3.1 FUNDAMENTAL OF ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P
4	-	4

RATIONALE

The objective of the course is to impart basic knowledge and skills regarding electrical and electronics engineering, which diploma holders will come across in their professional life

DETAILED CONTENTS

1. Overview of Electricity:

General use and applications of electricity; Use and applications of electricity to chemical Engineering, Paint Technology and Rubber Technology Advantages of electrical energy over other forms of energy.

(04 Periods)

2. DC Circuits:

Introduction to basic terms: charge, current, voltage, power, and energy; Ohm's law; Power dissipation in resistors; Series and parallel combination of resistors; Kirchhoff's laws; Star-delta conversions; Ideal and practical voltage source; Current source.

(06 Periods)

3. AC Circuits:

Concept of alternating voltage and current; Introduction to basic terms: cycle, frequency, time period, amplitude, instantaneous value, rms value, peak value, phase difference, form factor, and peak factor; Concept of phasor; Phasor diagrams; Concepts of reactance, impedance, admittance, susceptance, and conductance; Concepts of instantaneous power, real power, reactive power, apparent power, complex power, and power factor; Analysis of simple AC circuits; Overview of three-phase AC circuits.

(10 Periods)

4. Batteries and Solar Cells:

Primary and secondary cells; Construction, working, and applications of Lead-Acid,; Charging methods for Lead-Acid batteries; Maintenance of Lead-Acid batteries; Series and parallel connection of batteries; Maintenance free batteries; General idea of solar cells, solar panels and their applications.

(06 Periods)

5. Electrical Machines:

Electromagnetic induction; Introduction to magnetic circuits; Principles of electromechanical energy conversion; Construction and operation of single phase transformers; Tests of transformers; Efficiency and regulation; Operation of autotransformers;. Types of three-phase induction motors; principle of operation,; Methods of starting and speed-control of three-phase induction motors; Overview of single-phase induction motors.; Construction and operation of synchronous machines; Construction and operation of stepper motors. Applications of single and three phase induction motors.

(10 Periods)

6. Semi Conductor Physics

Conductors, Insulators, Semiconductors, Idea of Energy Level, Energy Band Diagrams of Insulators, Conductors and Semiconductors, Effect of Temperature,

Recombination of holes and electrons, n-type semiconductor, p-type semiconductor, Majority and Minority Carriers.

(04 Periods)

7. Semi Conductor Diode

Mechanism of current conduction and characteristics of ordinary diode, zener diode, LED

(06 Periods)

8. Transistor

Principle of operation characteristics and applications of BJT, JFET, MOSFET, UJT, Concept of configurations.

(06 Periods)

9. Electrical & Electronics Measuring Instruments

Construction and working Principle of PMMC and moving Iron voltmeter and ammeters, single phase dynamometer, wattmeter and induction type energy meter, operation and use of Analog, Digital multimeter, CRO and signal generators.

(06 Periods)

10. Electrical Installation and Safety:

Various accessories and parts of electrical installation; Overview of industrial and domestic wiring systems; Common electrical safety measures; Protection and precaution against electrical shock; Treatment of electrical shock; Basic protective devices like fuse, MCB, thermal overload relay, ELCB, and RCCB; Concepts and types of earthing; Protection against lightning.

(06 Periods)

LIST OF PRACTICALS

1. Verification of Ohm's Law.
2. Verification of KCL and KVL.
3. Test of charging and discharging of lead-acid battery using hydrometer.
4. Connection of a three-phase motor and starter with fuses and reversing of direction.
5. Study of a distribution board for domestic and industrial installation.
6. Open-circuit and short-circuit test on a single-phase transformer.
7. Star-delta starting of induction motors.
8. To draw V-I characteristics of PN-Junction diode and LED.
9. To draw input and output characteristics of a transistor in CB and CE configurations.
10. Use of analog & digital multimeter and measure resistance, voltage & current.
11. Use of CRO & measurement of frequency & voltage.
12. Use of Zener diode as a regulator.

RECOMMENDED BOOKS

1. Principle of Electrical Engineering by V.K. Mehta, S Chand Publication.
2. Basic Electrical Engineering by J.B. Gupta, S.K. Kataria & sons.

