---|---------------|
|              |              |                           |   |   |               |
| IS105        | Physics-II   | 3                         | 1 | 0 | 11            |

### Unit - 1: Wave motion and its applications

Wave motion, transverse and longitudinal waves with examples, definitions of wave velocity, frequency and wave length and their relationship, Sound and light waves and their properties, wave equation ( $y = r \sin \omega t$ ) amplitude, phase, phase difference, principle of superposition of waves and beat formation.

Simple Harmonic Motion (SHM): definition, expression for displacement, velocity, acceleration, time period, frequency etc. Simple harmonic progressive wave and energy transfer, study of vibration of cantilever and determination of its time period, Free, forced and resonant vibrations with examples.

Acoustics of buildings – reverberation, reverberation time, echo, noise, coefficient of absorption of sound, methods to control reverberation time and their applications, Ultrasonic waves – Introduction and properties, engineering and medical applications of ultrasonic.

### Unit - 2: Optics

Basic optical laws; reflection and refraction, refractive index, Images and image formation by mirrors, lens and thin lenses, lens formula, power of lens, magnification and defects. Total internal reflection, Critical angle and conditions for total internal reflection, applications of total internal reflection in optical fiber.

Optical Instruments; simple and compound microscope, astronomical telescope in normal adjustment, magnifying power, resolving power, uses of microscope and telescope, optical projection systems.

### Unit - 3: Electrostatics

Coulomb's law, unit of charge, Electric field, Electric lines of force and their properties, Electric flux, Electric potential and potential difference, Gauss law: Application of Gauss law to find electric field intensity of straight charged conductor, plane charged sheet and charged sphere.

Capacitor and its working, Types of capacitors, Capacitance and its units. Capacitance of a parallel plate capacitor, Series and parallel combination of capacitors (related numerical), dielectric and its effect on capacitance, dielectric break down.

### Unit - 4: Current Electricity

Electric Current and its units, Direct and alternating current, Resistance and its units, Specific resistance, Conductance, Specific conductance, Series and parallel combination of resistances. Factors affecting resistance of a wire, carbon resistances and colour coding.

Ohm's law and its verification, Kirchhoff's laws, Wheatstone bridge and its applications (slide wire bridge only), Concept of terminal potential difference and Electro motive force (EMF)

Heating effect of current, Electric power, Electric energy and its units (related numerical problems), Advantages of Electric Energy over other forms of energy.

### **Unit - 5: Electromagnetism**

Types of magnetic materials; dia, para and ferromagnetic with their properties, Magnetic field and its units, magnetic intensity, magnetic lines of force, magnetic flux and units, magnetization.

Concept of electromagnetic induction, Faraday's Laws, Lorentz force (force on moving charge in magnetic field). Force on current carrying conductor, force on rectangular coil placed in magnetic field.

Moving coil galvanometer; principle, construction and working, Conversion of a galvanometer into ammeter and voltmeter.

### **Unit - 6: Semiconductor Physics**

Energy bands in solids, Types of materials (insulator, semi-conductor, conductor), intrinsic and extrinsic semiconductors, p-n junction, junction diode and V-I characteristics, types of junction diodes. Diode as rectifier – half wave and full wave rectifier (centre taped).

Transistor; description and three terminals, Types- pnp and npn, some electronic applications (list only).

Photocells, Solar cells; working principle and engineering applications.

### **Unit - 7: Modern Physics**

Lasers: Energy levels, ionization and excitation potentials; spontaneous and stimulated emission; population inversion, pumping methods, optical feedback, Types of lasers; Ruby, He-Ne and semiconductor, laser characteristics, engineering and medical applications of lasers.

Fiber Optics: Introduction to optical fibers, light propagation, acceptance angle and numerical aperture, fiber types, applications in; telecommunication, medical and sensors.

Nano-science and Nanotechnology: Introduction, nanoparticles and nano-materials, properties at nanoscale, nanotechnology, nanotechnology based devices and applications.

### **TEXT BOOKS:-**

1. Text Book of Physics for Class XI& XII (Part-I, Part-II); N.C.E.R.T., Delhi

### **REFERENCE BOOKS:-**

1. Applied Physics, Vol. I and Vol. II, TTTI Publications, Tata McGraw Hill, Delhi
2. Concepts in Physics by HC Verma, Vol. I & II, BhartiBhawan Ltd. New Delhi
3. Engineering Physics by PV Naik, Pearson Education Pvt. Ltd, New Delhi.
4. Modern approach to Applied Physics-I and II, AS Vasudeva, Modern Publishers.
5. A Textbook of Optics, N Subramanyam, BrijLal, MN Avahanulu, S Chand and Company Ltd.
6. Introduction to Fiber Optics, AjoyGhatak and K Thyagarajan, Cambridge University Press India

Pvt. Ltd, New Delhi.

- 7 Nanoscience and Nanotechnology, KK Choudhary, Narosa Publishing House, Pvt. Ltd. New Delhi.
8. Nanotechnology: Importance and Applications, M.H. Fulekar, IK International Publishing House Pvt. Ltd, New Delhi.
9. e-books/e-tools/ learning physics software/websites etc.

| Subject Code | Subject Name | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------|---------------------------|---|---|---------------|
|              |              |                           |   |   |               |
| IE106        | Chemistry-I  | 3                         | 0 | 0 | 9             |

### **Unit-1: Environmental Chemistry**

Definition, types of pollution, Pollutants, Water Pollution – Causes, Effect and health hazards, Water quality parameters – D.O, B.O.D, C.O.D, T.D.S, Controlling of water pollution, Air pollution – Sources, Effect and controlling, Green house effect, Acid rain, Ozone layer depletion, photochemical smoke, Soil Pollution – Sources and controlling

### **Unit-2: Metallurgy**

General principles of metallurgy, Explain the terms mineral, ore, gangue, slag, flux, roasting, calcinations etc., Metallurgy of Iron and Aluminum, Manufacture of steel by Bessemer, open heart and L-D process, Introduction to alloys.

### **Unit-3: Fuel**

Definition and classification of fuel, calorific value, Gross and net calorific value, Solid fuel-Origin of coal, classification of coal by rank, pulverized coal, principle of carbonization of coal, distinguish between High temperature carbonization and low temperature carbonization, Liquid fuel-definition of Petroleum or crude oil, Classification of three varieties of crude oil, Fractional distillation of petroleum. Important properties of liquid fuel-flash point, fire point, aniline point, smoke point, knocking and octane number, cetane number, Cracking of petroleum.

### **Unit-4: Building Materials**

Portland Cement : Composition, raw materials, Types of manufacturing, setting and hardening of cement, special cements, Glass : Definition, types, raw materials and manufacturing, Bricks : Classification and preparation

### **Unit-5: Lubricant**

Definition of lubricant and lubrication, Classification of lubricants, Important functions of lubricants, Selection of lubricants

### **Unit-6: Metallic Corrosion**

Definition, causes of Corrosion, Different types of Corrosion and factors affecting corrosion rate, Explanation of rusting of iron, Methods of Corrosion Control

### **Unit-7: Plastic and Polymer**

Definition, types of polymerization, classification of polymers, Thermoplastic and Thermosetting polymers, Important Plastic materials-Monomers, properties and uses of Polythene, Polypropylene, Polystyrene, PVC, Bakelite, Teflon, neoprene, Buna-s, Nylon, Terelene.

### **Unit-8: Organic Chemistry**

Classification and Nomenclature of Organic compounds, Homologous series and functional groups, Isomerism-structural and stereo isomerism, General preparation, properties and uses of alkanes, alkenes and alkynes, Types of organic reactions-addition, substitution, elimination and rearrangement reaction, Aromatic compounds-Benzene and its derivatives (preliminary idea only)

### **SUGGESTED BOOKS:**

1. NCERT Text book (Class XI and XII)
2. Engg. Chem, B. K. Sharma
3. A Text Book of Engineering Chemistry, SashiChawla
4. Engineering Chemistry, Jain and Jain
5. Applied Chemistry, Dr. Raman Rani Mittal
6. Organic Chemistry, Volume I: I. L. Finer
7. Concise Inorganic Chemistry: J. D. Le

| Subject Code | Subject Name                           | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--|---------------------------|---|---|---------------|
|              |  |                           |   |   |               |
| IE 104       | Fundamentals of Mechanical Engineering | 2                         | 0 | 0 | 6             |

### **Unit 1- Fundamentals of Engineering Mechanics**

Fundamentals of Engineering Mechanics, Vector quantity, Scalar Quantity, Resolution of forces, Resultant of concurrent forces, parallel forces, Moment of force about a point, Couples, Centre of gravity, Centroid, C.G of simple plane figures, Moment of Inertia, Theorem of Parallel axis and Perpendicular axis, M.I of simple plane figures

### **Unit 2- Properties of gases:**

Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Relation between  $C_p$  and  $C_v$ , Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Poly-tropic process Properties of Steam: Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters. Steam Boilers: Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, functioning of different mountings and accessories.

### **Unit 3- Thermodynamics and Heat Engines:**

Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth law, First law and Second law of thermodynamics, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles

### **Unit 4- Pumps and Compressors:**

Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming Air Compressors: Types and operation of Reciprocating and Rotary air compressors, significance of Multistage. Refrigeration & Air Conditioning: Refrigerant, Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners.

### **Unit 5- Fundamentals of I.C Engines:**

Introduction, Classification of Engines, Parts of a I.C Engine, Engine details, Working of four-stroke and two-stroke cycle, Working of Petrol and Diesel engines, Indicated power, Brake Power, Efficiencies etc.

## **Unit 6- Couplings, Clutches and Brakes:**

Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc). Transmission of Motion and Power: Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive.

