3.1 FLUID FLOW

L	T	P
3	-	3

RATIONALE

The knowledge of fluid flow is very essential because all chemical plants have fluid flow. 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 equipments used for the transportation of fluids. With this background, students will be able to quantitatively find out material and power requirement for a process.

DETAILED CONTENTS

1. Various types of flow – steady and unsteady, uniform and non-uniform flow, streamline flow, laminar and turbulent flow

   Types of fluid: compressible and incompressible fluid, Newtonian and non-Newtonian flow (7 hrs)

2. Fluid statics and dynamics, Pascal's law, hydrostatic law, various types of manometers, single tube manometers, U tube manometer, differential manometer

   Continuity equation, Bernoullis theorem, flow through pipes and open channels: Hagen poiseulli's equation, friction factor charts, friction losses in pipes, friction loss from sudden enlargement and contraction, effect of roughness in pipes, effect of fitting and valves

   Simple numerical problems related to the above topics (14 hrs)

3. Flow measurement: flow through venturimeters, orifice meters, flow nozzles pitot tube, rotameters (12 hrs)

4. Flow through Fluid Machinery (15 hrs)

   Classification of pumps, construction and working of reciprocating pump, centrifugal pump and rotary pump, priming and NPSH, cavitation power requirement, efficiency of centrifugal pump, specific speed, blowers and compressors.

   Pipe and Fittings: Different types of pipes, schedule Number ID and OD of pipe, colour colding of industrial piping used for transportation of various fluids, different types of valves and fittings

   Dimensional analysis: the theorem and Rayleigh's method, dimensionless numbers and their significance (15 hrs)

LIST OF PRACTICALS

1. Verification of Bernoullis equation
2. Determination of friction loss in flow through pipe
3. Calibration of orifice meter and calculation of Cd, Cv, Ce
4. Calibration of Venturi meter
5. Calibration of Rotameter
6. Determination of discharge coefficient of V-notch
7. Study of constructional feature of centrifugal, gear, reciprocator diaphragm pump, blower and compressors and assembling and disassembling
8. Study of characteristics, curves of centrifugal, reciprocating pump
9. Study of fluidized bed characteristics
10. Calculation of Reynolds number

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

3.1 MECHANICAL OPERATIONS

L	T	P
3	-	3

RATIONALE

It gives the student the knowledge of working of individual mechanical operations and their significance in chemical industries. With this information student can control the operation of equipment and regulate production.

DETAILED CONTENTS

1. Characterization of Solid Particles (8 hrs)

   Particle shape, particle size, mixed particle sizes and size analysis, expressions for specific surface of mixture, average particle size, number of particles in mixture (expression and meaning of terms only, no derivation)

2. Size Reduction (14 hrs)

   i) Energy and power requirements in crushing efficiency, mechanical efficiency, expression for power required by macine

   ii) Crushing laws: Rittinger's law, Bond's law and Kick's law

   iii) Size reduction equipment: classification and names; study of machines: Blake crusher, Jaw crusher, Dodge crusher, Grinding rolls, Single roll toothed crusher, Impactor, Attrition mill, Ball mill, Fluid energy mill, Colloid mill, Rotary knife cutter, Flow sheet for closed circuit grinding

3. Mechanical Separation (26 hrs)

   i) Screen analysis, Tyler standard screen series, material balances over screen capacity and screen effectiveness definition and final expression only; meaning of terms in expression

   ii) Screening equipment in motion of screens, Gyrating screens, Stationary screens and Grizzlies vibrating screens

   iii) Filteration: (Qualitative treatment only) classification of filteration, filter media, filter aids, mechanisms of filteration, discontinuous Pressure filters, Filter press, Shell and leaf filters; Continuous: Vacuum filters, Rotary drum filters, Horizontal beltfilters; Centrifugal filters; Suspended batch centrifuges; Clarifying filters: Cartridge filters, Gas cleaning

iv) Separation based on the motion of particles through fluids; Gravity classifiers, Sorting classifier; Thickeners: Batch sedimentation, rate of sedimentation; centrifugal settling process: Cyclone, Hydro-cyclone, Tabular centrifuge, Disk centrifuge, Nozzle discharge centrifuge

v) Mixing of solids and pastes, Change can mixer, Double motion paste mixers, Two arm Kneader, Kneader and disperser blades