3. Basic Electrical Engineering by Sahdev & Sahdev, Uneek Publication.
4. Fundamental of Elex for polytechnics by Subhadeep Chaudhary, Paragon international Publication
5. Electrical machines by S.K. Bhattacharya Tata McGraw Hill Education Private Limited.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	05
2	06	10
3	10	15
4	06	15
5	10	05
6	04	10
7	06	10
8	06	10
9	06	10
10	06	10
TOTAL	**64**	**100**

3.2 ELEMENTS OF CHEMICAL ENGINEERING

L	T	P
4	-	4

RATIONALE

It is an introductory subject to be given to students opting for chemical engineering. It will expose the students to various areas to be covered in this course which have applications in field jobs where they can find employment. The course will also impart elementary knowledge, to the students regarding units and conversions.

DETAILED CONTENTS

1. Introduction: (05 Periods**)**

Definition of chemical engineering, scope of chemical engineering with respect to new emerging areas in the field of chemical engineering like environmental engineering, bio-chemical and biomedical engineering, membrane techniques, polymer science engineering, factors to be taken in to account in the location of chemical industries.

2. Concept of unit operations and processes: (14 Periods**)**

Unit Operations: Definitions, symbols and examples of unit operations like Distillation, Evaporation, Gas absorption, Extraction; size reduction, sedimentation, filtration; fluid handling, fluid solid contacting, fluid solid separation, fluid storage, mixing, solid handling, solid-solid separations, crystallization, drying, leaching, size separation and heat transfer.

Unit Processes**:** Introduction to unit processes with simple examples like sulphonation, polymerization, oxidation, reduction, hydrogenation, hydration, ammonolysis, chlorination, amination, calcination, and cracking/ pyrolysis.

3. Material and energy balance: (05 Periods**)**

Scope of Material and Energy balance in process Industries.

4. Concept of dimensions & units: (10 Periods**)**

Classification of system of units- Base units, Derived units and multiple units, Conversion of units.

Basic chemical Calculations: Atomic weight, Molecular weight, Basis of Calculation, Gram atom, Gram mole, Equivalent weight, Simple numerical Problems,

5. Methods of expressing the composition of mixtures and solutions: (10 Periods**)**

Normality, Molarity, Molality, Weight Percent, Volume percent, Mole percent Mole fraction, Weight fraction, Simple numerical problems.

6. Behaviour of Ideal Gas Law: (20 Periods**)**

Ideal gas law, PVT relationship, Normal temperature and pressure (NTP), Standard temperature and Pressure conditions (STP).Gaseous Mixtures: Partial Pressure, Pure component volume, Dalton's Law, Amagat's Law, Relation between Partial pressure, Mole fraction of component gas to Total pressure. Average Molecular weight of gas mixture, Density of gas mixture, Simple numerical problems.

LIST OF PRACTICALS

1. To study and draw layout of chemical engineering laboratories.
2. To determine the heat load to be removed from the hot fluid by double pipe heat exchanger.
3. To determine the amount of heat required to evaporate per kg.
4. To find out the energy possess by liquid and solid fuels.
5. To study and calibrate the given manometer for level measurement.
6. To study centrifugal pump.
7. To study Reynolds's experiment.
8. To study and draw layout of chemical industry/ plant visited during two days per month also draw sketches of various chemical engineering equipment in the visited industry.

INSTRUCTIONAL STRATEGY

The teacher should make the students aware of the fundamentals of chemical engineering. Its scope with respect to the new emerging areas in the field of chemical engineering like Environmental Engineering , Polymer Science, Bio-Chemical etc.