### **TEXT BOOKS:-**

1. Basic Mechanical Engineering / Pravin Kumar/ Pearson.
2. Introduction to Engineering Materials / B.K. Agrawal/ McGraw Hill.
3. Thermodynamics and Heat Engines / R. Yadav / Central Book Depot.
4. Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.
5. Thermal Engineering-P.L.Bellaney/ Khanna publishers.
6. Elements of Environmental Science and Engineering-Meenakshi/Anjali Bagad.
7. Engineering Mechanics / R.K Bansal
8. Internal Combustion engine / V. Ganesan

### **REFERENCE BOOKS:-**

1. Fundamental of Mechanical Engineering/ G.S. Sawhney/PHI.
  2. Thermal Science and Engineering / Dr. D.S. Kumar/ Kataria.
  3. Engineering Mechanics /Timoshenko.
  - 4.Heat transfer / J. P Holman.
- .



| Subject Code | Subject Name                            | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|---|---------------------------|---|---|---------------|
|              |   |                           |   |   |               |
| IE104        | Fluid Mechanics & Fluid Flow Operations | 3                         | 1 | 0 | 11            |

### **Unit 1: Introduction to Fluid Mechanics**

Fluid and fluid characteristics, Dimension and Units, International System (SI), Measures of fluid mass and weight -Density, Specific Weight, Specific Gravity, ideal gas law, Viscosity, Kinematic viscosity, Compressibility, Vapour Pressure, Surface Tension

### **Unit 2: Fluid Statics**

Pressure at a point, Compressible and Incompressible fluid, Measurement of pressure, Manometry, Buoyancy - Archimedes' Principle and stability

### **Unit 3: Fluid kinematics**

Ideal Fluid, Flow Types and comparisons, Reynold's Number, Fluid Flow rate, The Bernoulli's equation and its application

### **Unit 4: Flow in pipelines**

Flow regimes in a pipe, Energy loss in pipes – through Darcy-Weisbach equation and Hagen-Poiseuille Equation, Friction factor, Turbulent flow in pipes, Moody's Diagram

### **Unit 5: Pipeline systems**

Basic of Pipe Network system, Gathering System used in Oil & Gas Industry, Minor losses in pipes, Energy and Hydraulic grade line, valves in pipeline- Flow control valve, Check valve, Pressure relief valve/safety valves

### **Unit 6: Pumps and Compressors**

Pumps: Introduction, PD (Reciprocating) Pump, Rotary Pump, Centrifugal Pump; Compressors: Basics, Centrifugal compressor, Axial flow compressor.

### **TEXT BOOKS:**

- 1) R. W. Fox and A. T. McDonald, Introduction to fluid mechanics, 5<sup>th</sup> Ed
- 2) Unit Operations of Chemical Engineering, McGraw - Hill, International Edition.

### **REFERENCE BOOKS:**

- 1) K. A. Gavhane, Fluid Flow Operations, NiraliPrakashan.
- 2) R.K. Bansal, A textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.

| Subject Code | Subject Name         | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|----------------------|---------------------------|---|---|---------------|
|              |                      |                           |   |   |               |
| IE105        | Computer Programming | 2                         | 0 | 2 | 8             |

### **Unit 1- Information Storage and Retrieval**

- 1.1 Need for information storage and retrieval
- 1.2 Creating data base file
- 1.3 Querying database file on single and multiple keys
- 1.4 Ordering the data on a selected key
- 1.5 Programming a very simple application

### **Unit 2- Programming in C**

- 2.1 Basic structure of C programs
- 2.2 Executing a C program
- 2.3 Constants, variables, and data types
- 2.4 Operators and expressions
- 2.5 Managing input-output operations like reading a character, writing a character, formatted input, formatted output through print, scan, getch, putch statements etc.
- 2.6 Decision making and branching using IF-else, switch, go to statements
- 2.7 Decision making and looping using do-while, and for statements
- 2.8 Arrays – one dimensional and two dimensional
- 2.9 File

### **Unit 3- Computers Application Overview**

- 3.1 Commercial and business data processing application
- 3.2 Engineering computation
- 3.3 CAD, CAM , CAE, CAI

### **RECOMMENDED BOOKS**

1. Programming in C by Sachaum Series, McGraw Hills
2. Programming in C by Kerning Lan and Riechle Prentice Hall of India, New Delhi
3. Programming in C by BalaguruSwamy, Tata McGraw Hill, New Delhi
4. Let us C – YashwantKanetkar, BPB Publications, New Delhi
5. Vijay Mukhi Series for C and C++
6. Programming in C by R Subburaj, Vikas Publishing House Pvt Ltd., Jangpura, New Delhi
7. Programming in C by Kris A Jansa, Galgotia Publications Pvt.Ltd., Daryaganj, New Delhi
8. Programming in C by BP Mahapatra, Khanna Publishers, New Delhi
9. Elements of C by MH Lewin, Khanna Publishers, New Delhi

| Subject Code  | Subject Name  | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|---------------|---------------|---------------------------|---|---|---------------|
| <b>IS106L</b> | Chemistry Lab | 0                         | 0 | 2 | 2             |

**LIST OF CHEMISTRY PRACTICALS:**

1. Preparation of standard solution of oxalic acid or potassium permanganate.
2. Determination of strength of given sodium hydroxide solution by titrating against standard oxalic acid solution using phenolphthalein indicator.
3. Standardization of  $\text{KMnO}_4$  solution using standard oxalic acid and determine the percentage of iron present in given Hematite ore by  $\text{KMnO}_4$  solution.
4. Estimation of total hardness of given water sample using standard EDTA solution.
5. Determination of Alkalinity of given water sample using 0.01M sulphuric acid.
6. Determination of the conductivity of given water sample.
7. Determination of pH of given water sample.
8. Determination of the total dissolved solid of a given water sample.
9. Gravimetric estimation moisture in given coal sample.
10. Determination of viscosity of a solution using Ostwald viscometer.

**SUGGESTED READING:**

1. A text book of quantitative Inorganic analysis: A. I. Vogel
2. Analytical Chemistry: G. D. Christian
3. Advanced Practical Physical Chemistry: J. B. Yadav
4. A textbook of Elementary Practical Chemistry (Part I and II): Sudarshan Barua

| Subject Code | Subject Name         | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|----------------------|---------------------------|---|---|---------------|
|              |                      | 1                         | 1 | 0 |               |
| HU 102       | Community Internship | 1                         | 1 | 0 | 5             |

**Unit-1: Understanding Society**

- Social structure and relationships,
- Social institutions and social groups,
- Socialization and social control : development of self

**Unit-2: Community Health**

- Illness and Disease, Health and public health: Meaning, components, determinants of health,
- Wellbeing and Quality of life, Health as an aspect of social development,
- Nutrition and malnutrition,
- Community Health: relevance, needs assessment, developing mechanisms for people's participation,
- Community Mental Health

**Unit-3: Working with Groups**

- Social Groups: Definitions, characteristics, functions and group structure,
- Principles of group work and Models of group work practice,
- Leadership - Theories of leadership, roles and responsibilities of group leader, Leadership Power, Leadership Styles, Leadership in Administration,
- Techniques and skills in group work ,Group worker: roles and functions

**Unit-4: Work with Communities**

- Understanding Community: Definitions, types, approaches and framework,
- Community dynamics: Caste, class, religion and gender , Issues of identity, inclusion and exclusion, Community power structure,
- Community organization- principles, steps and process,
- Community work and community participation - Strategies and principles; Models and processes,
- Professionalism and inculcation of ethics in community practice

**Unit-5: Personality Development**

- Definition of Personality, Determinants of Personality- biological, psychological and sociocultural factors,Communication, Flow and barriers of Communication, Listening,
- Spirituality and its role in personality development
- Stress: Causes, Management and Impact,
- Groups in organization, Interactions in group, Group Decision Taking, Team Building

**Unit-6: Development Communication**

- Communication: concept, principles and its significance
- Process of Communication, Forms of communication: Verbal, non-verbal and written.

- Self-awareness in communication
- Barriers to communication

**SUGGESTED READINGS:**

1. Davis, K. 1969. *Human Society*, New York: The Macmillan.
2. Giddens, A.1999. *Sociology*, Cambridge: The Polity Press.
3. Dasgupta, M. & Lincoln, C.C. 1996, *Health, Poverty and Development in India*. New Delhi: Oxford University Press.
4. Trecker, H.B. 1972, *Social Group Work: Principles and Practices*. New York: Association Press.
5. Weil, M. (ed.) 1996, *Community Practice: Conceptual Models*. New York: The Haworth Press Inc.
6. Hergenhahn, B. R., &Olson., M. H. 2003, *An Introduction to Theories of Personality*, New Jersey: Prentice Hall.

**Syllabus**  
**Semester III**

| Subject Code | Subject Name                 | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|------------------------------|---------------------------|---|---|---------------|
|              |                              |                           |   |   |               |
| DC201        | Basics of Geological Science | 3                         | 0 | 0 | 9             |

**UNIT I: Introduction:**

Introduction, parts of earth- Atmosphere, lithosphere, Hydrosphere; subdivisions of geology, geology & geophysics

**UNIT II: Geological work of natural agencies**

Introduction, geological works of atmosphere (rock weathering: physical and chemical), water (streams/rivers, sea, groundwater), glaciers

**UNIT III: Mineralogy**

Introduction, Properties- Physical and optical, Formation of minerals from magma, gases, recrystallization, solution; Common rock forming minerals

**Unit IV: Structural features of Rocks Part A**

Basics: Introduction, Primary and secondary structures, basic terms

Folds and folding: Introduction, parts of fold, causes, classifications

**UNIT V: Structural features of Rocks Part B**

Faults and faulting: Introduction, Classification, effects, recognition and causes

Joints and jointing: Introduction, Classification, Occurrences, Origins

Unconformity: Introduction, origin and types

**UNIT VI: Study of Rocks Part A**

Introduction, Igneous rocks: definition, forms of igneous rocks -Concordant, discordant, igneous extrusions; Classification of igneous rocks, Important igneous rocks

**Unit VII: Study of Rocks Part B**

Sedimentary rocks: Introduction, Formation of sedimentary rocks – mechanical, chemical, organic; classification of sedimentary rocks – clastic, non-clastic; Important sedimentary rocks

**Unit VIII: Study of Rocks Part C**

Metamorphic rocks: Introduction, classification of metamorphic rocks, Important metamorphic rocks

**Unit IX: Stratigraphy and Paleontology**

Stratigraphy: Introduction, Principles of correlation, geological time scale, Topographic Maps

Paleontology: Introduction, preservation, importance of fossils

**Unit X – Sedimentary basins and Plate tectonics**

Sedimentary basins: Introduction, Types of sedimentary basins

Plate Tectonics: Introduction, Plate boundaries- transform, divergent, convergent; current plates of the earth.

**SUGGESTED BOOKS:**

1. Geology of Petroleum, A.I. Levorsen, CBS Publishers
2. Elements of Petroleum Geology, R.C. Shelly, Elsevier Science Publishing Co.
3. Engineering and General Geology, Parvin Singh, Katson Books
4. Textbook of Geology, P.K. Mukherjee, Wordls Press Private Limited
5. Textbook of Physical Geology, G.B. Mahapatra, CBS Publishers
6. Textbook of Geology, G.B. Mahapatra, CBS Publishers
7. Principles of Engineering Geology, K.M.Bangar, Standard Publishers

| Subject Code | Subject Name      | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|-------------------|---------------------------|---|---|---------------|
|              |                   |                           |   |   |               |
| IE201        | Materials Science | 3                         | 0 | 0 | 9             |

### UNIT-1

Introduction: Historical Perspective of Materials, Classification of Materials, Engineering Materials, Advanced Materials and Future Materials like ceramics, polymers, composites etc.

