# FACULTY OF ENGINEERING

Syllabus for the
**S.E (Petroleum, Petrochemical and Polymer Engineering)**
(W.e.f 2009-2010)

THE SYLLABUS IS PREPARED BY:

BOS- Petroleum and Petrochemical Engineering
University of Pune

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Note: - This syllabus is subject to change without prior notice by the concerned BOS

# UNIVERSITY OF PUNE
# STRUCTURE OF S.E. (PETROLEUM/PETROCHEMICAL/ POLYMER)
# 2008 COURSE

| Sub. No. | Subject | Teaching Scheme (H / W) | | | | Examination Scheme (Marks) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | Pr | D | P | TW | Pr. | Or | Total |
| **Term – I** | | | | | | | | | | |
| 212381 | Engineering Chemistry I | 4 | - | 2 | - | 100 | - | 50 | - | 100 |
| 212382 | Engg. Materials Science and Tech. | 3 | - | 2 | - | 100 | 50 | | - | 150 |
| 212383 | Chemical Process Calculations | 4 | - | - | - | 100 | | - | -- | 100 |
| 212384 | Momentum Transfer | 4 | - | 2 | - | 100 | - | - | 50 | 150 |
| 212385 | Strength of Materials | 3 | - | 2 | - | 100 | 25 | - | - | 125 |
| 212386 | Introduction to Petroleum Industry | - | - | 1 | - | - | 25 | - | - | 25 |
| 212387 | Technical Communications | 1 | - | 1 | - | - | 50 | - | - | 50 |
| **Total Part - I** | | **19** | **-** | **10** | **-** | **500** | **150** | **50** | **50** | **750** |
| **Term – II** | | | | | | | | | | |
| 207004 | Engineering Mathematics – III | 4 | - | | - | 100 | - | | - | 100 |
| 212388 | Engineering Chemistry II | 4 | - | 2 | - | 100 | - | 50 | | 150 |
| 212389 | Heat Transfer | 4 | - | 2 | - | 100 | - | - | 50 | 150 |
| 212390 | Particulate Technology | 3 | - | 2 | - | 100 | - | - | 50 | 150 |
| 212391 | Elements of Social Sciences | 3 | - | - | - | 100 | - | - | - | 100 |
| 212392 | Industrial Electronics and Electrical Engg. | 1 | - | 2 | - | - | 50 | - | - | 50 |
| 212393 | Machine Drawing and Workshop Practices | | - | 1 | 1 | - | 50 | - | - | 50 |
| **Total Part - II** | | **19** | **-** | **9** | **1** | **500** | **100** | **50** | **100** | **750** |
| **Annual Total** | | **38** | | **19** | **1** | **1000** | **250** | **100** | **150** | **1500** |

# 212381 Engineering Chemistry I

**Teaching Scheme:**
Lectures: 4 Hrs/week
Practical: 2 Hrs/Week

**Examination Scheme:**
Paper: 100 Marks
Practical: 50 Marks

## Objectives:

1) To study fundamentals of organic and physical chemistry.
2) To learn identification and synthesis techniques and its relevance to different processes in Petroleum Industry

## SECTION – I

### Unit 1: Structural Effects and Reactivity: (8Lect.)

Structure of benzene and concept of aromaticity (Huckel's rule), homolytic and heterolytic cleavages, formation of reaction intermediates such as carbonium, carbanion and free radical.

Basic structural electronic effects – Inductive, resonance, hyperconjugation, steric, tautomerism. Application of these effects to explain acidity and basicity of organic acids and bases.

Types of reactions – Important organic reactions such as substitution, addition, elimination etc.

### Unit 2: Reaction Mechanism: (8 Lect.)

### Reactions Involving Carbonium Ion Intermediates:

1. Nucleophilic substitution: $SN^1$, $SN^2$ reactions and their comparison. Aliphatic and aromatic nucleophilic substitution.
2. Electrophilic substitution: In benzene and monosubstituted benzene with orientation effect. Nitration halogenation, sulfonation, Friedel Craft alkylation and acylation.
3. Electrophilic addition to C = C: Addition of halogens, hydrogen halide and water.
4. Elimination: $E_1$ and $E_2$ reactions, Saytzeff and Hofmann elimination, comparison of elimination with substitution.
5. Rearrangement: Meaning with examples such as Beckman, pinacol.

### Reactions Involving Carbanion Intermediates:

1. Addition of carbon nucleophile to cabonyl group such as Grignard reaction for preparation of alcohols and carboxylic acids.
2. Nucleophilic substitution such as Wurtz and Condensation such as aldol, claisen ester.
3. Rearrangement such as Favorskii.

## Reactions Involving Free Radical Intermediate:

1. Addition of hydrogen halide to C = C in presence of peroxide.
2. Substitution such as halogenation of alkanes.
3. Dimerization such as Kolbe synthesis.

## Unit 3: (8 Lect.)

### A) Stereochemistry:

Basic concepts of stereochemistry, Conformation isomerism of ethane, propane, butane, cyclohexane, monosubstituted cyclohexane. Optical isomerism with one and two chiral centers (AA and AB type), enantiomers, threo, erythro, meso, distereoisomers. Geometrical isomerism (cis, trans and E, Z).

### B) Heterocyclic Compounds:

Structure, preparation and reactions. Five membered – Furan, pyrrole, thiophene. Six membered – Pyridine, Fused – Quinoline.

## SECTION – II

## Unit 4: Solid, Liquid and Gaseous State: (8 Lect.)

Solid state – Characteristics, melting point, sublimation, atomic and molar heats of solids.

Liquid State – Intermolecular forces, structure of liquids, general properties of liquids. Evaporation, vapour pressure, measurement of vapour pressure, Trouton's rule, boiling point, heat of vaporization, freezing point.

Gaseous State – Ideal gases, kinetic molecular theory of gases. The kinetic gas equation. Derivation of gas laws from gas equation, kinetic energy and temperature. Types of molecular velocities and their calculations. Real gases, deviation from ideal behaviour, Van der Waals equation of state and its limitations, intermolecular forces. The critical phenomenon. Experimental determination of the critical constants of a gas, Andrews experiment, calculation of critical constants.

Numericals on all above.

## Unit 5: Electrochemistry and fuel cells (8 Lect.)

Electrochemical cell. Conventions and standard states.
Cell diagram. Nernst equation, cell emf and Gibbs energy cell
Standard electrode potentials. Classification of electrochemical cells

Primary, secondary fuel cells. Features of fuel cell construction.
Anodic and cathodic reactions in fuel cells for verity of fuels.
Limitations on Power available from fuel cells.

## Unit 6: Colloidal Chemistry (8 Lect.)

The colloidal state properties of Lyophilic and Lyophobic – optical, Brownian movement, electrical, viscosity, methods of preparation, separation determination of particle size. Gels, colloidal electrolytes, emulsions, nanotechnology.