LIST OF PRACTICALS

1. To find the sieve analysis of a given sample of solid particles by sieve shaker
2. To determine the grindability of solids by ball-mill
3. To determine the crushing efficiency by a roll crusher using a sample of solid particles
4. To find the rate of filtration with the help of filter press
5. To perform an experiment on rotary vacuum filter and find rate of filtration
6. To perform an experiment on a cyclone separator and find collection efficiency
7. To perform an experiment on mixers for liquid-liquid mixing and find rate of mixing
8. To perform and experiment on a centrifuge for liquid-liquid separation and find rate of separation
9. To perform an experiment on mixer for solid-liquid mixing and find rate of mixing
10. To perform and experiment on separation of solid particles using a sedimentation tank

RECOMMENDED BOOKS

1. Chemical Engineering, Vol. I and II by Coulson and Richardson, Pergamon Press Publication
2. Unit Operation of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
3. Introduction to Chemical Technology by Badger and Banchero, McGraw Hill Publication
4. Fluid Mechanics and Its Applications by Gupta and Gupta, Wiley Eastern Publication
5. Principles of Unit Operations by Alen Foust, John Wiley Publication

3.2 INDUSTRIAL CHEMICAL CALCULATIONS

L	T	P
3	2	-

RATIONALE

This subject provides the knowledge of material and energy requirements for a process and with this knowledge raw material requirement for a given process can be calculated

DETAILED CONTENTS

1. Units, inter conversion of units of pressure, volume force, work, power, energy and heat in SI, CGS, MKS (6 hrs)

2. Boyle's law, Charle's Law, Ideal gas equation, limitation of ideal gas equation a Vander Warl's equation, simple numerical problems based on them; Delton's law, Amagat's law (8 hrs)

3. Mole concept and expressing concentration of solution in different ways like molarity, molality and normality (8 hrs)

4. Definition and meaning of material balance, basic steps to be followed in the material balance calculation, numerical problem based on material balance without chemical reaction; meaning of by-pass, recycle and purge system of material balance (only qualitative treatment) (10 hrs)

5. Definition and meaning of energy balance, standard heat of reaction, heat of formation, heat capacity, heat of combustion, Laplace law, Hess's law (simple numerical problems (8 hrs)

6. Application of material balance in following unit operations
   a) Distillation
   b) Drying
   c) Evaporation
   d) Combustion
   Working formulae and numericals (8 hrs)

RECOMMENDED BOOKS

1. Stoichiometry by Bhatt and Vohra; Tata McGraw Hill Publication
2. Chemical Process Principles by Hougen and Watson; Wiley International Edition
3. Industrial Strichiometry by Lewis and Lewis, McGraw Hill Publication
4. Solved Examples in Chemical Engineering by GK Ray; Khanna Publication
5. Basic Principles and Calculations in Chemical Engineering by Himmelblau, Prentice Hall Publication

3.3 GENERAL ENGINEERING

L	T	P
5	-	2

RATIONALE

A diploma holder has to assist in activities of installation, operation and maintenance etc of different machines and equipment. These activities are not branch specific and instead require him to know basics of civil, electrical and mechanical engineering. The subject of General Engineering has been included to impart basic knowledge of civil, electrical and mechanical engineering to the students.

Note:

1. The students of Civil Engineering, Chemical Engineering, Chemical Engineering (pulp and paper) will be studying only Part A (Mechanical Engineering) and Part B (Electrical Engineering)

2. The students of Electrical engineering, Electronics and Communication Engineering, Instrumentation and Control Engineering, Computer Engineering and Information Technology will be studying only Part A (Mechanical Engineering) and Part C (Civil Engineering)

3. The students of Mechanical Engineering will be studying only Part B (Electrical Engineering) and Part C (Civil Engineering)

4. **The students of other branches of engineering and technology will be studying all the three Parts A (Mechanical Engineering), Part B (Electrical Engineering) and Part C (Civil Engineering), unless specified otherwise**

5. A time of 2 hours per week has been allotted to Mechanical Engineering, 2 hours per week to Electrical Engineering and 1 hour per week to Civil Engineering in the lecture hours, for teaching theory and a lump-sum time of 2 hours week has been allotted for the Practicals.