Atomic Structure, Bonding and Crystal Structure of Solids: Atomic Structure, Atomic Bonding in Solids, Bravais Lattices, Crystal Structures, Crystalline, Quasi Crystalline and NonCrystalline Materials, Miller Indices, Miller-Bravais Indices for Planes and Directions of Cubic and Non-Cubic Structures, structure of ceramics, polymers, and composites materials.

### UNIT – 2

Diffusion: Diffusion Mechanisms, Steady & Non-steady State Diffusion.

Phase Diagrams: Phase Rule, Equilibrium Phase Diagrams, Phase Systems - Isomorphous, Eutectic with No and Limited Solid Solubility and Peritectic, Iron-Carbon Phase Diagram, TTT Diagram.

Imperfections in Solids and Strengthening Mechanisms: Point Defects, Line Defects and Dislocations, Interfacial Defects and Bulk or Volume Defects, Recovery, Recrystallization and Grain Growth.

### UNIT – 3

Mechanical Behaviour of Metals and Alloys : Types of Loading, Stress-Strain Curves for Brittle and Ductile Materials, Theoretical and Observed Shear Stress, Critical Resolved Shear Stress, Deformation – Elastic, Anelastic, Plastic and Super Plastic, Yield Criteria, Macroscopic Aspects of Plastic Deformation, Toughness Measurements by – S-S Curve, Impact Testing and Fracture Toughness Testing, material behavior in micro-Nano regime.

Types of Mechanical Loading and Failures : Ductile and Brittle Fracture, Modes of Fracture Toughness, Impact Fracture, Ductile-Brittle Transition, Types of Impact Testing, Fatigue, Crack Initiation and Propagation, Fatigue Testing, Creep, Stages of Creep Curve, Stress and Temperature Effects. Non-destructive testing of materials

### UNIT-4

Properties Alteration of Materials: Alteration of properties by heat treatment, Heat treatment method, Quantification of altered material properties by heat treatments.

### TEXT BOOKS:-

- 1) Materials Science, V. Raghavan, PHI Learning Private Ltd., 2010.
- 2) Materials Science, G.K. Narula, K.S. Narula, V.K. Gupta, Tata McGraw Hill, 2010.

### REFERENCE BOOKS:-

- 1) Engineering Materials: Polymers, Ceramics and Composites, A.K. Bhargava, PHI Learning (P)



Ltd.

- 2) Callister's Materials Science and Engineering, W.D.Callister,Jr,R.Balasubramaniam Wiley India, 2010

| Subject Code | Subject Name  | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|---------------|---------------------------|---|---|---------------|
|              |               |                           |   |   |               |
| DC202        | Heat Transfer | 3                         | 0 | 0 | 9             |

### **UNIT 1- Introduction:**

Various modes of heat transfer, Fourier's, Newton's and Stefan Boltzmann's Law, Combined modes of heat transfer, Thermal transfer, Thermal diffusivity, overall heat transfer coefficient.

### **UNIT 2-Conduction:**

The thermal conductivity of solids, Liquids and gases, Factors influencing conductivity measurement. The general differential equation of conduction, One dimensional steady state conduction, Linear heat flow through a plane and composite wall, Tube and sphere, Critical thickness of insulation, Effect of variable thermal conductivity, Conduction with heat generation in slab and cylinders, Spheres.

### **UNIT 3-Transient/Unsteady State Heat Conduction:**

System with negligible internal resistance, Lumped capacity method and its Validity. Unsteady state conduction through finite and semi- infinite slab without surface resistance, convection boundary conditions. Solution through Heisler's chart.

### **UNIT 4-Forced Convection:**

Physical Mechanism of Forced Convection, Dimensional analysis for forced convection, velocity and Thermal Boundary layer, Flow over plates, Flow across cylinders and spheres, Flow in tubes, Reynolds's analogy.

### **UNIT 5-Natural Convection:**

Physical Mechanism of Natural Convection, Dimensional analysis of natural convection; Empirical relationship for natural convection.

### **UNIT 6-Boiling and condensation:**

Condensation and boiling heat transfer – film and drop wise condensation – film boiling and pool boiling – boiling curve – empirical relations for heat transfer with change of face. Boiling heat transfer, Pool boiling.

### **UNIT 7-Heat Exchangers:**

Different types of heat exchangers; Determination of heat exchanger performance, Heat exchanger transfer units, Analysis restricted to parallel and counter flow heat exchanger (LMTD and NTU method)

### **UNIT 8-Thermal Radiation:**

Introduction, absorption and reflection of radiant energy, Emission, Radiosity and irradiation, Black and non black bodies, Kirchoff's law, intensity of radiation, Radiation exchange between black surface, Geometric Configuration factors. Grey body relation exchange between surface of unit

configuration factors, Electrical analogy to simple problems. Non-luminous gas radiation.Errors in temperature measurement due to radiation.

**TEXT BOOKS:-**

- 1) S.P. Sukhatme, Heat Transfer,4th Ed., TataMcGrawHill,2008
- 2) J.P. Holman, Heat Transfer, 10th Ed., TataMcGrawHill,2011

**REFERENCE BOOKS:-**

- 1) Yunus A. Cengel, Heat Transfer – A Practical Approach,2nd Ed.,McGrawHill,2002
- 2) P.S. Ghoshdastidar, Heat Transfer,2nd Ed., OxfordUniversityPress,2012
- 3) D.S. Kumar, Basics Heat & Mass Transfer,8th Ed., S.K. Kataria&Sons,2010

| Subject Code | Subject Name  | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|---|---------------------------|---|---|---------------|
|              |   |                           |   |   |               |
| IE202        | Fundamentals of Electrical & Electronics<br>Engineering | 3                         | 1 | 2 | 13            |

### **UNIT I**

Overview of Electronic Components & Signals: Passive Active Components: Resistances, Capacitors, Inductors, Diodes, Transistors, FET, MOS and CMOS and their Applications. Signals: DC/AC, voltage/current, periodic/non-periodic signals, average, rms, peak values, different types of signal waveforms, Ideal/non-ideal voltage/current sources, independent/dependent voltage current sources.

### **UNIT II**

Overview of Analog Circuits: Operational Amplifiers-Ideal Op-Amp, Practical op amp, Open loop and closed loop configurations, Application of Op-Amp as amplifier, adder, differentiator and integrator.

### **UNIT III**

Overview of Digital Electronics: Introduction to Boolean Algebra, Electronic Implementation of Boolean Operations, Gates-Functional Block Approach, Storage elements-Flip Flops-A Functional block approach, Counters: Ripple, Up/down and decade, Introduction to digital IC Gates (of TTL Type).

### **UNIT IV**

Electric and Magnetic Circuits: EMF, Current, Potential Difference, Power and Energy; M.M.F, magnetic force, permeability, hysteresis loop, reluctance, leakage factor and BH curve; Electromagnetic induction, Faraday's laws of electromagnetic induction, Lenz's law; Dynamically induced emf; Statically induced emf; Equations of self and mutual inductance; Analogy between electric and magnetic circuits.

### **UNIT V**

A.C. Circuits: Cycle, Frequency, Periodic time, Amplitude, Angular velocity, RMS value, Average value, Form Factor Peak Factor, impedance, phase angle, and power factor; Mathematical and phasor representation of alternating emf and current; Voltage and Current relationship in Star and Delta connections; A.C in resistors, inductors and capacitors; A.C in R-L series, R-C series, R-L-C series and parallel circuits; Power in A. C. Circuits, power triangle.

### **UNIT VI**

Transformer and Machines: General construction and principle of different type of transformers; Emf equation and transformation ratio of transformers; Auto transformers; Construction and Working principle of motors; Basic equations and characteristic of motors.

### **RECOMMENDED BOOKS:-**

1. RituSahdev, Basic Electrical Engineering, Khanna Publishing House

2. Mittle and Mittal, Basic Electrical Engineering, McGraw Education, New Delhi, 2015, ISBN :978-0-07-0088572-5
3. Saxena, S. B. Lal, Fundamentals of Electrical Engineering, Cambridge University Press, latest edition ISBN : 9781107464353
4. Theraja, B. L., Electrical Technology Vol – I, S. Chand Publications, New Delhi, 2015, ISBN: 9788121924405
5. Theraja, B. L., Electrical Technology Vol – II, S. Chand Publications, New Delhi, 2015, ISBN:9788121924375
6. Jegathesan, V., Basic Electrical and Electronics Engineering, Wiley India, New Delhi, 2015, ISBN : 97881236529513
7. Sedha, R.S., A text book of Applied Electronics, S.Chand, New Delhi, 2008, ISBN-13: 978-8121927833
8. Malvino, Albert Paul, David, Electronics Principles, McGraw Hill Education, New Delhi,2015, ISBN-13: 0070634244-978
9. Mehta, V.K., Mehta, Rohit, Principles of Electronics, S. Chand and Company, New Delhi, 2014, ISBN-13-9788121924504
10. Bell Devid, Fundamental of Electronic Devices and Circuits, Oxford University Press, New Delhi.

| Subject Code | Subject Name  | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|---|---------------------------|---|---|---------------|
|              |   |                           |   |   |               |
| DC203        | Fluid Particle Mechanics & Mechanical<br>Operations | 2                         | 0 | 0 | 6             |

### **Unit 1: Properties and Storage of Solids**

Characteristics of Solid Particles, Particle Shape, Particle Size, Average Particle sizes. Solids in Bulk, Angle of Repose, Angle of Internal Friction, Storage of Bulk Solids, Flow of Bulk Solids

### **Unit 2: Size Reduction of Solids**

Objectives and Methods of size reduction, Impact, Attrition, Compression, Shear Properties of Solids, Energy and Power consumption, Crushing Efficiency, Laws of Communiton, Rittinger's Law, Kick's law, Bond's Law. Size Reduction Equipments, Classification, Coarse Crushers, Intermediate Crushers, Fine Crushers

### **Unit 3: Separation and Transportation of Solids**

Introduction, Screening, Screening Equipments, Transportation Equipment, Belt Conveyors, Screw Conveyors, Bucket Elevators

### **Unit 4: Filtration**

The theory of filtration, relation between thickness of cake and volume of filtrate, flow of liquid through the cloth, flow of filtrate through the cloth and cake combined, compressible filter cakes, Filtration practice, The filter medium, blocking filtration, preliminary treatment of slurries before filtration, washing of filter cake, Filtration equipment, Filtration in a centrifuge.

### **Unit 5: Mixing and Agitation**

Agitation of liquids, Purpose of agitation equipment, Impellers, Flow patterns in agitation vessels, effect of system geometry.

### **Unit 6: Fluid particle Mechanics**

Free settling and Hindered settling, Stock's law & Newton's law regimes of settling, Gravity settling processes, gravity classifiers, sorting classifiers: sink-and-float methods, differential settling methods. Clarifiers and thickeners, flocculation, batch sedimentation, rate of sedimentation. Equipment for sedimentation: thickeners. Clarifier and thickener design, sedimentation zones in continuous thickeners. Cyclones, hydrocyclones, centrifugal decanters.