Colloidals and inter faces – the ideal solution, Roult's law of ideal solutions, solutions of liquids in liquids, Theory of dilute solution. Colligative properties, osmosis, osmotic pressure, measurement of osmotic pressure.

Colligative properties of dilute solution – lowering of vapor pressure, elevation of boiling point with derivation, depression in freezing point with thermodynamics derivation. Abnormal behaviour of solutions of electrolytes.

Numericals on all above.

## List of Practicals:

A Minimum of four experiments from group I and four experiments each from group II are to be carried out as a part of journal

### Group I

1. Volumetric estimation of amide from the given solution of amide.
2. Volumetric estimation of acetone from the solution of acetone.
3. Purification of organic compounds by using techniques such as recrystallisation, distillation, sublimation, column chromatography and to find their physical constants.
4. Preparation of benzoic acid from benzamide.
5. Preparation of osazone derivative of glucose.
6. Preparation of aspirin from salicylic acid.

### Group II

1. To determine radius of macromolecule by using Ostwald's viscometer.
2. To determine molecular weight of non-volatile solute by depression in freezing point method.
3. To determine molecular weight of solid by elevation in boiling point method.
4. To determine distribution coefficient of iodine between water and carbon tetrachloride and hence to determine the molecular condition of iodine.
5. To determine of rate constant of hydrolysis of methyl acetate by dilute HCl and to show that it is a first order reaction.
6. To determine the rate constant of hydrolysis of ethyl acetate by NaOH (saponification) and to show that it is a second order reaction.

## Text Books:


1. Morrison R. T. and Boyd R.N.; Organic Chemistry; Prentice Hall of India Private Ltd.; (1973).
2. Atkins P.W.; Physical Chemistry; ELBS publications; (1987).

## Reference Books:


1. March Jerry; Advanced Organic Chemistry; McGraw Hill International Book Company; (1995).
2. Sykes Peter; A Guide Book to Mechanism in Organic Chemistry; Prentice Hall.
3. Glasstone Samuel; Textbook of Physical chemistry; McMillan and Co. Ltd.; (1981).
4. Barrow G.M.; Physical Chemistry; McGraw Hill Publications; (1996).

## 212382 Engineering Materials Science and Technology

**Teaching Scheme:**
Lectures: 3 Hrs/week
Practicals: 2 Hrs/week

**Examination Scheme:**
Paper: 100 Marks
Oral: 50 Marks

**Objectives:**

1. To understand the structure and properties of engineering materials.
2. To acquaint with the changing trends in materials science and engineering.
3. To develop futuristic insight into materials.

### SECTION – I

### Unit 1: Materials Science and Engineering (6 Lect)

Introduction, Developments in materials, Engineering profession and materials, Classification of materials, introduction to standards and specifications, Structure and properties relationship in materials, Macro, Micro, Nano, Submicroscopic observations of materials,

Point, Linear, Planar and volume defects and their relationship with properties of materials, Crystalline, Noncrystalline and semicrystalline materials.

Criteria for selection of materials for special applications in Industries.

### Unit 2: Microstructural developments (6 Lect)

Components, Phases and phase equilibrium diagrams, Eutectic, Etectoid and peritectic reactions.

Phase transformations and relationship with properties.

Microstructures of materials and transformations.

Relation of microstructure with properties and applications.

### Unit 3: Properties of materials (6 Lect.)

Mechanical properties: Hardness, Strength, Toughness, Stiffness, Ductility, Malleability, Hardenability, Creep fatigue and Rheology

Electrical properties: Conduction, Semiconductotrs and insulators.

Optical properties: Absorption, Reflection, Transmission and Refraction optical fibers and lasers.

Magnetic properties: various types of magnetic materials, Diamagnetic, Paramagnetic, Ferromagnetic, Antiferromagnetic and Ferrimagnetic materials, Domain theory, Hard and soft magnetic materials.
Thermal Properties: Thermal expansion, Heat capacity, Thermal Conduction, Thermal Stresses.

## SECTION – II

### Unit 4: Composite Materials (6 Lect.)

Classification of composites, Reinforcing phase, Matrix phase, Fiber reinforced plastics, Metal matrix composites, Flake and Particulate composites, General and practical composite systems, Tribological behavior of composite, Special composites.

### Unit 5: Materials environment interactions (6 Lect.)

Liquid solid reaction, Electrochemical corrosion direct dissolution mechanisms, Dry and wet corrosion, Galvanic corrosion, Polarization Corrosion prevention,

Gas solid reactions, Oxidation prevention, Solid solid interactions, Wear, Surface fatigue Radiation damage, Protective coatings, Different methods to prevent environmental attack.

### Unit 6: Materials Processing (6 Lect.)

Processing of metals, Ceramics, Polymers, Composites Semiconductors,

Nanostructured materials, Casting, Forming, Powder processing, Machining, Joining, Surface coating treatments, Fiber Manufacturing,

Recent techniques in material processing.

### Term Work:

Term Work shall consist of the experiments listed below of which, at least eight should be performed in laboratory by the students. A record of the work performed should be presented in the form of a journal.

### LIST OF PRACTICALS:

1. Microstructural observations of ferrous and non ferrous metals and alloys (Minimum five)
2. Annealing and normalizing of steel, observations.
3. Hardening and tempering of steel, observations.
4. Study of fractures of engineering materials.
5. Non destructive testing (Minimum two tests)
6. Macro observation of flow lines in forged products.
7. Macro etching Sulphur printing test of steel.

8. Cupping test of sheet materials
9. Hardness test any one out of the following
   (Rockwell, Brinell or Vickers)
10. Jominy end quench test for hardenability of steel.
11. Electro chemical corrosion test half cell test using two metals plates of different electrode potentials.

## REFERENCE BOOKS


1. Schaeffer J.P.: Saxena A., Antolovich S.D., Sanders T.H.Jr., Warner S.B., The Science & Design of Engineering Materials, McGraw-Hill International.

2. Askeland Donald R. and Phule P.P. The Science and Engineering Materials, Thomson Learning,

3. Callister William D. Jr. Material Science and Engineering an Introduction, John Wiley & Sons Inc.

## 212383 Chemical Process Calculations

**Teaching Scheme:**
Lectures: 4 hrs/week

**Examination Scheme:**
Paper: 100 Marks

**Objectives:**

1. To understand different aspects of material and energy balances on chemical process systems.
2. To develop an organized and systematic approach in the analysis of practical engineering problems.

### SECTION – I

### Unit 1: Introduction to Basic calculations (8 Lect)

Introduction to unit operations and unit processes. Units and Dimensions. Conversion of units. Basic process variables: Mass. Volume. Flow rate. Chemical composition. Volume, Mass and mol fractions. Wet basis and dry basis, Average molecular weight, specific gravity, API gravity, Behavior of gases: ideal and Van der Waal Gases

### Unit 2: Material balance on non reacting systems (8 Lect)

Overall and Component balances. Steady state and unsteady state Processes.
Degrees of Freedom analysis for given process unit. The general balance equation for various unit operations. Material balance on non-reacting systems. Recycle, Bypass and Purge calculations. Calculations for Absorber- Stripper, Extraction- Distillation.