DETAILED CONTENTS
PART-A

MECHANICAL ENGINEERING

Theory

1. Transmission of Power (8 hrs)

1.1 Transmission of power through belt, rope drives and pulleys, gears and chains
1.2 Different type of pulleys and their application
1.3 Chain drives and its comparison with belt drive
1.4 Gear drives, types of gears, simple gear trains and velocity ratio

2. Internal combustion Engines (14 hrs)

2.1 Classification and application of IC Engines commonly used: spark ignition and compression ignition engines.
2.2 Working principles of two stroke and four stroke petrol and diesel engines
2.3 Ignition system in petrol engines i.e. spark ignition, magneto ignition
2.4 Spark plug
2.5 Carburetor
2.6 Cooling system of IC Engines: Lubrication of IC Engines
2.7 General maintenance of engines

3. Air Conditioning System (8 hrs)

3.1 Basic principle of refrigeration and air conditioning
3.2 Working of centralized air conditioner
3.3 Concept of split air conditioner and its applications

4. **Pumps:** Types and their uses (2 hrs)

PRACTICAL EXERCISES IN MECHANICAL ENGINEERING

1. Study of main parts of 4 stroke petrol and diesel engines by actually dismantling them (The idea is to acquaint the students with the most common troubles occurring in the engines)
2. Study of main parts of 2 stroke petrol engine by actually dismantling it. (The idea is to acquaint the students with the most common trouble occurring in the engines)
3. Study of ignition system of petrol engines
4. Study of fuel and air circuit of a petrol engine
5. Study of fuel injection system and air circuit of a diesel engine
6. Study of cooling system and lubricating (including greasing) of an IC Engine
7. Study of friction clutch
8. Study of hydraulic brake
9. Study of various drives for transmission of powers. Models of belts, pulleys, gears, chains and clutches
10. Study of air conditioning system in a building

NOTE: Study will include dismantling and reassembling of actual parts

PART B

ELECTRICAL ENGINEERING

Theory

5. Application and Advantages of Electricity: (3 hrs)

5.1 Difference between AC and DC

5.2 Various applications of electricity
5.3 Advantages of electrical energy over other types of energy

6. Basic Quantities of Electricity: (4 hrs)

6.1 Definition of voltage, current, power and energy with their units
6.2 Name of the instruments used for measurement of quantities given in 5.1
6.2 Connection of the instruments in 5.2 in electric circuit

7. Various Types of Power Plants: (3 hrs)

7.1 Elementary block diagram of thermal, hydro and nuclear power stations
7.2 Brief explanation of the principle of power generation in above power stations

8. Elements of Transmission Line: (4 hrs)

8.1 Pictorial diagram of a three-phase transmission and distribution system showing transformers, supports, conductors, insulators and earth wire etc.
8.2 Brief function of accessories of transmission lines
8.3 Earthing of lines, substation and power station - need and practices adopted

9. Distribution System (4 hrs)

9.1 Distinction between high and low voltage distribution system
9.2 Identification of three phase wires, neutral wires and the earth wire on a low voltage distribution system
9.3 Identification of the voltage between phases and between one phase and neutral
9.4 Distinction between three phase and single phase supply

10. Supply from the Poles to the Distribution Board: (3 hrs)

10.1 Arrangement of supply system from pole to the distribution board
10.2 Function of service line, energy meter, main switch, distribution board

11. Domestic Installation: (4 hrs)

11.1 Distinction between light and fan circuits and single phase power circuit, sub circuits
11.2 Various accessories and parts of installation, identification of wiring systems
11.3 Common safety measures and earthing
11.4 Introduction to BIS code of safety and wiring installation

12. Electric Motors and Pumps: (5 hrs)

12.1 Definition and various application of single phase and three phase motors
12.2 Connection and starting of three phase motors by star delta starter
12.3 Conversion of horse power in watts or kilowatts
12.4 Type of pumps and their applications

PRACTICAL EXERCISES IN ELECTRICAL ENGINEERING:

1. Use of Megger:
   Objective: To make the students familiar with different uses of megger

2. Connection of a three phase motor and starter including fuses and reversing of direction of rotation.
   Objective: Students may be made familiar with the equipment needed to control a three-phase motor
   The students must experience that by changing any two phases, the direction of rotation is reversed.