**TEXT BOOKS:**

- 1) W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw - Hill, International Edition.

**REFERENCE BOOKS:**

- 1) W.L. Badger and J.T. Banchero, Introduction to Chemical Engineering, Tata McGraw-Hill, International Edition
- 2) C. J. Geankoplis, Transport Processes and Unit Operations, Prentice Hall, India.
- 3) B.K. Dutta. Principles of Mass Transfer and Separation Processes Phi Learning Private Ltd.

| Subject Code | Subject Name                        | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|-------------------------------------|---------------------------|---|---|---------------|
|              |                                     |                           |   |   |               |
| DC204        | Chemical Engineering Thermodynamics | 2                         | 1 | 0 | 8             |

### **Unit 1: Properties of solutions**

Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures.

### **Unit 2: Phase equilibria**

Criteria for equilibrium between phases in multi component non-reacting systems in terms of chemical potential and fugacity, application of phase rule, vapour-liquid equilibrium, phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium

### **Unit 3: Correlation and prediction of phase equilibria**

Activity coefficient-composition models, thermodynamic consistency of phase equilibria, application of the correlation and prediction of phase equilibria in systems of engineering interest particularly to distillation and liquid extraction processes.

### **Unit 4: Chemical reaction equilibria**

Definition of standard state, standard free energy change and reaction equilibrium constant, evaluation of reaction equilibrium constant, prediction of free energy data, equilibria in chemical reactors, calculation of equilibrium compositions for homogeneous chemical reactors, thermodynamic analysis of simultaneous reactions.

### **Unit 5: Refrigeration**

Principles of refrigeration, methods of producing refrigeration, liquefaction process, coefficient of performance, evaluation of the performance of vapour compression and gas refrigeration cycles.

#### **TEXT BOOKS:**

- 1) J. M. Smith, H C Van Ness, Introduction to Chemical Engineering Thermodynamics, McGraw Hill Edition
- 2) K. V. Narayanan, Chemical engineering Thermodynamics, Eastern Economy Edition

#### **REFERENCE BOOKS:**

- 1) Y. V. C. Rao, Engineering Thermodynamics, University Press
- 2) P. K. Nag, Basic and Applied Thermodynamics, Tata McGraw Hill Edition





**Syllabus**  
**Semester IV**

| Subject Code | Subject Name          | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|-----------------------|---------------------------|---|---|---------------|
| DC 205       | Reservoir Engineering | 3                         | 1 | 0 | 11            |

**UNIT I:**

Fundamentals in Reservoir Engineering.

**UNIT II:**

Classification of petroleum reservoir.

**UNIT III:**

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 IV:**

Reservoir Fluids: Phase behavior of hydrocarbon system, ideal & non ideal system, equilibrium ratios, reservoir fluid sampling, PVT properties determination, different correlations and laboratory measurements, data reduction, evaluation and application.

**UNIT V:**

Flow of Fluids through Porous Media : Darcy's law, single and multiphase flow, linear, radial & spherical flow, steady state & unsteady state flow, flow through fractures, GOR, WOR equations, Water and gas coning. Principles of Fluid Flow for steady state, semi steady state & non steady state conditions.

**UNIT VI:**

Reservoir Drives : Reservoir drive mechanics and recovery factors, Reserve estimation: Estimation of petroleum reserve, resource & reserve concept, MBE, decline curve analysis.

**UNIT VII:**

Rational development plan, Rate and order of drilling well, well spacing & pattern, selection of development scheme, economic aspect of development of oil and gas fields.

**UNIT VIII:**

**Reservoir Management:** Concepts, Components and Applications.

**TEXT BOOKS:**

1. Tarek Ahmed, "Reservoir Engineering Handbook", Gulf Professional Publishing, 4th ed, (2010).

2. NnaemekaEzekwe, “Petroleum Reservoir Engineering Practice”, Pearson Education, Inc, (2010).

**REFERENCE BOOKS:**

1. Benjamin Cole Craft, Murray Free Hawkins, and Ronald E. Terry, “Applied Petroleum Reservoir Engineering” by Prentice Hall, (1991).

2. LP Dake, “Fundamentals of Reservoir Engineering” shell learning and development, (1998).

3. Tarek Ahmed, Paul D. McKinney, “Advanced Reservoir Engineering” Gulf Professional Publishing , 4th ed, (2005).

3. BF Towler, “Fundamental Principles of Reservoir Engineering”, SPE, (2002).

4. Heriot Watt, “Reservoir Engineering Handbook”.

5. Abhijit Y. Dandekar, “Petroleum Reservoir Rock and Fluid Properties”, CRC Press, (2013).

| Code   | Subject Name                                 | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------|--|---------------------------|---|---|---------------|
|        |  |                           |   |   |               |
| DC 206 | Well Logging: Instrumentation and Operations | 3                         | 0 | 0 | 9             |

### **UNIT I: Introduction:**

Introduction, history, objectives, log, logrun-log chart & ideal logging condition, classification: non-wireline logs and wireline logs, procedure of logging, Mud logging, core analysis, drilling operation logs (MWD-LWD), wireline logging, and production logging techniques

### **UNIT II: Electrical/Resistivity Log & SP Log**

Electrical/Resistivity Log: Introduction, normal & lateral logs, laterologs, micro-resistivity logs, induction log, log presentation, Archie's laws

SP Log: Introduction, electrochemical potential, electro-kinetic potential, total potential, SP tool, log presentation

### **Unit III: Gamma Ray Log**

Natural Radioactivity, gamma ray interactions with matter: pair production, compton scattering, photoelectric adsorption; gamma ray detector, Log presentation, shale content, well log trend patterns

### **UNIT IV: Nuclear Log (Density & Neutron Log) & Acoustic Log**

Nuclear Log (Density & Neutron Logs): Density Logging tool & technique, bulk density and porosity measurement, typical log presentation; Neutron tool principle, log interpretation, gas anomaly, uses

Acoustic (Sonic) Log: Introduction, sonic logging tools, log presentation, Wyllie equation, effect of drilling mud and altered zone arrivals

### **UNIT V: Caliper & Temperature Logs**

Caliper Logs: Introduction & types of tools, method of recording, log presentation, interpretation, uses

Temperature Logs: Importance of subsurface temperature and geothermal gradient, borehole temperature measurement, well temperature profile, uses

### **Unit VI: CBL-VDL & Production Logging**

CBL-VDL: Cementing technique efficiency, cement bond log-variable density log, bond index

Production Logging: Overview, purpose, applications, basic production logging tools

### **Unit VII: Dipmeter Log presentation & Well Log correlation techniques**

Dipmeter log presentation: Introduction, formation dip angle & azimuth, applications, tadpole presentation.

Well Log correlation techniques: Introduction, applications, some logs used for correlation: SP log, resistivity log, gamma ray log & sonic log.

### **SUGGESTED BOOKS:**

1. Fundamentals of Well-Log Interpretation 1. The Acquisition of logging data, O.Serra, Elsevier

Science Publishers B.V.

2. Formation Evaluation, Heriot Watt University
3. Open-Hole Log Analysis and Formation Evaluation, Richard M.Bateman, Springer Netherlands
4. The Geological Interpretation of Well Logs, Malcom Rider, Whittles Publishing Services

| Subject Code | Subject Name                  | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|-------------------------------|---------------------------|---|---|---------------|
|              |                               |                           |   |   |               |
| DC 207       | Petroleum Refinery Operations | 3                         | 0 | 0 | 9             |

### **UNIT I: Origin, Formation & Composition of Petroleum**

Origin & formation of petroleum, Reserves & deposit of world, Indian Refineries with their location and capacity, Composition of petroleum

### **UNIT II: Petroleum product testing**

Evaluation of petroleum, Thermal properties of petroleum fractions, petroleum product properties and product testing

### **UNIT III: Fractionation of Petroleum**

Dehydration and desalting of crude, pipe still heaters, distillation of crude oil

### **Unit IV: Cracking**

Cracking: Thermal and vis-breaking; Catalytic cracking: types, working. Process, fluidic catalytic process; catalytic reforming & naphtha cracking

### **Unit V: Coking, hydrocracking & Hydro-treating**

Delayed coking and fluid coking; hydrocracking, hydro-desulfurisation, hydro-treatment and hydrotreating

### **Unit VI: Alkylation & Isomerisation**

Definition, Cascade sulfuric acid alkylation, H.F. Alkylation, isomerisation, isomerisation catalysts, aluminum chloride isomerisation process

### **UNIT VII: Treatment techniques**

Physical & mechanical impurities, chemical impurities, dehydrating and sweetening operations for gases, Treatment of gasoline, kerosene & lubes, dewaxing with solvents

### **SUGGESTED BOOKS:**

- 1) Fundamentals of Petroleum Refining, M.A. Fahim, T.A. Al-sahhaf, A.S. Elkilani; Elsevier Science and Technology
- 2) Handbook of Petroleum Refining, James G. Speight, Taylor and Francis Inc.
- 3) Modern Petroleum Refining Processes, BK BhaskaraRao, Oxford & IBH Publishing Co. Pvt. Ltd.
- 4) Handbook of Petroleum Analysis, James G. Speight, Wiley-Interscience, John Wiley & Sons, Inc., Publications
- 5) The Chemistry and technology of Petroleum, James G. Speight, CRC Press, Taylor & Francis Group

| Subject Code | Subject Name          | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|-----------------------|---------------------------|---|---|---------------|
|              |                       |                           |   |   |               |
| DC 208       | Production Operations | 3                         | 0 | 0 | 9             |

**UNIT-I: Introduction to Oil Recovery methods:**

Recovery Techniques: Primary recovery, Secondary recovery, Improved Oil Recovery, Enhanced Oil Recovery, Recovery factor.

**UNIT-II: Well Equipment and Well Completion Design:**

Well Head Equipment, Christmas tree, valves, hangers, flow control devices, packers, tubular and flow lines. Perforating Oil & Gas Wells - Conventional and Unconventional techniques viz. Through tubing and tubing conveyed underbalanced perforating techniques, type size and orientation of perforation holes, Well Activation methods, Coiled Tubing unit, Down-hole equipment selection, servicing, installation & testing, smart wells- intelligent completions.