Unsteady state process calculations

### Unit 3: Material balance on reacting systems (8 Lect)

Introduction to Stiochiometry, Balances on reacting systems. Limiting and excess reactants. Fractional conversion. Extent of reaction. Multiple reactions. Yield and selectivity. Recycle and Purge calculations involving chemical reactions.. Theoretical and excess air.

Fuels and Combustion.

### SECTION – II

### Unit 4: Calculations for two phase Single stage systems (8 Lect)

Vapor-Liquid equilibrium. Ideal solution and Raoult's law. Deviation from ideal behavior. Henry's laws and gas solubility. Bubble Point, dew point calculations, Flash calculations. Calculations on condensation, vaporization and absorption single stage systems

Introduction to Psychrometry: Humidity and air- conditioning and drying calculations

## Unit 5: Energy balance on non reactive systems (8 Lect)

Law of conservation of energy**.** Revision of Heat capacities, Latent Heats, use of Steam table. Enthalpy changes accompanying phase changes. Balances on dissolution and mixing processes. Energy balance on flow processes. Unsteady state energy balance calculations

## Unit 6: Energy balance on reactive systems (8 Lect)

Heat effects accompanying chemical reactions**,** Hess's Law, Standard Heat of Reaction, combustion and formation, Effect of temperature on standard heat of reaction, Adiabatic Reaction Temperature, Heat Load and utility Calculations for non adiabatic operations

## Reference Books:


1. Felder R. M. and R. W. Rousseau; Elementary Principles of Chemical Processes; 3/e, John Wiley and Sons; (2000).
2. Himmelblau D. M.; Basic Principles and Calculations in Chemical Engineering; 6/e, Prentice-Hall, India, (1996).
3. Bhat B. I. and Vora; Stoichiometry; 2/e, Tata McGraw Hill; (2000).
4. Hougen O. A., K. M. Waston & R. A. Ragatz; Chemical Process Principles Part-I, Material and Energy Balances; Asia Publishing House, Mumbai; (1995).
5. Narayanan K.V.and.Lakshmikutty B; Stiochiometry and Process Calculations; 1/e, Prentice-Hall, India, (2006).

## 212384 Momentum Transfer

**Teaching Scheme:**
Lectures: 4 Hrs/week
Practicals: 2 Hrs/week

**Examination Scheme:**
Paper: 100 Marks
Oral: 50 Marks

**Objectives:**

1) To develop understanding of fundamental principles of fluid behavior
2) To show how the fundamental principles underlying the behavior of fluids can be applied in an organized and systematic manner to the solution of practical engineering problems.

### SECTION – I

### Unit 1: Fluid Properties and Fluid Statics (8 Lect)

Definition of a fluid, Application areas of Fluid mechanics, Properties of fluids: Continuum hypothesis, viscosity, density, vapor pressure and Cavitation, surface tension and capillary effect, coefficient of compressibility and volume expansion

Fluid Statics: Concept of pressure; types of manometers – simple and differential, different Fluid forces on plane and curved surfaces. Concept of buoyancy.

### Unit 2: Fluid Flow Visualization and Fluid Kinematics (8 Lect)

Classification of Flows, Classification of Fluids, Concepts of control volume; Lagrangian and Eulerian Descriptions of fluid flows; Acceleration Field and Material Derivative, Fundamentals of flow visualization: stream tube, streamline, pathline, streakline, timeline, Vector plots, profile plots, contour plots. Deformation of fluid elements, vorticity and rotationality.

Forces acting on a control volume.

### Unit 3: Fluid Dynamics: Momentum Equation, Bernoulli's equation and its applications (8 Lect)

Continuity Equation. Bernoulli equation. Forms of Bernoulli equation, Limitations on use of Bernoulli equation and correction terms involved in different cases, Hydraulic Grade Line (HGL) and Energy Grade Line (EGL), Application of Bernoulli equation. The Momentum equation and its applications

## SECTION – II

### Unit 4: Flow Through Pipes: Pressure drop calculations in single-phase flow (8 Lect)

Reynolds Number, Laminar and Turbulent flow, Hydrodynamic development of a flow, Hagen-Poiseuille's equation and its applications

Turbulent flow: flow analysis for smooth and rough boundaries. Friction factor and its variations

Darcy-Weisbach equations. Moody's diagrams. Explicit equation for friction factor.

Minor losses in piping system: concept of equivalent length and loss coefficient

Pressure drop Calculations of laminar and turbulent flow through pipes.

### Unit 5: Boundary Layer and Pressure drop calculations in Multiphase flows (8 Lect)

Boundary Layer: Boundary layer theory, various boundary layer thicknesses, Prandtls boundary layer equation and its assumptions, Boundary layer separation: skin and form drag. Importance of turbulence and boundary layer in heat and mass transfer

Multiphase flows: Gas – liquid Two phase flow: types of flow regimes, regime maps, hold-up and slip velocity, Lockhart-Martinelli correlation to find the two-phase pressure drop

Particle Dynamics, Flow through Fixed and Fluidized Beds

### Unit 6: Dimensional Analysis and Fluid Machinery: (8 Lect)

Fundamental dimensions; units; dimensional analysis; dimensionally homogeneous equation; importance of dimensional analysis in experimental work. Buckingham's Pi theorem.

Comparison between fans, blowers, compressors. Pump's principle, construction and working of centrifugal pumps. Characteristic curves. NPSH concepts.

Fundamental relationships, formulae and Numerical Calculations.

## Term Work:

Term Work shall consist of the experiments listed below of which, at least eight should be performed in laboratory by the students and data analysis for at least two of the performed experiments should be carried out using computer. A record of the work performed should be presented in the form of a journal.

## List of Practicals:

1. Determination of viscosity.
2. Flow through pipes. Analysis for laminar and turbulent regions.
3. Flow through packed bed.
4. Flow through venturimeter.
5. Flow through orifice meter
6. Flow through pipe fittings.
7. Identification of Flow regimes in Two-phase horizontal and vertical flow
8. Verification of Darcy's law.
9. Characteristics of centrifugal pump.
10. Pump and blower specifications writing in a format routinely used by process industry.
11. Trial and error solution to a given flow problem on computer.

**Oral Exam:** Oral examination will be based on the above term work

## Reference Books:


1. Noel de Nevers; Fluid Mechanics for Chemical Engineers, Third Edition; McGraw Hill, 2005.
2. Yunus A Cengel , John M. Cimbala ; Fluid Mechanics; Tata-McGraw-Hill
3. Denn Morton M.; Process Fluid Mechanics; Prentice Hall
4. McCabe W. L., SmithJ. C. and Harriot P.; Unit Operations in Chemical Engineering; 5/e, McGraw-Hill Inc.; (1993).
5. Evett Jack B. & Cheng Lin; Fundamentals of Fluid Mechanics -McGraw Hill; (1987).
6. Darby Ron, Chemical Engineering Fluid Mechanics. Second Edition, Marcel Dekker, 2001.