3. Connection of a lamp, ceiling fan, socket outlet, geyser, floor grinder, voltage stabliser etc.
   Objective: Students may be made familiar with the different types of equipment and circuits used in the domestic installations

4. Trouble shooting in a three-phase motor
   Note: The teacher may create anyone of the following faults
   (a) Loose connections
   (b) Blown fuse
   (c) Tripped overload protection
   (d) Incorrect direction of rotation
   (e) Single phasing
   (f) Burnt winding to be simulated by a loose connection behind a terminal box.
   Objective: The students must be able to detect the most common faults, which may occur in a three-phase motor, using meggar wherever necessary

5. Trouble shooting in a domestic wiring system.
   Note: The teacher may introduce a fault in the existing wiring system of a classroom or workshop like
   (a) blown fuse
   (b) loose connection
   (c) faulty components/accessories etc.
   Objective: Students must be able to detect common faults which may occur in a domestic wiring system

6. Treatment of electric shock

Note: The teacher may give a demonstration how an electric shock must be treated.

Objective: Students must be trained to treat the persons suffering from an electric shock

7. Study of a distribution Board

Note: Students may be asked to study the distribution board in the institution and note down all accessories.

Objective: Students must be made familiar with the distribution board

8. Connections and reading down an energy meter

Objective: Students may be asked to connect an energy meter to a load and calibrate reading

9. Demonstration in electrical machine laboratory

Objective: Students may be shown different types of electrical machines and their starters and should be told that the three phase induction motors are most commonly used.

10. Study of submersible motor pump set:

Objective: To tell use of the set in water supply and irrigation works.

PART C

CIVIL ENGINEERING

Theory

13. Construction Materials (10 hrs)

Basics of various construction materials such as stones, bricks, lime, cement and timber along with their properties, physical/ field testing and uses, elements of brick masonry.

14. Foundations (8 hrs)

i) Bearing capacity of soil and its importance

ii) Types of various foundations and their salient features, suitability of various foundations for heavy, light and vibrating machines

15. Concrete (8 hrs)

Various ingredients of concrete, different grades of concrete, water cement ratio, workability, physical/ field testing of concrete, mixing of concrete

16. RCC (4 hrs)

Basics of reinforced cement concrete and its use (elementary knowledge), introduction to various structural elements of a building

PRACTICAL EXERCISES IN CIVIL ENGINEERING

1. Testing of bricks
   a) Shape and size
   b) Soundness test
   c) Water absorption
   d) Crushing strength

2. Testing of concrete
   a) Slump test
   b) Compressive Strength of concrete cube

3. The students should be taken to different construction sites to show them various construction materials, concreting process and construction of RCC structural elements, foundations and other civil works

Note: While imparting instructions, teachers are expected to lay more emphasis on concepts and principles. It will be better if the classes for general engineering are conducted in the laboratories and organized demonstrations for explaining various concepts and principles.

RECOMMENDED BOOKS

Mechanical Engineering

1. General Mechanical Engineering by M. Adithan; TTTI, Chandigarh
2. Basic Civil and Mechanical Engineering by Jayagopal; Vikas Publications, New Delhi
3. IC Engines and Automobile Engineering by Dr.MP Poonia, Standard Publishers, New Delhi
4. Refrigeration and Air Conditioning by RK Rajput; SK Kataria and sons; Ludhiana
5. Theory of Machines by RS Khurmi and JK Gupta; S. Chand and Company Ltd., New Delhi

Electrical Engineering

1. Electrical Technology Part 1: Basic Electrical Engineering by Theraja, BL; S Chand and Company, New Delhi
2. Principles of Electrical Engineering by Gupta BR, S Chand and Company, New Delhi
3. Basic Electrical Engineering by Mehta VK; S Chand and Company, New Delhi