**UNIT-III: Performance Evaluation and Production optimization:**

Drawdown and Productivity Index (PI), Specific Productivity Index (SPI), Inflow performance relationship (IPR), Determination of inflow performance, vertical lift performance- flow regime in vertical two phase flow, stable and unstable flowing conditions, choke performance, Flow optimization: choke, tubing, pipeline Field optimization: Nodal analysis

**UNIT-IV: Artificial Lift Completion:**

Gas lift- Continuous and intermittent gas lift, unloading operations, gas lift valve components and mechanics, Plunger lift, chamber lift Mechanical pumping-Sucker Rod Pumping, components and operation, SRP installation, ESP-components and operation, Jet pump, Hydraulic pump-operation and components, Progressive Cavity Pump.

**UNIT-V: Gathering and collection of oil and gas:**

Surface Operation: Separator and storage, Typical flowsheet in a production facility, Common flow sheet symbols, Well to sales flow, Stage Separation, Process controls, Safety symbols, Group Gathering Station (GGS)

**UNIT-VI: Processing of Oil & Gas**

Introduction, Factors affecting separation, Separators: components, types, operating problems, Phase separations, Vertical and horizontal separators, Emulsion: Emulsifiers and de-emulsifiers, De-emulsification & Dehydration process, Types of Treating equipment: vertical, horizontal and electrostatic treaters

**UNIT-VII: Storage of Petroleum and Petroleum Products:**

Different types of storage system, Types & features of storage tanks, fixed roof and floating roof tanks. Design of storage tanks with introduction to API codes, Specification, maintenance and operation of tank batteries, Vapour control and gravity conservation measures. Vapour recovery system. LPG & LNG storage.

**TEXT BOOKS:**

- 1) Petroleum Production Engineering: A computer Assisted Approach, BoyunGuo, William C. Lyons, Ali Ghalambor, Elsevier Science & Technology Books, 2007.
- 2) Production Operations, (2-Volume Set: Volume I & Volume II), Thomas O. Allen and Alan P. Roberts.
- 3) Well Completion Design, Jonathan Bellarby.
- 4) Technical Manual on Work-over Operation by IOGPT, ONGC

**REFERENCE BOOKS:**

- 1) Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.
- 2) Petroleum Engineering Handbook by Howard B. Bradley
- 3) Non-Technical guide to Petroleum Geology, Exploration, Drilling and Production - Norman J Hyne
- 4) Dictionary of Petroleum Exploration, Drilling & Production by Norman J, Hyne
- 5) Petroleum Production Systems, M. J. Economides, A. Daniel Hill & C. E. Economides, Prentice-Hall, N. J – 07488, 1994.



| Subject Code | Subject Name                                  | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|---|---------------------------|---|---|---------------|
|              |   |                           |   |   |               |
| DC 209       | Drilling Technology: Equipment and Operations | 3                         | 0 | 0 | 9             |

**UNIT I:** Overview of drilling

Drilling planning approaches, drilling team, types of drilling.power systems

**UNIT II:** Hoisting system

Derrick & substructure, steel derricks, making a connection, tripping operation, draw-works, travelling assembly: crown block, travelling block & hook, drilling line, static crown load

**UNIT III:** Drill String

Drill string, drill string components, and design, stretch of drilling pipe, drill pipe maintenance

**UNIT IV:** Drill Bits

Types of bits, standard classification of bits, failure mechanism of bits, bit selection and evaluation

**UNIT V:** Drilling Mud Engineering

Introduction, functions, types of mud, fundamental properties of mud, mud circulation, mud conditioning system

**Unit VI:** Casing & Cementing

Casing, functions, types, casing policy, casing design basics, cementing, functions of cement, cement classes, casing accessories, setting casing, single stage and two stage cementing

**Unit VII:**Borehole Problems

Introduction, pipe sticking differential sticking, mechanical sticking, and key seating; sloughing shale, lost circulation zones.

**SUGGESTED BOOKS:**

- 1) Oil well Drilling Engineering, H Rabia
- 2) Well Construction and Engineering, H. Rabia
- 3) Composition and Properties of Drilling and Completion Fluid, H.C.H Darley and George R. Grey
- 4) Drilling Engineering- A complete Well Planning Approach, Neal J. Adams
- 5) Drilling Operation Practices Manual, IDT, ONGC

| Subject Code | Subject Name                          | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|---------------------------------------|---------------------------|---|---|---------------|
|              |                                       |                           |   |   |               |
| DC210        | Petroleum Exploration and Prospecting | 2                         | 0 | 0 | 6             |

#### **UNIT I:**

##### **Geological Methods**

Surface indications of subsurface oil and gas accumulations. Oil accumulation parameters. Regional structural plan and local structures. Time of accumulation vis-avis time of oil generation.

#### **UNIT II:**

**Geochemical methods of prospecting:** Soil geochemical surveys; Source rock characterization and Hydro geochemistry as a tool for oil exploration. Development Geology. Theoretical principles of prognostication of hydrocarbon reserve. Role of plate tectonics in Hydrocarbon accumulation onshore and offshore. Sequence of geological methods of oil exploration.

#### **UNIT III:**

##### **Geophysical Methods**

**Magnetic Method:** The geomagnetic field, Magnetic anomalies. Magnetic survey instrument, Field method of magnetic surveys. Reduction of magnetic data, diurnal and geomagnetic correction. Interpretation of magnetic anomalies. Magnetic response of simple geometric shapes. Application of magnetic survey.

#### **UNIT IV:**

**Gravity Method:** Units of gravity, gravity measuring instruments, gravity survey, gravity anomalies, Gravity data reduction, Drift, Latitude, Elevation, and Free-air correction. Free-air and Bouguer anomalies. Gravity response of simple geometric shapes. Interpretation of gravity anomalies and application of gravity methods.

#### **UNIT V:**

**Seismic Methods:** Geometry of refracted ray path, planar interface. Two layer case with horizontal interface. Methodology of refraction profiling. Field surveys arrangements. Recording instruments and energy source. Corrections applied to refraction data. Interpretation of refraction data. Application of seismic refraction method, Passive seismic.

#### **UNIT VI:**

**Advanced methods:** Geometry of reflected ray path, planar interface, and single horizontal reflector. Importance of seismic reflection survey over seismic refraction survey technique. Common depth point (CDP) profiling and stacking. 2-D data processing and interpretation of reflection data. Introduction to 3-D data acquisition, processing and interpretation. Applications of seismic method in oil exploration, Concept of 4-D seismic and its application.

#### **UNIT VII:**

Well seismic shooting for velocity determination and Vertical Seismic Profiling (VSP). Data processing. Interpretation of reflection data.

**TEXT BOOKS:**

1. Philip Kearey, et.al., "An Introduction to Geophysical Exploration", Wiley publications, (2002)
2. Applied geophysics, WM W. M. Telford, L.P Geldart, R.E sherief, Cambridge university press, (1990)

**REFERENCE BOOKS:**

1. Milton B. Dobrin, and Carl H. Savit, "Introduction to Geophysical Prospecting", 4th Ed., McGraw Hill, (1988)
2. M.B. RamachandraRao, "Outlines of Geophysical Prospecting: A Manual for Geologists", EBD Educational Pvt Ltd., (1993)
3. John Milsom and AsgerEriksen, "Field Geophysics" 4th Ed., John Wiley, 2011.
4. J. Guillemot, "Elements of Geology: Oil and Gas Exploration Techniques", Technip, (1991)

| Subject Code | Subject Name                                 | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--|---------------------------|---|---|---------------|
| DC212        | <b>Petroleum Exploration and Prospecting</b> | 2                         | 0 | 0 | 6             |

#### **UNIT I:**

##### **Geological Methods**

Surface indications of subsurface oil and gas accumulations. Oil accumulation parameters. Regional structural plan and local structures. Time of accumulation vis-à-vis time of oil generation.

#### **UNIT II:**

**Geochemical methods of prospecting:** Soil geochemical surveys; Source rock characterization and Hydro geochemistry as a tool for oil exploration. Development Geology. Theoretical principles of prognostication of hydrocarbon reserve. Role of plate tectonics in Hydrocarbon accumulation onshore and offshore. Sequence of geological methods of oil exploration.

#### **UNIT III:**

##### **Geophysical Methods**

**Magnetic Method:** The geomagnetic field, Magnetic anomalies. Magnetic survey instrument, Field method of magnetic surveys. Reduction of magnetic data, diurnal and geomagnetic correction. Interpretation of magnetic anomalies. Magnetic response of simple geometric shapes. Application of magnetic survey.

#### **UNIT IV:**

**Gravity Method:** Units of gravity, gravity measuring instruments, gravity survey, gravity anomalies, Gravity data reduction, Drift, Latitude, Elevation, and Free-air correction. Free-air and Bouguer anomalies. Gravity response of simple geometric shapes. Interpretation of gravity anomalies and application of gravity methods.

#### **UNIT V:**

**Seismic Methods:** Geometry of refracted ray path, planar interface. Two layer case with horizontal interface. Methodology of refraction profiling. Field surveys arrangements. Recording instruments and energy source. Corrections applied to refraction data. Interpretation of refraction data. Application of seismic refraction method, Passive seismic.

#### **UNIT VI:**

**Advanced methods:** Geometry of reflected ray path, planar interface, and single horizontal reflector. Importance of seismic reflection survey over seismic refraction survey technique. Common depth point (CDP) profiling and stacking. 2-D data processing and interpretation of reflection data. Introduction to 3-D data acquisition, processing and interpretation. Applications of seismic method in oil exploration, Concept of 4-D seismic and its application.

#### **UNIT VII:**

Well seismic shooting for velocity determination and Vertical Seismic Profiling (VSP). Data processing. Interpretation of reflection data.

**TEXT BOOKS:**

1. Philip Kearey, et.al., "An Introduction to Geophysical Exploration", Wiley publications, (2002)
2. Applied geophysics, WM W. M. Telford, L.P Geldart, R.E sherief, Cambridge university press, (1990)

**REFERENCE BOOKS:**

1. Milton B. Dobrin, and Carl H. Savit, "Introduction to Geophysical Prospecting", 4th Ed., McGraw Hill, (1988)
2. M.B. RamachandraRao, "Outlines of Geophysical Prospecting: A Manual for Geologists", EBD Educational Pvt Ltd., (1993)
3. John Milsom and AsgerEriksen, "Field Geophysics" 4th Ed., John Wiley, 2011.
4. J. Guillemot, "Elements of Geology: Oil and Gas Exploration Techniques", Technip, (1991)

**Syllabus**

**Semester**

**V**

| Subject Code | Subject Name                          | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|---------------------------------------|---------------------------|---|---|---------------|
| DC301        | Directional Drilling and Well Control | 3                         | 0 | 0 | 9             |

**Unit I: Straight hole drilling**

Causes of hole deviation, mechanical factors, crooked-hole tendency, Bottom hole assembly: Slick BHA, Pendulum BHA, packed hole BHA; stabilizers and reamers

**Unit II: Directional hole drilling**

Well geometry, types, directional BHAs, surveying tools, Well path deflection & correction. deflection tools- bent-sub, whipstock, jet bit downhole motors – turbine and positive displacement mud motor, Rotary Steerable motors, dog leg severity,

**Unit III: MWD-LWD**

Introduction, mud pulse telemetry, components, toolface, orientation: gravity and magnetic tool face; Non-magnetic drill collars, orienting tools, real time logging, types of LWD, depth control, data interpretation.