RECOMMENDED BOOKS

1. Introduction to Chemical Engineering by Little John, CE and Meenaglum CM; McGraw Hill.
2. Introduction to Chemical Engineering by Anderson LB; McGraw Hill Publication.
3. Basic Principles of Chemical Engineering by Shaheen El; Joplin, Missouri, USA.
4. Elementary Principles of Chemical Processes Second Edition by Felder RM and Fouisseau RW; John Wiley and Sons.
5. Basic Principles and Calculations of Chemical Engineering by Himmelbleu DM; Prentice Hall.
6. Unit Operations of Chemical Engineering by McCabe and Smith, McGraw Hill Publication.
7. Elementary Chemical Engineering by Petu, McGraw Hill Publication
8. Introduction to Chemical Engineering by Shyamal K. Sanyal, Siddhartha Datta, Tata McGraw Hill Publication.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	4	10
2	4	10
3	12	20
4	10	10
5	15	20
6	15	20
7	04	10
Total	**64**	**100**

3.3 FLUID MECHANICS

L	T	P
4	-	4

RATIONALE

The knowledge of fluid flow is very essential because all chemical plants have fluid flow operations. The examples are flow of stream and gases in pipes, flow of liquid in pipes and open channels etc. This subject aims at the basic concepts of fluid flow, measurement techniques involved for the same and equipment used for the transportation of fluids. With this background, students will be able to find out quantitatively material and power requirements for a process.

DETAILED CONTENTS

1. Classification of fluids: (02 Periods)

Compressible fluids, incompressible fluids, Newtonian and Non-Newtonian fluids, Properties of fluids (only definitions), mass density, weight density, vapour pressure, specific gravity, viscosity, surface tension, compressibility, thermal conductivity, specific volume.

2. Various types of flow: (02 Periods)

Steady and unsteady flow, uniform and non-uniform flow, streamline flow, laminar and turbulent flow

3. Various types of manometer: (04 Periods)

U-tube manometer, inclined manometer, differential manometer / two liquid manometer / Multiplying gauge, simple numerical problems.

4. Basic equations of fluid flow: (18 Periods)

Stream line and stream tube, Average velocity, Mass velocity, Equation of continuity, derivation of continuity equation, Bernoulli's theorem, derivation of Bernoulli's equation, Hagen Poiseulli's equation, friction factor chart, Fanning equation, friction losses in pipes, friction loss from sudden enlargement and contraction, friction losses in various types of fittings and valves, effect of roughness, Equivalent length, Form fiction losses in Bernoulli's equation, Simple numerical problems related to above topics.

5. Flow measurements: (15 Periods)

Classification of flow meters, principle, construction, working, derivation of flow equation, advantages, disadvantages of (i) Venturimeter (ii) Orifice meter (iii) Pitot tube (iv) Rotameter, difference between Orifice meter and Venturimeter, Measurement of flow in open channels, classification of notches, derivation of total discharge equation of Rectangular notch and V-Notch, advantages of V-Notch over rectangular notch.

6. Transportation of fluids: (23 Periods)

Classification of pipes and fittings, different types of pipes, tubes and fittings, Schedule number, Birmingham wire gauge (BWG), internal diameter and outer diameter of pipes, difference between pipe and tube,

Classification of valves, gate valve, globe valve, ball valve, diaphragm valve, needle valve, butterfly valve,

Classification of pumps,

(i) Centrifugal pumps, principle, construction or components of centrifugal pumps, working, advantages and disadvantages, Head of a centrifugal pump, priming, cavitation and Net Positive Suction Head (NPSH), power requirement and efficiency of centrifugal pump, characteristics curves, centrifugal pump troubles and remedies.

(ii) Positive displacement pumps, positive displacement pumps classification, Reciprocating pump, classification of reciprocating pumps, piston pumps, plunger and diaphragm pumps, single acting and double acting, Rotary pumps.

Comparison of centrifugal and reciprocating pump, advantages of centrifugal pump over reciprocating pump.

Centrifugal blowers, compressors, vacuum pumps: rotary vacuum pump, steam jet ejectors, water ejectors.

LIST OF PRACTICALS

1. To determine the co-efficient of discharge of Orifice meter.
2. To determine the co-efficient of discharge of Venturi meter
3. To determine the co-efficient of discharge of V-Notches.
4. To determine the co-efficient of discharge of rectangular notches
5. To determine coefficient of velocity (Cv). coefficient of discharge (Cd), coefficient of contraction (Cc) and verify the relation between them.
6. To determine frictional losses in pipes and fittings.
7. To determine the equivalent length of pipes and fittings.
8. To verify Bernoulli's Theorem.
9. To determine the efficiency of a centrifugal pump.
10. To determine point velocity in a pipe by Pitot tube.