# 212385 STRENGTH OF MATERIALS

**Teaching Scheme:**
Lectures: 3 Hrs/week
Practicals: 2 Hrs/week

**Examination Scheme:**
Paper: 100 Marks
Term work: 25 Marks

**Objectives:**

1. To understand the engineering fundamentals of materials.
2. To know the laws and derivations governing design principles and strength of materials.

## SECTION – I

### Unit 1: Simple Stresses and Strains: (6 Lect.)

Concept of stress, strain, shear stress, shear strain, Hooke's Law, Elastic limit, Stress-strain curve for mild steel and important points on that curve. Deformations of axially loaded members (prismatic as well as tapering bars), deformation due to self-weight, axial force diagrams, relationship between various elastic constants of a material (E, G, K).

Stresses and Strains in determinate and indeterminate axially loaded members, bars of composite sections, stresses due to changes of temperature in simple and composite members.

Strain energy due to axial load (gradual and sudden) and impact.

### Unit 2: (6Lect.)

**Torsion:**
Stresses and strains in determinate and indeterminate circular shafts subjected to tensional moment, torsional moment diagrams, power transmitted by shafts, flanged coupling.

**Stresses on Inclined Sections:**
Normal and shear stresses on inclined sections due to bi-axial stress system. Principal stresses and strains (Analytical as well as Mohr's Circle Method)

Introduction to 2-D and 3-D Mohr's Circle and numerical on same.

### Unit 3: Thin Walled Pressure Vessels: (6 Lect.)

Thin cylinders and spheres subjected to internal pressure. Hoop stress, longitudinal stress, principal stresses, strains in cylinder and sphere changes in dimensions, joints in pressure vessels.

Lame's Formulae for thick cylinder (derivation expected), thick spherical vessels subjected to internal pressure (only application of formulae).

## SECTION – II

### Unit 4: (6 Lect.)

**Shear Force and Bending Moment Diagrams:**

Shear force and bending moment in determinate beams due to concentrated loads, uniformly distributed loads, uniformly varying loads and couples, relation between SF and BM, point of contraflexure for simple and compound beams.

**Bending Stresses in Beams:**

Theory of simple bending, assumptions, derivation of flexure formula, Moment of inertia of common cross sections with respect to centroidal and parallel axes. Bending stress distribution diagrams, Moment of resistance and section modulus calculations.

### Unit 5: (6 Lect.)

**Shear Stresses in Beams:**

Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections. Maximum and average shear stress; shear connection between flange and web.

**Columns:**

Concept of buckling of columns, Derivation of Euler's formula for buckling load for column with hinged ends, equivalent length of a column for various end conditions, limitations to Euler's formula, Rankine's formula.

### Unit 6: (6 Lect.)

**Direct and Bending Stresses:**

1. Middle third rule Core or Kernel of a section
2. Combined bending and torsion
3. Eccentrically loaded rivetted joints

**Slope and Deflection of Beams:**

Introduction and only Macaulay's Method.

## Term Work:

Student should carry out 10 experiments out of the list given below and submit the journal. Practicals should be performed as per the Indian Standard Code of practice.

1. Tension test on mild steel, aluminium.
2. Izod and Charpy impact test on mild steel, copper, brass and aluminium, cast-iron.
3. Bending test on cast-iron and timber.
4. Shear Test: Single Shear and Double Shear Test on mild steel and aluminium.
5. Different types of Hardness tests on metals i.e. Rockwell Hardness Test, Brinell Hardness Test, Shore Scleroscope Test etc.
6. Torsion test on mild steel and cast-iron.
7. Fatigue test on metals.
8. Impact test on polymeric materials.
9. Tension test on polymeric materials.
10. Compression test on concrete.
11. Compression test on Cement Mortar Cube.
12. Measurement of shear force in beams.
13. Measurement of bending moment in beams.
14. Measurement of deflection of beams.

## Reference Books:


1) Timoshenko Stephen; Strength of Materials Part I; Elementary theory and problems; 3/e, CBS Publishers & Distributors; (1986).
2) Beer F. P. and Johnston E. R.; Mechanics of Materials; McGraw-Hill; (1981).
3) Singer F.L. and Pytel A.; Strength of Materials; Harper International, (1980).
4) Pytel and Singer; Strength of Materials; Harper and Row; New York; (1987).
5) Egar Popov Egar; Mechanics of Materials; Prentice Hall; (1983).

## 212386 Introduction to Petroleum Industry

**Teaching Scheme:**
Practical: 1 hours /W

**Examination Scheme:**
TW: 25 marks

**Objectives:**

1. To understand the vertical integration in Petroleum Industry
2. To learn different areas of study in upstream, midstream and downstream industry

**Term Work:**

Minimum six out of the following lists of list of experiments are to be carried out as a apart of syllabus for the course. A record of the work performed should be presented in the form of a journal.

1. Worldwide distribution of oil and gas reserves. Subsurface data sampling and interpretation. Measurement scaling. Core, log and test data.
2. Rock/fluid systems. Rock and fluid parameters used in the petroleum industry. Interrelations between these parameters. Coring and core analysis. Well logging and log interpretation. Well testing and test analysis.
3. Drilling of oil and gas wells. Classification of wells. Drilling operating systems. Drilling fluids. Well completions. Gun perforating.
4. Hydrocarbon production techniques. Hydrocarbon recovery mechanisms.
5. Environmental aspects in Drilling and Production Operations
6. Introduction to Refining operations and separation processes
7. Petrochemicals derived
8. Measurement of Fluid Properties
9. Environmental aspect of refining and petrochemicals
10. Introduction to Polymerization Processes
11. Introduction to preliminary methods of identification of polymers
12. Introduction to basic composite processes
13. Introduction to basic injection molding processes

## 212387 Technical Communications

**Teaching Scheme:**
Lectures: 1 Hr/week
Practicals: 1 Hrs/week

**Examination Scheme:**
TW: 50 Marks

**Objectives:**

(1) To understand and learn the factors to be considered in a technical communication.
(2) To learn to use modern tools of communication.
(3) To practice skills of communication in front of varied audience.

**Introduction:**

**Personal Communication: (1 Lect.)**

Face-to-face Conversation, Telephonic Conversation, Communication within an organization.

**Non-verbal Communication: The Body Language: (1 Lect.)**

Personal Appearance, Posture, Gestures, Facial Expression, Eye Contact, Space Distancing.

**Introduction to Internet Facilities (Two Sessions). (1 Lect.)**

Email communication, website browsing, searching of material / pictures / data. Ethics: Plagiarism, patent search, intellectual property rights, social networking, cyber crime.

**Effective Stress Management: (1 Lect.)**

Source of Stress, Recognizing Stress, Managing emotional and physical stress.

**Meetings: (1 Lect.)**

Purpose, Procedure, Chairmanship, Participation, Noting minutes of meeting, Physical Arrangements.