**Unit IV: Horizontal drilling and advanced methods**

Introduction, Horizontal well objectives and selection, Different profiles: long radius, medium radius, short radius, ultra-short radius; BHAs used, special drilling methods: ERD, UBD, CTD, slant hole drilling, TAML, HPHT Drilling, Variable pressure regime, Plasma drilling, Electrical Drilling, Top drive drilling, Re-entry drilling, Jet Drilling, Slim hole drilling, Geo-steering & Drilling automation.

**Unit V: Basics of well control**

Introduction to Well Control , Overburden stress, hydrostatic pressure, fracture pressure, fracture gradient – leak off test, casing seat selection, Causes of Kicks, Kick Warning Signs and Kick Indicators, Influx Characteristics and Behavior, Well Control Methods, Well Control during Casing and Cementing, Well Control Management

**Unit VI: Well control and Well killing methods**

Well Control Equipment: Blowout Preventers (BOPs), Associated Well Control Equipment, Choke Manifolds and Chokes, Auxiliary Equipment, BOP Control Systems, well killing procedure, kill mud, pumping speed, effect of gas, killing methods: wait and wait method, driller's method.

**SUGGESTED BOOKS:**

- 1) Directional and Horizontal Drilling, J.A. Short, PennWell Publishing
- 2) Oil well Drilling Engineering, H Rabia, Gulf Publishing
- 3) Blowout and Well Control Handbook, Robert D. Grace, Guld Professional Publishing
- 4) Advanced Drilling Engineering, G. Robello Samuel, Xiushan Liu; Gulf Publishing
- 5) Drilling Engineering Workbook, Baker Hughes INTEQ
- 6) Drilling Operation Practices Manual, Institute of Drilling Technology, ONGC
- 7) Drilling Engineering, Heriot Watt University

| Subject Code | Subject Name       | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------------|---------------------------|---|---|---------------|
|              |                    |                           |   |   |               |
| DC302        | Basic Well Testing | 3                         | 0 | 0 | 9             |

### **Unit I: Introduction**

Definition, objectives, basic reservoir terms and equation, radius of investigation, productivity index, applications, bottom hole studies-measurement of flowing bottom hole pressure

### **Unit II: Oil Well testing**

Role of oil well tests, oil well test types- periodic production test, productivity test (bean study), pressure transient tests; indicator diagram study: procedure and parameters obtained

### **Unit III: Buildup test and drawdown test**

Buildup: Introduction, assumptions, procedure for conducting build up study, Horner method, analysis of build-up curve, parameters determined from build-up plot, types of buildup curves, uses. Drawdown: Introduction, procedure, drawdown plot, parameters obtained from drawdown curve, total skin, additional pressure drop due to multiphase flow, Wellbore storage effect and coefficients

### **Unit IV: Type curves**

Introduction, concept of type curves, curve matching- dimensionless pressure drop, dimensionless time, dimensionless radius, calculation of reservoir permeability and porosity

### **Unit V: Gas well test**

Introduction, Multirate test, deliverability tests, absolute open flow, types- Flow after flow test, isochronal test, modified isochronal test

### **Unit VI: Other well tests**

Drill stem testing, wireline formation tests, multiple well tests- interference well test and pulse test, Injectivity and fall off tests.

### **SUGGESTED BOOKS:**

1. Well Testing, John Lee, SPE Books
2. Advanced reservoir Engineering, Tarek Ahmed & Pauk D McKinney, Gulf Professional Publishing
3. Oil Well Testing Handbook, Amanat U. Choudhury, Gulf Professional Publishing
4. Applied Well testing Interpretation, John P. Spivey and John Lee, SPE Books.



| Subject Code | Subject Name                   | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------------------------|---------------------------|---|---|---------------|
|              |                                |                           |   |   |               |
| DC303        | Work over and Well Stimulation | 3                         | 0 | 0 | 9             |

### **Unit I: Well problems**

Introduction, Source of well problems, Reservoir associated problems-Productivity/injectivity, Completion associated problems-equipment malfunctions or failure, wellbore problems-mechanical failures

### **Unit II: Well completion and activation**

Completion of a well-casing and tubing utilized in a well, wellbore perforation, hydrostatic and formation pressure, well activation methods

### **Unit III: Hydrate, wax and scales**

Hydrate: Introduction, Conditions for hydrate formation, Inhibitions; Wax/paraffin: Introduction, mechanism, Causes, Remedial measure, prevention; Scales: Introduction, causes, removal methods, scale prevention

### **Unit IV: Sand Control**

Introduction, Types of formation sand, effects of excess sand production, causes, Sand Control Mechanism, Gravel Pack: size, requirement, carrier fluid, hardware, gravel placement

### **Unit V: Squeeze cementing**

Purpose of squeeze cementing, cementing techniques, cement slurry, cement volume and squeeze pressure, bradenhead method, packer squeeze method, hesitation squeeze, plug back operations-balanced plug and dump bailer method

### **Unit VI: Fishing operations**

Introduction, types of fish -stuck pipe, parted pipe, junk; fishing tools – catching tools, milling tools, cutting tools, junk retrieval tools; accessories: scrappers, bumper subs and jars; planning and preparation for fishing operations, challenges

### **Unit VII: Well Stimulation: Acidization treatment**

Introduction to well stimulation, methods of well stimulation, Acidization treatment, Matrix acidization: working, types of acids for carbonate and sandstone reservoirs, mechanism and placement technique of acid job; Acid fracturing – fracture orientation, purpose, working process, fracture pressure, fracture growth

### **Unit VIII: Well Stimulation: Hydraulic formation fracturing**

Introduction, fracturing fluid properties, components of fracturing fluid, Types of fracture fluids- water based, oil based, foam based, alcohol based; proppant, purpose, fracturing process

### **SUGGESTED BOOKS:**

1. Introduction to Petroleum Production, Vol I, D.R. Skinner, Gulf Publishing Company

2. Petroleum production engineering; BoyunGuo, William C.Lyons, Ali Ghalambor; Gulf Professional Publishing
3. Petroleum Engineering Handbook, Volume IV: Production Operation Engineering, Joe Dunn Clegg, SPE books
4. Petroleum Production Systems, Michael J. Economides, A. Daniel Hill, Christine Ehlig-Economides, Ding Zhu; Prentice Hall
5. Production Technology I, Heriott-Watt University

| Subject Code | Subject Name         | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|----------------------|---------------------------|---|---|---------------|
|              |                      |                           |   |   |               |
| DC304        | Fire Safety & Hazard | 2                         | 0 | 0 | 6             |

### **UNIT-I**

Introduction to environmental control in the petroleum industry: Overview of environmental issues- A new attitude. Drilling and production operations: Drilling- Production- Air emissions.

### **UNIT-II**

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

Environmental transport of petroleum wastes: Surface paths- Subsurface paths- Atmospheric paths.

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

### **UNIT-III**

Oil Mines regulations: Introduction>Returns, Notices and plans- Inspector, management and duties- Drilling and workover- Production- Transport by pipelines- Protection against gases and fires- Machinery, plants and equipment- General safety provisions- Miscellaneous.

### **UNIT-IV**

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

### **UNIT- V**

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

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

### **UNIT-VI**

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

**Text Books:**

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

**Reference Books:**

1. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, 1995.
2. Guidelines for Fire Protection in Chemical, Petrochemical and Hydrocarbon Processing Facilities, Centre for Chemical Process Safety, American Institute of Chemical Engineers, 2003.
3. Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety, Wiley-AIChE, 3<sup>rd</sup> Edition, 2008.
4. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.

| Subject Code | Subject Name          | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|-----------------------|---------------------------|---|---|---------------|
|              |                       | 2                         | 1 | 0 |               |
| LM301        | Engineering Economics | 2                         | 1 | 0 | 8             |

### **Unit 1- INTRODUCTION TO ECONOMICS:**

Introduction to economics – Flow in an economy – Law of supply and demand – Concept of engineering economics – Engineering efficiency – Economic efficiency – Scope of engineering economics – Element of costs – Marginal cost – Marginal revenue – Sunk cost – Opportunity cost – Break-even analysis – V ratio – Elementary economic analysis – Material selection for product design selection for a product – Process planning.

### **Unit 2- VALUE ENGINEERING:**

Make or buy decision – Value engineering – Function – Aims – Value engineering procedure – Interest formulae and their applications – Time value of money – Single payment compound amount factor – Single payment present worth factor – Equal payment series sinking fund factor – Equal payment series payment Present worth factor – Equal payment series capital recovery factor – Uniform gradient series annual equivalent factor – Effective interest rate – Examples all methods.

### **Unit 3- CASH FLOW:**

Methods of comparison of alternatives – Present worth method (Revenue dominated cash flow diagram) – Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram) – Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram) – Rate of return method – Examples all methods.

### **TEXT BOOKS:-**

- PanneerSelvam, R., “Engineering Economics”, Prentice Hall of India Ltd, 2001.
- Smith, G.W., “Engineering Economy”, Iowa State Press, 1973.

### **REFERENCE BOOKS:-**

- Park, C.S., “Contemporary Engineering Economics”, Prentice Hall of India, 2002.
- Newman, D.G. and Lavelle, J.P., “Engineering Economics and Analysis”, Engineering Press, 2002.
- Degarmo, E.P., Sullivan, W.G. and Canada, J.R., “Engineering Economy”, Macmillan, 1984.
- Grant, E.L., Ireson, W.G. and Leavenworth, R.S., “Principles of Engineering Economy”, Ronald Press, 1976.

| Subject Code | Subject Name | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------|---------------------------|---|---|---------------|
|              |              |                           |   |   |               |
| HU301        | Humanities   | 2                         | 0 | 0 | 6             |

### **Unit - 1: Introduction to Sociology**

Definition of sociology, some sociological concepts: social structure, status, role, norms, values etc. Socialization, and culture and change.

Social stratification - various approaches and concept of social mobility.

Population and society - Trends of demographic change in India and the world, Human Ecology, Trends of Urbanization in the developing countries and the world.

Major social institutions - Family and marriage, caste and tribe and organizations: (i) formal organization (bureaucracy) (ii) informal organization.

Processes of social change - Modernization (including Sanskritization), industrialization, environmental/ecological changes and development.

Social movements - protest movements, reformist movement and radical movements in India.

### **Unit - 2: Introduction to Literature**

Nature of Literature: Literature as a Humanistic Experience. Definitions: (i) Humanities: concern with culture, values, ideologies; (ii) Literature: concepts of imitation, expression, intuition & imagination.