INSTRUCTIONAL STRATEGY

This syllabus is designed in such a way that the students get theoretical as well as practical knowledge about all the topics so that students should be first taught theoretical knowledge and then practical knowledge. The students may be asked to make files related to their experiments.

RECOMMENDED BOOKS

1. Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
2. Chemical Engineering Vol. I and II by Coulson and Richardson; Pergamon Press Publication
3. Introduction to Chemical Engineering by Badger and Banchero; McGraw Hill Publication
4. Principles of Unit Operations by Foust John; Wiley Eastern Publication
5. Unit Operations by Brown, John Wiley Publications
6. Unit Operation – 1 (Fluid Flow and Mechanical Operations) by Gavhane KA; Nirali Prakashan

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	02	05
2	02	05
3	04	10
4	18	25
5	15	20
6	23	35
Total	**64**	**100**

3.4 FUELS AND MATERIAL SCIENCE

L	T	P
4	-	-

RATIONALE

The students of chemical engineering has to deal with various types of fuels and materials. The fuels generally used are solid, liquid and gaseous. Their properties, advantages and disadvantages are included in the curriculum. Also a knowledge of non-conventional fuels will be imparted.

DETAILED CONTENTS

1. Introduction: **(04** Periods**)**

Types of conventional fuels, Characteristics of a good fuel, their merits and Demerits.

2. Solid fuels: **(19** Periods)

Classification of fuels- wood, charcoal, peat, coal, Indian classification of coal – rank of coal, caking and coking coal; Origin of coal, properties of coal. Testing/ Analysis- proximate and ultimate analysis, Methods of storage of coal; coal preparation. Washing methods of coal- objective of coal washing, advantages of coal washing. Various type of coal washing processes, (a) gravity separation- (i) wet process – lauder washer, jig washer (ii) dry process – jig washer (b) float and sink method- froth floatation. Pulverization of coal, various uses of coal.
Liquid Fuel: Advantages & disadvantages
Gaseous Fuels: Advantages & disadvantages

3. Furnaces: **(08** Periods**)**

Classification of furnaces, chimney gases and draught, furnace atmosphere, operation in different chemical and allied industries.

4. Atomic structure: **(10** Periods**)**

Different types of crystal structure, BCC, HCC, FCC, Melter indices of plans, structure of common metallic, polymeric, ceramic and amorphous materials.

5. Ferrous materials: **(10** Periods**)**

Cast Iron, plain carbon steel, low alloy steel, high alloy steel, types of stainless steel, effect of alloying elements on steel, iron carbon phase diagrams.

6. Other materials: **(13** Periods**)**

Introduction to non-ferrous material, copper, brass, bronze, aluminum, Non-metallic materials and their construction, Ceramic: types of specialty glasses, refractory, properties and application, Polymers: classification, comparison of properties of various polymers and their applications.

INSTRUCTIONAL STRATEGY

This specialized subject will enable the students to study the various conventional and non-conventional sources of energy. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with assignments.

RECOMMENDED BOOKS

1. Elements of Fuels, Furnaces and Refractories by OP Gupta,

2. Fuel – Solid, Liquid and Gaseous by Brame, JS and king JC, Students. Martin Press

3. Fuels and Fuel Technology, Vol I & II by Francis W, Pargamon Press

4. Coal, Coke and Coal Chemicals by Wilson, PJ Wells, GH, McGraw Hill

5. Introduction to Engineering Materials by Raghvan

6. Science and Engineering of Materials by Askelland. Donald R.

7. Introduction to Material Science for Engineers by Shacketford, Jaiw. F.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	05
2	19	30
3	08	15
4	10	15
5	10	15
6	13	20
Total	**64**	**100**

3.5 MECHANICAL OPERATIONS

L	T	P
4	-	4

RATIONALE

This subject gives the knowledge of working of individual mechanical operations and their significance in chemical industries. With this information, students, learn about the control of operation of equipment and regulate production.