**Group Discussion: (1 Lect.)**

Group Dynamics, Purposes, Organization. Group discussion for any four Technical / Non Technical topics.

**Audio Visual Aids: (1 Lect.)**

Basic Principles and Guidelines, Types of Aids and their use, Graphics Aids. Development of Power point presentation on any one technical or non-technical topic with use of animations, sound, videos etc.

**Seminars and Conferences: (1 Lect.)**

Type of Discussion groups, Regulating Speech, Conducting Seminars, Organizing Conferences, Evaluating Oral Presentation. Development of Seminar report on any one technical topic in group of two students.

**Mock Interviews and Extempore Practice: (1 Lect.)**

Interview practice for Technical, non-technical, HR questions. Interview Dynamics and Interview protocol to follow. Extempore for any one topic, given on time for presentation, for a period of 3 minutes.

**Technical Proposals: (1 Lect.)**

Definition, Key Factors, Types, Contents, Format, Evaluation.

**User Manual: (1 Lect.)**

Definition, Preparatory Steps, Types, Structure, Style, Copy Editing. Development of one user manual (For e.g. calculator, TV) in group of two students.

**Research Papers and Articles: (1 Lect.)**

Literature Survey, Reference Writing, Abstracting articles etc.

**Business Correspondence, Notices, Advertising etc. (1 Lect.)**

Notice writing for any one organization, Development of advertisement for any product / services for news paper/pamphlet.

**Term Work:**

Term work and theory are considered as an integral part of the course.

Term work shall consist of a journal containing regular assignments and presentations completed in the practical class and at home. The total number of assignments should not be less than twelve, generally covering the topics mentioned above. As far as possible, submission should be word processed on computer using standard package by the student himself.

For the purpose of assignments, extensive use of research papers published in technical journals and articles published in magazines and newspapers may be made so that there is no repetition by individuals.

Oral presentation exercises and group discussions should be conducted batch wise so that there is a closer interaction.

**Reference Books:**

(1) Krisna Mohan and Banerji Meera; Developing Communication Skills; Macmillan India Ltd.; (1996).
(2) Rutherford A. J.; Basic Communication Skills for Technology; Pearson Education; Inc.; (2000).

# 207004 Engineering Mathematics – III

**Teaching Scheme:**
Lectures: 4 Hrs/week

**Examination Scheme:**
Paper: 100 Marks

**Objectives:**

1. To develop basic understanding in engineering mathematics
2. To learn and apply usefulness of different equations in different areas of chemical engineering

## SECTION - I

### Unit 1: Linear Differential Equations (LDE): (8 Lect.)

General $n^{th}$ order Linear Differential Equations. Solution of $n^{th}$ order Linear Differential Equations with constant coefficients. PI by variation of parameters. Cauchy's and Legendre's DE. Solution of Simultaneous and Symmetric Simultaneous DE.

### Unit 2: (8 Lect.)

### Application of Differential Equations

Applications of Linear Differential Equations to problems on bending of beams and chemical engineering problems involving batch systems (mixing and heating).

### Solution of Partial Differential Equations (PDE)

(1) $\partial u / \partial t = a^2 (\partial^2 u / \partial x^2)$, (2) $\partial^2 u / \partial t^2 = a^2 (\partial^2 u / \partial x^2)$ and (3) $(\partial^2 u / \partial x^2) - (\partial^2 u / \partial y^2 = 0)$ by separating variables only.

Applications of PDE to problems of Chemical engineering (one dimensional diffusion and conduction).

### Unit 3: Fourier Transform (FT): (8 Lect.)

Fourier Integral Theorem. Sine and Cosine Integrals. Fourier Transform, Fourier Cosine Transform, Fourier Sine Transforms and their inverses. Finite FT.

Applications of FT to problems on one and two dimensional heat flow problems.

## SECTION - II

### Unit 4: Laplace Transform (LT): (8 Lect.)

Definition of Laplace Transform, Inverse LT. Properties and theorems. LT of standard functions. LT of some special functions viz. error, $1^{st}$ order Bessel's Periodic, Unit Step, Unit Impulse, ramp, jump, parabolic, Si(t) and Ei(t). Problems on finding LT and inverse LT.

## Unit 5: Vector Calculus: (8 Lect.)

Vector Differentiation and its physical interpretation. Radial, Transverse, Tangential and Normal components of Velocity and Acceleration. Vector differential operator. Gradient, Divergence and Curl. Directional derivative. Vector identities. Line, Surface and Volume integrals. Work done. Conservative, Irrotational and Solenoidal fields. Scalar potential. Gauss's Stoke's and Green's theorems (without proofs).

## Unit 6: Applications of Laplace Transforms and Vector Calculus: (8 Lect.)

Applications of Vectors to problems in Fluid Mechanics, Continuity equations, Stream lines, Equations of motion, Bernoulli's equations.

Applications of LT for solving ordinary differential equations, liquid level systems, consisting of single tank and two tanks in series (interacting and non-interacting systems), second order systems (damped vibrator).

## Text Books:


1. Peter V. O'Neil; Advanced Engineering Mathematics; 5e,; Thomson Learning.
2. Erwin Kreyszig; Advanced Engineering Mathematics; Wiley Eastern Ltd.


## Reference Books:


1. Wylie C. R. and Barrett L. C.; Advanced Engineering Mathematics; McGraw-Hill, Inc.
2. Grewal B. S.; Higher Engineering Mathematics; Khanna Publication, Delhi.
3. Greenberg M. D.; Advanced Engineering Mathematics; 2e; Pearson Education.
4. Raman B. V.; Engineering Mathematics; Tata McGraw Hill, Inc.
5. Wartikar P. N. and J. N. Wartikar; Applied Mathematics; Volume I and II; Pune Vidyarthi Griha Prakashan, Pune.

# 212388 Engineering Chemistry – II

**Teaching Scheme:**
Lectures: 4 Hrs/week
Practical: 2 Hrs/Week

**Examination Scheme:**
Paper: 100 Marks
Practical: 50 Marks

## Objectives:

1) To study fundamentals of organic and inorganic chemistry.
2) To learn identification and synthesis techniques and its relevance to different processes in Petroleum Industry
.

## SECTION - I

### Unit 1: (8 Lect.)

### Biomolecules:

**Carbohydrates:** Definition, classification and reactions such as oxidation, reduction, osazone formation, ester formation, isomerisation. D and L configuration, cyclic structure of glucose and fructose, Fischer, Haworth projection, chair form. Brief account and cyclic structure of disaccharides – maltose, sucrose, cellobiose, polysaccharide – starch, cellulose.

**Aminoacids:** $\alpha$ - aminoacids – Fischer projection and relative configuration. Classification of $\alpha$ - amino acids, properties and reactions.

**Proteins:** Formation of peptide linkage, features of peptide linkage, $\alpha$ - helical configuration, $\beta$ -pleated structure, primary, secondary, tertiary and quaternary structure of proteins.