Major Themes of Literature: Nature, Science, Selfhood, Love, Rebellion.

The Language of Literature: Modes of literary and non-literary expression. The concepts of Figurative language, imagery, symbolism, style. The Forms of Literature: Prose Narratives (short stories & novels)

Poetry, Drama and Essays (Suitable texts are to be chosen by the instructors), Use of a Learner Dictionary.

### **Unit - 3: Introduction to Philosophy**

Philosophy and History of Science: Growth of scientific knowledge: factors leading to the emergence of modern science. Conceptual evolution: internal and external history. Methodology of science: induction, falsificationism, confirmation and probability. Nature of scientific laws and theories: realism, instrumentalism and under-determination. Relationship between scientific observation, experiment and scientific theory. Nature of scientific explanation: teleological explanations and the covering law model. Selected case studies on scientific theories.

Logic and the nature of mathematical reasoning: Inductive and deductive forms of reasoning. Nature of axioms: formal axiomatic systems. Concept of consistency, independence and completeness. Nature of rules of inference and proof. Selected examples of axiomatic systems and proof procedures.

Cognition: Current approaches to the understanding of mind and mental processes: empiricist, rationalist, behaviorist and cognitivist.

Ethics: Impact of science and technology on man and society: elements of environmental and professional ethics.

**TEXT / REFERENCE BOOKS:-**

(A) Introduction to Sociology:

- (a) L. Broom, P. Selznick and D. Dorrock, Sociology, 11th Edn. 1990 (Harper International).
- (b) M. Haralambos, Sociology: Themes and Perspectives, Oxford University Press, 980.
- (c) M.S.A. Rao (ed) Social movements in India, vols. 1-2, 1984, Manohar.
- (d) David Mandelbaum, Society in India, 1990, Popular.
- (e) M.N. Srinivas, Social change in modern India, 1991, Orient Longman.
- (f) Guy Rocher, A. General Introduction to Sociology, MacMillan, 1982.

(B) Introduction to Literature:

- (a) David Murdoch (ed.). The Siren's Song: An Anthology of British and American Verse, Orient Longman, 1988.
- (b) S. Alter & W. Dissanayake (eds.) The Penguin Book of Modern Indian Short Stories. Penguin Books (India), 1989.
- (c) Bertrand Russell, Impact of Science on Society. Allen &Unwin, 1952.
- (d) Henrik Ibsen, A Doll's House, Macmillan India, 1982.
- (e) George Orwell, Animal Farm, Penguin, 1951.
- (f) J. Bronowski. The Ascent of Man, BBC, 1973.

(C) Introduction to Philosophy:

- (a) A.C. Grayling (ed.) Philosophy: A Guide through the subject, Oxford Univ. Press, London, 1995.
- (b) Marx W. Wartofsky, Conceptual Foundations of Scientific Thought: An Introduction to the Philosophy of Science, Macmillan, London, 1968.
- (c) I.B. Cohen, The Birth of a New Physics, Vakils, Feffer and Simons Pvt. Ltd., Bombay, 1968.
- (d) H. Eves and C.V. Newsom, Foundations and Fundamental Concepts of Mathematics, Boston, PWS-Kart Pub. Co., 1990.
- (e) K.E. Goodpaster and K.M. Sayre (eds.) Ethics and Problems of 21st Century, Univ. of Notre Dame Press, London, 1979.
- (f) S.D. Agashe, A. Gupta & K. Valicha (eds.) Scientific Method, Science, Technology and Society: A Book of Readings, Univ. of Bombay Press, 1963.

**Syllabus**  
**Semester VI**

| Subject Code | Subject Name                   | Credit Lecture |   |   | Total Credits |
|--------------|--------------------------------|----------------|---|---|---------------|
|              |                                | (L-T-P)        |   |   |               |
| DC305        | Industrial Pollution & Control | 2              | 0 | 0 | 6             |

**Unit 1: Types of environments and their pollutants**

Classification of pollutants. Legislative aspects including water act. 1974, Air Act 1981 and effluent standards. EPA Air pollution: Sources and effects of different air pollutants, Sampling and analysis of air pollutants, Air pollution control methods and equipment, Cyclone Separator, Baghouse, ESP, Venturi Scrubber

**Unit 2: Water pollution**

Sources, sampling and classification of water pollutants, determination of basic parameters and computations associated with: BOD, COD, TS, TDS, SS; Waste water treatment: primary, secondary, tertiary and advanced; aerobic treatment with special reference to activated sludge, trickling filter, RBDC and RBRC, EA; non-conventional: WSP, anaerobic treatment with special reference to AFFR, UASB

**Unit 3: Solid waste management**

Sources and classification, public health aspects, Methods of collection and disposal methods: open dumping, landfill, incineration, composting, vermiculture; Solid waste management using bioremediation for specific pollutants like chromium. Mercury, ammonia / urea, phenolic sludges. Management and handling of Bio-medical waste; E-waste-classification and re-use and disposal; Hazardous waste management- Electro-chemical and photo-chemical oxidation - dye waste, chrome slag – case studies.

**Unit 4: Pollution control in selected process industries**

fertilizer industries, petroleum refineries and petrochemical units, pulp and paper industries, Tanning industries, Sugar industries, Dairy, Alcohol industries, Electroplating and metal finishing industries, Radioactive wastes, ranking of wastewater treatment alternatives. Case Studies.

**TEXT BOOKS:**

- 1) C. S. Rao Environmental Pollution Control Engineering , New age Connwell and Devis, Introduction to Environmental Engineering, Tata McGraw - Hill Publishing Co. Ltd



**REFERENCE BOOKS:**

- 1) Metcalf and Eddy, Wastewater Engg, Tata McGraw - Hill Publishing Co Ltd
- 2) S.P. Mahajon Pollution Control in process industries, Tata McGraw - Hill Publishing Co Ltd
- 3) S.J. Arceivala , Wastewater treatment for pollution control, Tata McGraw - Hill Publishing Co Ltd

| Subject Code | Subject Name          | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|-----------------------|---------------------------|---|---|---------------|
|              |                       |                           |   |   |               |
| DC306        | Enhanced Oil Recovery | 3                         | 0 | 0 | 9             |

### **UNIT I: Introduction:**

Introduction, Improved Oil Recovery: Conventional IOR and EOR, Primary and IOR chart; Primary recovery, Pressure decline after primary recovery, Secondary recovery, Factors causing High residual oil Saturation, EOR/Tertiary Recovery, Viscous fingering, Economic value of different EOR techniques

### **UNIT II: Fluid Displacement:**

Reservoir Heterogeneity and its types, Injection v Production well, Water breakthrough, Displaced v Displacing, Mobility ratio, Microscopic displacement efficiency, Macroscopic/Volumetric Displacement efficiency, Recovery Factor, Water cut and Recovery in terms of water cut

### **UNIT III: Flooding**

Definition, reasons, flood patterns, factors for making selection, factors & aspects to consider in water flooding, waterflooding & fill up period, frontal theory, fractional flow equation, buckleylevrett displacement (frontal advance) equation

### **UNIT IV: Chemical EOR**

Introduction, basic mechanism, selection of chemical EOR processes, surfactant flooding, co-surfactants and classification of surfactants, types of surfactant flooding, micelles, alkaline flooding, polymer flooding, asp flooding

### **UNIT V: Miscible Flooding**

Miscible, first and multi contact miscibility, minimum miscibility pressure, miscible slug flooding, CO<sub>2</sub> flooding, ternary diagram, high pressure gas injection, enriched gas injection, nitrogen & flue gas injection

### **UNIT VI: Thermal EOR**

Introduction, steam injection, steam injection methods: huff & puff method, water flooding by steam, hot water flood, SAGD; in-situ combustion: dry forward, wet forward and reverse combination

### **Unit VII: Microbial EOR**

Introduction, steps involved, MEOR mechanisms, MEOR vs conventional EOR, microbial products and their action, factors for selection of microbes, biosurfactants, microbial generation of gases and solvents, microbial clogging, advantages & limitations.

### **TEXT BOOKS:**

1. Enhanced Oil Recovery, Marcel Latil, InstitutFrancais Du Petrole Publications, France
2. Enhanced Oil Recovery, TeknicaPetroleum Services Ltd, Alberta.
3. Enhanced Oil Recovery, I, Fundamentals and Analyses, Erle C. Donaldson, George V. Chiligrarian and The Fu Yen, Elsevier, The Netherlands

| Subject Code | Subject Name                         | Credit Lecture |   |   | Total Credits |
|--------------|--------------------------------------|----------------|---|---|---------------|
|              |                                      | (L-T-P)        |   |   |               |
| DC307        | Pipeline Transportation of Oil & Gas | 2              | 0 | 0 | 6             |

### **UNIT I: Introduction**

Mode of transportation, scope, advantages of pipeline transportation, planning and evaluation, technical, financial and economics and cost structure, Lease Automatic Custody Transfer

### **UNIT II: Design of Pipeline**

Overview, Types of onshore/offshore(subsea) pipeline and gathering systems, factors influencing design: physical properties of fluid, physical properties of pipelines, Climatic conditions, Hydraulic Shock/surge and water hammering, Road, railroad and water body(river) crossings, Piping codes and specifications

### **UNIT III: Flow of Fluids**

Basic planning and initial planning, Types of pipeline system, Laminar and turbulent flow, Compressible and incompressible fluids, Newtonian and non-Newtonian fluids and time dependent and independent fluids, Flow Regimes: bubble, slug, churn, mist, annular

### **UNIT IV: Construction of Pipelines**

Pipeline project construction specifications, Material and equipment, Types of line pipe- seamless line pipe, flexible pipe, composites; Types of valves- gate, plug, ball, check, butterfly and Pressure Relief Devices: safety valve and relief valve, pipe coating

### **Unit V: Pipeline Pigging**

Introduction of Pigs, Types of Pigs, pig launchers, Smart pigs/Intelligent pig, Plugs

### **UNIT VI: Corrosion protection**

Causes, Types, Protection: coating, cathodic protection, Internal corrosion, Corrosion Monitoring and control.