DETAILED CONTENTS

1. Introduction: **(04** Periods**)**

Concept and role of unit operation in industries, force, pressure, work, power, heat.

2. Size Reduction (Communition): **(15** Periods**)**

Size reduction, necessity of size reduction, principles of size reduction, characteristics of size reduced/ comminuted product, expression for power required by machines, Rittinger's law, Kick's law, Bond's law and work index, simple numerical problems.

Size reduction equipment:

Classification of size reduction equipment, general description of crushers: Jaw crusher, Gyratory crusher, Roll crusher, Grinders: Hammer mill, Ball mill, critical speed of Ball mill, difference in crushing and grinding, Equipment operation: (i) Open circuit (ii) Closed circuit.

3. Characterization of solid particles: **(15** Periods**)**

Characterization of solid particles, particle shape, sphericity, particle size, particle size measurement by screen analysis, mesh, screen aperture or screen size opening, differential and cumulative methods of analysis of particle size, specific surface of mixture, average particle size, number of particles in a mixture.

Screen analysis: Tyler standard screen series (or US sieve series), screening, types of screening equipment their construction, working, vibrating screens, Grizzlies and Trommels, comparison of Grizzlies and Trommels.

4. Handling of solids: **(10** Periods**)**

Mechanical and pneumatic conveying equipment, classification of conveying equipment, general construction, working and industrial application of Belt conveyors, Chain conveyors, Bucket conveyors, Bucket elevators, Screw conveyors, Pneumatic conveyors.

5. Mechanical separations: **(15** Periods**)**

Filtration and sedimentation: define filtration, filter medium, characteristics of filter medium, filtrate, filter aids, characteristics of filter aids.

Types of filtration: (i) cake filtration (ii) deep bed filtration

Classification of filter equipment: (i) clarifying filter (ii) cake filter. Clarifying filter- principle, construction, working and industrial application of pressure filters: plate and frame filter press, rotary drum filter, leaf filter, sand filter.

Classifiers, thickeners, centrifugal filtration – centrifuge.

6. Mixing equipment: **(05** Periods**)**

Utility of mixing, mixing equipment used for liquid-liquid, liquid-solid, liquid-gas systems, impellers, propellers, turbines, flow pattern in agitated vessels, vortex formation and its prevention.

LIST OF PRACTICALS

1. To find the sieve analysis of a given sample of solid particles by sieve shaker.
2. To determine the grind ability of solids by ball mill.
3. To determine the effectiveness of disintegrator.
4. To find the rate of filtration with the help of filter press.
5. To determine the rate of settling of slurries of various concentration. Draw a height vs. time curve.
6. To determine the efficiency of jaw crusher.
7. To perform an experiment on rotary vacuum filter and find rate of filtration.

INSTRUCTIONAL STRATEGY

Mechanical operation has significant importance in the area of chemical engineering. Adequate competency needs to be developed by giving sufficient practical knowledge in mechanical operation (characterization of solid particles, size reduction, energy requirement and mechanical separations) A field visit may be conducted to expose the working of various conveyors and filtration equipment in industries.

RECOMMENDED BOOKS

1. Unit Operations of Chemical Engineering by McCabe and Smith, McGraw Hill Publications.
2. Chemical Engineering, Vol. I & II by Coulson and Richardson, Pergamon Press Publications.
3. Introduction to Chemical Engineering by Badger and Banchero, Tata McGraw Hill Publication.
4. Principles of Unit Operations by Allen Fourst, John Wiley Publication.
5. Unit Operations by Brown, C.G., John Wiley Publication.
6. Unit Operation – 1 (Fluid Flow and Mechanical Operations) by Gavhane KA; Nirali Prakashan

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	10
2	15	20
3	15	20
4	10	15
5	15	20
6	05	15
Total	**64**	**100**

3.6 PROCESS INSTRUMENTATION

L	T	P
4	-	4

RATIONALE

The subject will enable the student to gather the knowledge of different instruments used to measure different process parameters. This course will impart knowledge on working principle, construction, repair and use of these instruments.