**Enzymes:** General information, coenzyme, vitamins, harmones, catalytic site of enzyme, factors affecting enzyme activity. Specificity of enzymes, classification of enzymes.

### Unit 2: Organic Conversions (8 Lect.)

Definition of functional group, functional group interconversions and common methods for synthesis of carboxylic acids and their derivatives, nitriles, aldehydes, ketones, amines, alcohols, phenols, alkyl halides, ethers, alkanes, alkenes and alkynes.

### Unit 3: Spectroscopy (8 Lect.)

Introduction to principles of U.V., I.R. and N.M.R. spectroscopy. Applications of U.V. and I.R. and N.M.R. spectroscopy for identification of simple organic compounds (simple problems).

## SECTION II

### Unit 4: Atomic Structure and Bonding (8 Lect.)

Review of atomic structure – electronic configuration, energy levels, orbitals, quantum numbers.

Chemical bonding – Covalent bond, VBT, Hybridizational shapes of molecules with examples (upto C. N. 6), Molecular orbital theory, LCAO. M.O. diagrams for diatomic molecules like $H_2$, CO, $O_2$, $N_2$. Long form of periodic table – trends

### Unit 5: Transition Elements and their Complexes (8 Lect.)

Transition elements, study of First transition series with respect to oxidation states, magnetic behaviour, colour, ability to form complexes and catalytic behaviour

Co-ordination compounds – different terms involved such as C.N., legand, EAN.

Nature of metal legand bonding – VBT and CFT – Formation and above properties of tetrahedral, square planar and octahedral complexes of First transition series on the basis of VBT and CFT.

### Unit 6: Analytical Chemistry (8 Lect.)

**Chromatography**–Paper, Column, T.L.C. and G.C. applications. Thermogravimetry, principles, method, applications.

**Spectroscopy** –A.A.S., Instrumentation and applications.

### Term Work:

Term Work shall consist of the experiments listed below. A record of the work performed should be presented in the form of a journal.

### List of Practicals:

Any six **compounds** from group I and **four experiments** from group II are to be carried out as a part of practical.

Use Double burette method wherever applicable.

### Group I

Organic qualitative analysis - Preliminary tests, type, elements, functional group and physical constants - atleast one compound from each type:

1. Acids – benzoic acid, salicylic acid, phthalic acid, oxalic acid, acetic acid cinnamic acid p-nitrobenzoic acid.
2. Phenols - $\alpha$ naphthol, $\beta$ naphthol, resorcinol, o- nitrophenol, p-nitrophenol, p-cresol, phenol.
3. Bases – Aniline, p-toludine, diphenylamine

4. Neutral – Benzaldehyde, glucose, acetone, ethylmethyl ketone, benzophenone,methyl acetate, ethyl acetate, naphthalene, nitrobenzene, urea, thiourea, m-dinitrobenzene.

## Group II

1. To determine loss in weight and percent composition of mixture of $NaHCO_3$ and $Na_2CO_3$ by gravimetric method.
2. To determine water of crystalisation of $MgSO_4.XH_2O$ by gravimetric method.
3. To standerdise $KMnO_4$ solution using oxalic acid and to estimate ferrous ions.
4. Preparation of tetramine Cu(II) sulphate.
5. Identification of metal ions by paper chromatography.
6. Separation of metal ions by column chromatography.

## Text Books:


1. Morrison R.T. and Boyd R.N.; Organic Chemistry; Prentice Hall of India Ltd.
2. Mr. Manku; Inorganic Chemistry; Tata McGraw-Hill.


## Reference Books:


1. Hoffman Robert V.; Organic Chemistry – An Intermediate Text; Oxford University Press.
2. Dyer John R.; Applications of absorption spectroscopy of organic compounds; Prentice Hall of India Ltd.
3. Shriver D.F.; Inorganic Chemistry; ELBS Publications.
4. Chatwal Gurdeep and Yadav M.S.; Co-ordination Chemistry – Himalaya Publishing House.

# 212389 HEAT TRANSFER

**Teaching Scheme:**
Lecture/Week: 3 Hrs
Practical/Week: 2 Hrs

**Examination Scheme:**
Paper: 100 Marks
Oral: 50 Marks

## Objectives:

1. To study basic modes of heat transfer and the laws governing them.
2. To know basic principles underlying the process design of industrial heat equipments.

## SECTION - I

### Unit 1: Conduction (8 Lect.)

Heat transfer modes, laws. Steady state problems. Thermal resistance. Insulation and critical radius. Differential equation. Unsteady state heat conduction. Extended surfaces.

### Unit 2: Radiation (8 Lect.)

Basic concepts. Emission characteristics and laws of black body radiation. Radiation incident on a surface. Solid angle and radiation intensity. Heat exchange by radiation between two black surface elements. Heat exchange by radiation between two finite black surfaces. The shape factor. Radiant heat exchange in an enclosure having black surfaces. Heat exchange by radiation between two infinite parallel diffuse-gray surfaces. Heat exchange by radiation in the annular space between two infinitely long concentric tubes. Radiant heat exchange in an enclosure having diffuse-gray surfaces. Radiation shields.

### Unit 3: Convection (8 Lect.)

Principles, Dimensional analysis.

### Heat Transfer by Forced Convection:

Laminar and turbulent flow heat transfer in a circular pipe. Analogy between heat and momentum transfer. Heat Transfer in agitated vessels.

### Heat Transfer by Natural Convection:

Natural convection heat transfer from plate and cylinder.

## SECTION – II

### Unit 4: Heat Exchangers (8 Lect.)

Basic types of heat exchangers. Direct transfer type heat exchangers. Flow arrangements. Overall heat transfer coefficient and fouling factor. Mean temperature difference. Effectiveness – NTU Method. TEMA.Heat exchanger design considerations.

### Unit 5: Condensation and Boiling (8 Lect.)

Types of condensation. Film condensation on a vertical plate, vertical tube and horizontal tubes. Effect of superheated vapor and non-condensable gases. Types of boiling. Simplified relations for boiling heat transfer with water. Flow boiling. The heat pipe.

### Unit 6: Evaporators (8 Lect.)

Single and multiple effect evaporation. Types of evaporators. Methods of feeding for multiple effect evaporators.

### Term work:

Every student should carry out minimum 10 experiments from the following list and submit the journal which will form the term work.

### List of Practicals:

1. To determine thermal conductivity of a metal bar.
2. To determine thermal conductivity of a liquid.
3. To determine critical radius of an insulating material.
4. To determine heat transfer coefficient in an unsteady-state.
5. To determine efficiency of a Pin Fin.
6. To study heat transfer through vacuum.
7. To determine the emissivity of a test plate.
8. To determine heat transfer coefficient in forced convection.
9. To study analogy between heat and momentum transfer.
10. To determine individual and overall heat transfer coefficient in an agitated vessel.
11. To determine heat transfer coefficient in natural convection.
12. To determine heat transfer coefficient in Double Pipe Heat Exchanger.
13. To determine overall heat transfer coefficient (U) for Shell and Tube Heat Exchanger.
14. To determine overall heat transfer coefficient and effectiveness of a plate type heat exchanger.
15. To determine heat transfer coefficient in drop and film condensation.
16. To study heat transfer in a steam generating boiler.
17. To study heat transfer in a heat pipe.
18. To study two phase heat transfer.
19. To study evaporators.