### **TEXT BOOKS:**

1. Pipeline Rules of thumb Handbook, E.W. McAllister, Gulf Professional Publishing
2. Pipeline & risers : Young Boi ,Elsevier Ocean Engineering Book series 2001 Volume
3. Piping Handbook, Mohinder L. Nayyar, McGraw Hill
4. NACE Corrosion Engineer's Reference Book, Robert Baboian, NACE International

| Subject Code | Subject Name                  | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|-------------------------------|---------------------------|---|---|---------------|
|              |                               |                           |   |   |               |
| DC308        | Offshore Oil & Gas Operations | 2                         | 0 | 0 | 6             |

### **UNIT I: Meteorology & oceanography**

Weather and climate, elements of weather, wind circulation, Storms, oceanography: ocean environment, ocean physiography, wave driven current, manning conditions

### **UNIT II: Offshore Drilling Rigs**

Introduction, types of offshore rigs: bottom supported rigs- submersible drilling pontoons, self-elevating Jack up rigs. Floating rigs: Degree of freedom in rig motion, Semi-submersible rigs, drill ships, mooring and dynamic positioning, drilling: preliminary drilling operations, subsea BOP, marine riser, motion compensation

### **UNIT III: Offshore Production Systems**

Introductions, common elements, types- Fixed: Compliant towers, Gravity platforms; Floating: Tension Leg Platforms (TLP), Floating production storage and offloading (FPSO) system, Spar; system for handling oil: Single point mooring- Single anchor leg mooring (SALM), Catenary anchor leg mooring (CALM), Vertical anchor leg mooring (VALM), Single point mooring tower (SPMT)

### **UNIT IV: Subsea system**

Introduction, subsea field architecture, Subsea components: wells, subsea trees, manifolds & sleds, flowlines& jumpers, umbilical & flying heads, control systems, heat retention in flowlines

### **UNIT V: Topsides**

Introduction, oil treatment, water treatment, gas treatment and gas stabilization, metering, categories of topsides, personnel transportation & their accommodation, safety systems, auxiliary systems

### **UNIT VI: Offshore pipelines laying& risers**

Flow path, mechanical and hydraulic considerations, pipeline laying: S lay, J-lay, reel lay and towing; pipe protection: coating & corrosion protection, bottom conditions & burial; Risers: attached risers, pull tubes, steel catenary risers, top tensioned risers, riser tower, flexible risers

### **UNIT VII: Offshore support vessels**

Platform supply vessels, anchor handling towing supply vessels, crew boats, heavy lift vessels, specialty vessels, remotely operated vessels (ROVs)

### **TEXT BOOKS:**

1. Deepwater Petroleum: Exploration & Production – a nontechnical guide, William L. Leffler, Richard Pattarozzi, Gordon Sterling; PennWell
2. Offshore Petroleum Drilling and Production, SukumarLaik, CRC Press, Taylor and Francis
3. Handbook of Offshore Oil and Gas Operations, James G.Spheight, Gulf Professional Publishing

4. Handbook of Offshore Engineering, Vol I, V SubrataK.Chakrabarti, Elsevier, The Netherlands
5. Handbook of Offshore Engineering, Vol II, V SubrataK.Chakrabarti, Elsevier, The Netherlands

| Subject Code | Subject Name          | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|-----------------------|---------------------------|---|---|---------------|
|              |                       |                           |   |   |               |
| DE301        | City Gas Distribution | 3                         | 0 | 0 | 9             |

### **Unit I: Introduction**

Natural gas: definition, composition, uses, liquified natural gas (LNG) compressed natural gas (CNG) and piped natural gas (PNG), Path of flow of natural gas, application in domestic, commercial, and industrial sector, Storage of CNG, Advantages, limitations

### **Unit II: Liquefied Natural Gas**

LNG, history, LNG characteristics, LNG properties, need of LNG, LNG chain, liquefaction technology, LNG transportation, LNG terminal, LNG storage, Uses

### **Unit III: Distribution**

CGD concept, infrastructure-distribution network, various stations involved: city gas station (CGS), pressure reduction station (PRS), district regulation station (DRS), setting up the network, network pressures, challenges

### **Unit IV: City gas pipelines and metering**

Market Demand, Type of pipelines used- carbon steel, MDPE and GI and Copper; procedure of carbon steel and MDPE pipe laying, city gas metering- gas meters, gas chromatograph, pressure and temperature transmitter,

### **Unit V: Operation and maintenance**

Hazards, built-in design, operation preparedness, emergency preparedness- emergency response and disaster management plan, customer related operations, liasoning

### **Unit VI: Safety at CGD**

Statutory rules and safety codes, behavioral safety, infrastructure safety, Process safety, Environmental safety, Overall safety areas, Safety compliance, Safety kits and equipment, PPE.

### **TEXT BOOKS:**

1. Natural Gas- A Basic Handbook, James Speight, Gulf Professional Publishing
2. Handbook of Liquefied Natural Gas; S. Mokhatab, J. Mak, J Valappil, David A.Wood; Gulf Professional Publishing
3. Handbook of Natural Gas Transmission and Processing, S. Mokhatab, W. Poe, J. Speight; Gulf Professional Publishing

| Subject Code | Subject Name                               | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--|---------------------------|---|---|---------------|
| <b>DE301</b> | <b>Reservoir Modeling &amp; Simulation</b> | 3                         | 0 | 0 | 9             |

#### **UNIT I:**

**Introduction & Overview:** Organization, Design, Testing, Forecasting, Special processes, Economics, Credibility, decision making, Performance Monitoring, beneficial application, planning a simulation study, Study Approach, Model design, Programming, History Matching, Predicting & Analyzing results, reporting.

#### **UNIT II:**

**Modeling Concepts:** The concept of Grid blocks & Time steps, Representation of wells, Mobility Weighting, Numerical Dispersion, Grid Orientation effects, Explicit & Implicit functions, Treatment of Vertical saturation & Pressure distributions, Well functions, History Matching, Well Management, Solution methods.

#### **UNIT III:**

**Designing the reservoir model:** Checklist for model design, Selecting the number of dimensions, Tank models, 1D, 2D (Areal, cross-sectional, radial), Multilayer, 3D, Simplification of complex problems, Pseudo-relative permeability & Capillary pressure functions, VE pseudo functions, Windowed models, Naturally fractured reservoirs, Representation of reservoir fluids, Representation of reservoir rock, Well models.

#### **UNIT IV:**

**Selecting reservoir rock and fluid properties data:** Data for model construction, Sensitivity of results to data accuracy, Porosity & Permeability: Sources of data, developing reservoir description, rock property distribution, Thickness and depth, Capillary pressure and relative permeability: Selection and assignment of data Fluid properties, Establishing Initial pressure and saturation distribution.

#### **UNIT V:**

**Selecting Grid & Time-step sizes:** Selection of grid block size example grids, Selection of time-steps, Numerical dispersion, Grid orientation, Cost considerations.

**Selecting the Numerical solution method:** Terminology, Formulating the equations, Material Balance & pressure equations, Formulating options, Numerical Dispersion, Choosing the formulation option, Matrix Equations, Solution methods, Selecting the Equation-solving technique.

#### **UNIT VI:**

**Well Management:** Designing & Controlling Production Parameters.

**History Matching:** Validity of the Reservoir Model, Strategy & Plans, Adjustment of parameters, Pressures, Pressure gradients, GOR-WOR behavior Automatic History Matching. **Forecasting Future**

**Performance:** Planning prediction cases, Preparation of input data, smooth transition from history to

predictions, Review & Analysis of predicted performance, Evaluating & Monitoring predicted performance.

#### **UNIT VII:**

**Simulating Special Processes:** Compositional Simulation, Miscible displacement, Chemical & polymer flooding, Steam simulation and steam drive, In-Situ combustion, Special Data requirements.

#### **TEXT BOOKS:**

1. Jamal H. AbouKasem, S. M. Fariuq Ali, M. Rafiq Islam, "Petroleum Reservoir Simulation: A Basic Approach", Gulf Publishing Company, (2006).
2. John R. Fanchi, "Principles of Applied Reservoir Simulation", Elsevier, (2005).

#### **REFERENCE BOOKS:**

1. Heriot Watt, "Reservoir Simulation Handbook"
2. M.R. Carlson, "Practical Reservoir Simulation", PennWell, (2003).
3. Zhangxin Chen, "Reservoir Simulation: Mathematical Techniques in Oil Recovery", Cambridge University Press, (2008).
4. Richard E. Ewing, "Mathematics of Reservoir Simulation", Society for Industrial and Applied Mathematics (SIAM), (1983).



| Subject Code | Subject Name                         | Credit Lecture<br>(L-T-P) |   |   | Total Credits |
|--------------|--------------------------------------|---------------------------|---|---|---------------|
|              |                                      |                           |   |   |               |
| DE301        | Unconventional Oil and Gas Resources | 3                         | 0 | 0 | 9             |

### **Unit I: Introduction**

Unconventional resources, occurrence, Geological perspective-source, reservoir, unconventional oils, unconventional gas maturities; Drilling and production of unconventional resources – horizontal drilling, fracturing, production profile; Environmental concerns – water utilization, chemical additives, noise pollution, emission of green house gases

### **Unit II: Shale Gas**

Introduction, comparing shale gas with shale oil/tight oil, characteristics of a shale gas play-maturity, type of gas, TOC, permeability; drainage area and spacing unit, drilling a shale gas well, hydraulic fracturing operation and use of proppants, challenges in shale gas exploitation, shale gas resource in india

### **Unit III: Coal Bed Methane**

Coal and methane, Materials comprising coalbed, porosity systems on coalbeds – primary porosity and secondary porosity systems, methane storage in coalbeds, CBM wells, gas production process, coal bed field development, CBM potential in India

### **Unit IV: Heavy Oil**

Origin of heavy oil, occurrence, categories of heavy oil- mobile: heavy and extra heavy oil, non -mobile – oil sands; heavy oil recovery- primary cold production, cold heavy oil production with sand (CHOPS), thermal and combustion production, enhanced oil recovery; pipeline flow using heating and dilution,

### **Unit V: Gas Hydrates**

Introduction, Basis of gas hydrates, phase diagram of methane hydrate, worldwide locations, marine gas hydrate and permafrost associated gas hydrate, gas hydrate resource pyramid, producing methane from hydrates Thermal stimulation, Depressurization, Chemical inhibition; hydrates in India

### **Unit VI: Tight Gas reservoirs**

Introduction, basin centered extensive deposits, conventional traps, source rock, abnormal pressure, stacking pressure, reservoir quality, drilling and completion, producing gas from tight reservoirs, tight gas potential in India

### **TEXT BOOKS:**

1. Advanced Reservoir Engineering, Tarek Ahmed and Paul D.McKinney, Gulf Professional Publishing
2. Unconventional Oil and Gas Resources Handbook, Y Ma and Stephen Holditch, Gulf Professional Publishing

3. Shale Oil and Gas Handbook, SohrabZendehboudi and AlirezaBahadori, Gulf Professional Publishing
4. Unconventional Oil and Gas Resources- Exploitation and Development, Usman Ahmed and D.Nathan Meehan, CRC Press
5. Coal Bed Methane-Theory and Application; Pramod Thakur, Steven J.Schatzel, KashyAminian, Gary Rodvelt, Morgan H.Mosser and Joseph S.D'Amico, Elsevier