DETAILED CONTENTS

1.0. Introduction (05 Periods)

1.0. Functional block diagram of instrumentation system.
1.1. Description of each block
1.2. Process
1.3. Process Characteristics
1.4. Process Variables

2.0. Pressure Measurement (08 Periods)

2.0. Types of Pressure
2.1. Measurement of Pressure by Manometers
2.2. Diaphragms
2.3. Bourdon Tube
2.4. Bellows
2.5. Differential Pressure Measurement
2.6. Vacuum Measurement
2.7. Dead wt Tester

3.0. Temperature Measurement (08 Periods)

3.0. General
3.1. Heat Transfer modes
3.2. Temperature Measuring Devices Like Thermocouples.
3.3. Pyrometer
3.4. Resistance Thermometer.
3.5. Thermister
3.6. Bimetallic Thermometer

4.0. Strain Measurement (06 Periods)

4.0. Requirements for strain measurement
4.1. Strain Gauges
4.2. Selection of Gauges
4.3. General Strain Measurement
4.4. Load Cell

5.0. Vibration and Angular Velocity Measurement (08 Periods)

5.0. Vibration Measurement Systems
5.1. Analysis of acceleration data.
5.2. Measurement of Angular Velocity
5.3. DC & AC Tachometer Generators
5.4. Digital Methods
5.5. Stroboscope

6.0. Flow Measurement (08 Periods)

6.0. General
6.1. Types of Flow

6.2. Flow Coefficient
6.3. Renolds No
6.4. Flow Meters
6.5. Venturi Meter
6.6. Orifice Plate
6.7. Pitot Tube
6.8. Rotameter
6.9. Turbine Meter
6.10. Electromagnetic Meter & mass flow measurement

7.0. Liquid Level Measurements (06 Periods)

Visual indicators, Float actuated level meters, static pressure type instruments. The bubbler system, diaphragm box and air trap system. Electrical contact type liquid level indicators.

8.0. Humidity, Moisture & Thickness Measurement (04 Periods)

9.0. Chemical & Analytical Instruments (06 Periods)

9.1. Spectrophotometer, Filters
9.2. Electrochemical Sensors
9.3. PH Meter
9.4. Analytical Sensor
9.5. Viscosity measurements by constant stress rational viscometer & falling ball type viscometer.

10.0. Plastic Testing Instruments (05 Periods)

Tensile testing machine, Melt flow index testing machine, Impact testing machine

INSTRUCTIONAL STRATEGY

The teacher should take the students to some industries and show them these instruments so that they get a better knowledge of every instrument.

LIST OF PRACTICALS

1. Experiment of Pressure Measurement
2. Experiment of Temperature Measurement
3. Experiment of Flow Measurement
4. Experiment of Humidity Measurement
5. To calibrate pressure gauge with the help of dead weight pressure gauge
6. Experiment of Strain Measurement
7. Experiment of Load Cell
8. Experiment on spectrophotometer and PH meter.
9. Measurement of Level
10. Measurement of angular velocity
11. To find out drying characteristics of given sample and drew drying rate curve by infrared moisture meter and rapid moisture meter.

RECOMMENDED BOOKS

1. Instrumentation Devices & Systems by S.Ranjan (Tata McGraw-Hill Publishing)
2. Electrical & Electronics Measurement by A.K.Sawhney (Danpat Rai & Co.)
3. Industrial Instrumentation by Tyson
4. Industrial Instrumentation by Donald P.Echman
5. Industrial Instrumentation by S.K.Singh
6. Instrumentation by Cirk & Rimboi
7. Instrumentation Measurement and Analysis by B.C.Nakra and KK Chaudhary (McGraw Hill Publication)
8. Electronics Instrumentation by H.S. Kalsi (McGraw Hill Publication)
9. Principles of Industrial Instrumentation by D. Patronalis (Tata McGraw Hill Publication)

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	**Time Allotted (Hrs)**	**Marks Allotted (%)**
1	05	05
2	08	10
3	08	15
4	06	10
5	08	10
6	08	10
7	06	10
8	04	10
9	06	10
10	05	10
Total	**64**	**100**