## Oral:

The oral examination will be based on the practicals done during the term.

## Text/ Reference Books:


1. Sukhatme S. P.; Heat Transfer, 4th Edition; University Press (India) Private Limited, 2005.
2. McCabe W. L., J. C. Smith and P. Harriott; Unit Operations of Chemical Engineering, 7th Edition; McGraw Hill, 2005.
3. Holman J. P.; Heat Transfer, 9th Edition; Tata McGraw-Hill, 2002.
4. Kern D. Q.; Process Heat Transfer; McGraw Hill, 1997.

## 212390 Particulate Technology

**Teaching Scheme:**
Lecture/Week: 3 Hrs/W
Practical/Week: 2 Hrs/W

**Examination Scheme**:
Paper: 100 Marks
Oral: 50 Marks

**Objectives:**

1. To gain basic understanding of properties and behavior of systems containing particulate solids.
2. To acquaint with major equipments used for solid handling in Petroleum Industry.

**SECTION – I**

**Unit 1: (6 Lect)**

### Particle Characterization and solid flow

Single Particles. Measurement of particle size. Particle size distribution. Mean particle size. Efficiency of separation and grade efficiency.

### Particulate Solids in Bulk:

General Characterizations. Agglomeration. Resistance to shear and tensile forces. Angles of repose and of friction. Flow of solids in hoppers. Flow of solids through orifices. Measurement and control of solids flowrate. Overview of solid conveyers.

### Blending of Solid Particles:

The degree of mixing. The rate of mixing.

### Unit 2: Size Reduction and enlargements (6 Lect )

Mechanism of size reduction. Energy for size reduction. Methods of operating crushers. Nature of the material to be crushed. Type of Crushing equipment. Coarse crushers. Intermediate crushers. Fine crushers. Specialized applications.

Brief outline of particle size enlargement

### Unit 3: Sedimentation (6 Lect)

Principles of sedimentation. Kynch theory of sedimentation. Flocculation. Thickener design using Badger Benchen method

## SECTION – II

### Unit 4: Fluidization: (6 Lect)

Fundamentals of fluidization, types of fluidization. Particulate, bubbling and turbulent fluidization. Minimum fluidizing velocity. Minimum fluidizing velocity in terms of terminal falling velocity. The centrifugal fluidized bed. The spouted bed. Applications of the fluidized solids technique.

Pneumatic conveying

### Unit 5: (6 Lect)

### Liquid Filtration:

Filtration Theory. 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. Effect of particle sedimentation on filtration. Delayed cake filtration. Preliminary treatment of slurries before filtration. Washing of the filter cake.

### Filtration Equipment:

Filter selection. Bed filters. Bag filters. The filter press. Pressure leaf filters. Vacuum filters. The tube press.

### Centrifugal Separations:

Basic concepts of centrifugal separator methods.

### Unit 6: Solid handling equipments (6 Lect)

Gravity settling. Centrifugal separators

The hydrocyclone or liquid cyclone. Sieves or screens. Magnetic separators. Electrostatic separators. Flotation. Separation of suspended solid particles from fluids. Gas cleaning equipment. Liquid washing .

### Term Work:

Term work shall consist of a journal based on the reports of at least 12 experiments performed from the list given below:

1. To determine particle size distribution for a given sample. Using standard sieve series.
2. To determine angles of repose and of friction for a given particulate mass.
3. To validate the equation (for example Brown's equation) for flow of solids through an orifice.
4. Experiment on blending of solid particles using a simple drum mixer.
5. Experiment on the working of hydro cyclone.

6. Experiment on the working of gas-solid cyclone separator.
7. Experiment on particle size reduction in Ball Mill.
8. Experiment on settling of solid particles in stagnant fluid. (Stroke's Regime).
9. Experiment on characteristics of fluidized beds.
10. Experiment on Cake filtration.
11. Experiment on membrane separation.
12. Experiment on batch Sedimentation.
13. Experiment on froth flotation.
14. Experiment on Jaw Crusher.
15. To work out material balance calculations over a continuous screening equipment using electronic spreadsheet.

## Reference Books:


1. Richardson J. F. & J. H. Harker; Coulson and Richardson's Chemical Engineering, Vol.2 Particle Technology & Separation Processes; 5/e, Butterworth – Heineman (2002).
2. McCabe W. L., J. C. Smith & P. Harriott; Unit Operations of Chemical Engineering; 5/e, McGraw-Hill Inc. (1993).
3. Badger W. L. & J. T. Banchero; Introduction to Chemical Engineering; Tata McGraw – Hill Edition (1997).

# 207391 Elements of Social Sciences

**Teaching Scheme:**
Lectures: 3 Hrs/week

**Examination Scheme:**
Paper: 100 Marks

**Objectives:**

1. To get introduced to the concepts of macroeconomics.
2. To get acquainted with the contemporary economic perspectives in India.
3. To understand the nature of social structure and social change.
4. To enhance the perception of human values.

## SECTION – I :Economics

### Unit 1: Basic Problems of Economic Organization (8 Lect.)

What is Economics? The Scientific Approach, Pitfalls in Economic Reasoning, The Law of Scarcity, The Uses of Economics.

### Basic Problems of Economic Organization

a. The key problems of economic organization. What, how, and for whom?.
Inputs and Outputs, Market, Command and Mixed Economies.

b. Society's Technological Possibilities
The Production Possibility Frontier, Efficiency, Opportunity cost, The Law of diminishing returns.

c. Features of a modern economy
Specialization, and division of labor, Money; Factors of production (land, labour, capital). Capital and private property.

### Unit 2: Markets and Government in a Modern Economy (6 Lect.)

a. How markets solve the basic economic problems
The market mechanism, Who governs the market? Prices as signals, market equilibrium, perfect and imperfect competition, Adam Smith's "Invisible Hand Doctrine".

b. The economic role of government.
The three functions of government, Efficiency, Equity, and Stability, Macroeconomic Growth.

### Basic Elements of Supply and Demand:

Analysis of supply and demand, the demand schedule, Supply schedule. Influences affecting supply and demand curves, Equilibrium of supply and demand, Effect on equilibrium of a shift in supply or demand. Rationing by prices.

### Unit 3: Indian Economy: (6 Lect.)

A historical perspective on the economic policies implemented in India during the post independence period to achieve the goals of planned economic development. Monitory and fiscal policies, industrial policy, foreign trade and exchange rate policies, price and wage policies.

Overview of economic reforms introduced after year 1990. Vision of India 2020.

## SECTION – II :Social Science

### Unit 4: (8 Lect.)

### A) Basic Sociology:

Civilization, Culture and Society, Cultural diversity and cultural change, Socialization, Individual freedom, Crime and punishment in modern society, Gender and Sexuality, Origins of Sex differences, Gender Socialization, Gender Relations, Feminism, Marriage and family in modern society, Features of modern urbanism, Globalization: its impact on third world in economic, Social and cultural areas, Human rights, Values and ethics in profession.

### B) Indian Sociology:

Cultural diversity in India, Bases of secular polity, Problem of communalism, Casteism in India, Social reform and reformers, Census in India, Changing demographic picture.

### Unit 5: Technology and Society (6 Lect)

Technology and social change, Ecological crisis, Concept of sustainable development, Science and technology policy in India, Nature and impact of IT revolution.

### Unit 6: Religion and Philosophy: (6 Lect)

Nature of religion, Functions of religion, Problem of religious fundamentalism, Harmonious coexistence of different religious faiths, Vivekananda’s views on religion and union of science and religion, Distinctive features of Indian philosophy.

## Reference Books

Relevant pages from following reference books:


1. Broom Leonard, Selznic Philip and Dorothy Broom Darroch; Sociology; Harper and Row; (1981).
2. Haralambos Michael; Sociolocy themes and Perspectives; Oxford University Press; (1980).
3. Samuelson Paul A. and Nordhaus William D.; Economics; McGraw Hill International; (1992).
4. Datt Ruddar & Sundharam K. P. M.; Indian Economy; S. Chand and Company Ltd.;, (1991).
5. Kalam A. P. J.; India - 2020; Viking; (2002).
6. Giddens Anthony; Sociology; Polity Press; (1989).
7. Radhakrishnan S. and Moore C. A. (Eds); A Source Book in Indian Philosophy; Princeton Univ. Press; (1967).
8. Chatterjee S. and Datta D.; Introduction to Indian Philosophy; University of Calcutta 6th Edition; (1960).

## 212392 Industrial Electronics and Electrical Engineering

**Teaching Scheme:**
Lecture: 1 hr/week
Practical: 2 hrs/week

**Examination Scheme:**
Term Work: 50 Marks

**Objectives:**

1. To get familiarized with Electrical and Electronics systems.
2. To study motor characteristics.
3. To acquire knowledge about electrical and electronic starters for ac and dc motors.
4. To know about generation of power.

**3-Phase Circuits: (2 Lect.)**

Measurement of power in 3-phase circuits using 2-wattmeter method for balanced star and delta loads; Measurement of reactive power using one-wattmeter method.

**D. C. Motors: (2 Lect.)**

Principle of working, construction, types, characteristics, starters, Methods of speed control, applications.

**Induction Motors: (2 Lect.)**

a) 3-phase: Rotating Magnetic Field, Slip, and Torque slip, Characteristics, Starters and Applications.

b) Single phase: Types, Starting methods, Applications.

**Alternators: (4 Lect.)**

Principles of operation, definition of regulation and efficiency. Converters and Invertors.

**Industrial Electronics Devices and Applications: (4 Lect.)**

SCR, Triac, Power MOSFET, IGBT, Characteristics and Simple applications like Controlled Rectifiers, Study of UPS, Light Dimmers, Fan Regulators (Only Block Diagram).

**Controllers, Transducers and Sensors: (4 Lect.)**

AC / DC / Stepper Motor Controllers.
Transducers for Temperature, Pressure, Displacement, Level, Photo Sensors, Actuators.

**Note**: The term work shall consist of a record of the following experiments performed.

## List of Practicals:

1. Measurement of power in three-phase circuit by two wattmeter methods.
2. Measurement of reactive power in three phase circuit using one wattmeter method.
3. Brake Test on D.C. shunt motor.
4. Load test on D.C. series Motor.
5. Speed variation of D.C. shunt motor using armature voltage and field current control.
6. Load Test on three phase Induction Motor.
7. Study of single-phase induction motors.
8. Study of starters for (a) D.C.Motors (b) 3-phase Induction Motors

## Reference Books:


1. Hughes Edward; Electrical Technology, 5th Edition; English Language Book Society; (1982.)
2. Taylor E. O.; Utilisation of Electric Energy; Orient Longman Pvt. Ltd.; (1983.)
3. Cotton H.; Electrical Technology; CBS; (1999.)
4. Liptak -Instrument Engineers Hand Book Vol-I & Vol-II
5. Krishna Kant PHI -Computer Based Industrial Control

# 212393 Machine Drawing and Workshop Practices

**Teaching Scheme:**
Practical/Drawing/Week: 2 Hrs

**Examination scheme:**
Term work: 50 Marks

## Objectives:

1. To study principles of machine drawing and its importance in machine shop operations.
2. To understand basics of detailed and assembly drawing for various equipments, machine elements and machine components.
3. To learn the software for computer aided drawing of machine equipment and components.
4. To familiarize with the workshop tools, fundamental machine shop operations and to learn machining processes on different types of engineering materials.

## Term Work:

Every student should carry out minimum four practicals / experiments from the given list of practicals. Drawings are to be completed on A-1 size drawing sheet. A brief report of each workshop experiment is to be submitted in the form of journal. Drawing sheets, the jobs completed in the workshop and the journal report will be the basis for term work assessment.

## List of Practicals:

### Group I: Drawing

1. One drawing sheet of symbols and basic conventions of machine elements, materials and processes as per Indian and International Standards.
2. One drawing sheet of screw threads, screwed fastenings, cotter pin joints, pipe joints, knuckle joint, riveted and welded joints etc. (minimum two views of each component)
3. One drawing sheet on detail parts and their assembly of valves, couplings, clutches, brakes, pulleys, engine parts etc.
4. One drawing sheet based on AutoCAD with all three views for at least two machine elements / components mentioned above.

### Group II: Workshop

5. Study of different types of machine tools like lathe, drilling, jig boring, shaper, milling and grinding.
6. One job on lathe with taper turning, thread cutting and drilling.

7. One job on lathe + milling machine – keyway cutting + grinding etc.
8. One job of welding and related processes.
9. One job of pattern making and foundry – one job of non- ferrous material.

## Reference Books:


1. S. K. Hajra Choudhary, A. K. Hajra Choudhary; Elements of Workshop Technology; Vol. I: Manufacturing Processes, Vol. II: Machine Tools; Media Promoters and Publisheres Pvt. Ltd.
2. R. K. Jain; Engineering Metrology; Channa Publishers; New Delhi.
3. N. D. Bhatt, V. M. Panchal; Machine Drawing; Charotor Publishing House, Anand, India.
4. Dr. K. L. Narayana, Dr. P. Kannaiah, K. Venkata Reddy; Machine Drawing; New Age International Limited.
5. Goutam Pohit, Goutam Ghosh; Machine Drawing with AutoCAD, PEARSON Education.
6. Faculty of Mechanical Engineering (Compiled by), PSG College of Technology, Coimbatore – 641004; Design Data, Data Book of Engineers, Kalaikathir Achchagam, Coimbatore.