4. Basic Electricity and Measurements by Suryanarayan NV and N Delhi; Tata McGraw Hill, 1987, New Delhi
5. Basic Electrical and Electronics Engineering by SK Sahdev; Dhanpat Rai and sons, New Delhi
6. Basic Electrical Engineering by PS Dhogal, Tata McGraw Hill, New Delhi
7. Basic Electricity by BR Sharma; Satya Parkashan, New Delhi

Civil Engineering

1. Textbook of Concrete Technology 2nd Edition by Kulkarni, PD Ghosh RK and Phull, YR; New Age International (P) Ltd., Publishers, New Delhi
2. Materials of Construction by Ghose; Tata McGraw Hill Publishing Co., Ltd., New Delhi
3. Civil Engineering Materials by TTTI, Chandigarh; Tata McGraw Hill Publishing Co. Ltd., New Delhi
4. Concrete Technology by Gambhir; Tata McGraw Hill Publishing Co., Ltd., New Delhi
5. Building Construction by J Jha and Sinha; Khanna Publishers, Delhi
6. Building Construction by Vazirani and Chandola; Khanna Publishers, Delhi
7. Civil Engineering Materials by SV Deodhar and Singhai; Khanna Publishers, Delhi
8. Soil Mechanics and foundation Engineering by SK Garg; Khanna Publishers, Delhi

3.5 HEAT TRANSFER - I

L	T	P
3	1	3

RATIONALE

Most of the chemical engineering operations will involve either heat addition or heat removal in one way or the other. It is, therefore, extremely necessary to have good understanding about the heat transfer mechanisms such as conduction, convection and radiation. These methods can then be used for understanding the performances of heat transfer equipment used in almost all chemical and related industries

DETAILED CONTENTS

1. Modes of Heat Transfer (3 hrs)

   Conduction, Convection, Radiation, concept of steady state and unsteady state heat transfer

2. Conduction (15 hrs)

   Fourier's law of heat conduction, thermal conductivity of materials – solids, liquids and gases and effect of temperature on thermal conductivity, one dimensional steady state heat conduction through a composite solid, steady state heat conduction through a variable area – the cylinder and the sphere, one dimensional steady state heat conduction in bodies with heat sources – the plane wall, the cylinder and the sphere

   Insulation and insulating materials, critical thickness of insulation, physical properties of insulating materials

3. Convection (15 hrs)

   Convective heat transfer and concept of heat transfer coefficient, free and forced convection, dimensional analysis and significance of various dimensional groups such as Reynolds number, Prandtl number, empirical correlations for free and forced convection, heat transfer with phase change – brief introduction about boiling, condensation and evaporation

4. Radiation (15 hrs)

   Black body radiation, Planck's law, Wein's displacement law, Stefan – Boltzmann Law, Kirchhoff's law, Grey body, view factor, radiative heat exchange between black bodies, exchange of radiation between diffuse grey surfaces, radiation shield, absorption and emission in a gaseous medium

LIST OF PRACTICALS

1. To determine the heat transfer rate between hot and cold fluids – double pipe
2. To determine the overall heat transfer co-efficient for an open pan evaporator
3. To determine the amount of steam required in evaporating the solution in open pan evaporator
4. To determine overall heat transfer co-efficient for a heat loss using coil type evaporator
5. Measurement of heat loss using insulating materials and compare it with bare pipe
6. Measurement of emissivity of test surfaces
7. To determine the heat transfer in extended surfaces
8. To determine heat transfer coefficient for forced convection
9. To determine heat transfer coefficient for free convection
10. To determine thermal conductivity of metal
11. To determine the rate of evaporation for a given solid sample

RECOMMENDED BOOKS

1. Heat Transfer by Chapman, MacMillan Publication
2. Principles of Heat Transfer by Kreith, Harper and Row Publication
3. Process Heat Transfer by Kern, McGraw Hill Publication
4. Heat Transfer by McAdams, McGraw Hill Publication

3.6 INDUSTRIAL PROCESS EQUIPMENT

L	T	P
3	1	3

RATIONALE

The diploma holder in chemical engineering has to deal with all kinds of equipments in the chemical industry. This subject provides him/her thorough knowledge of uses, types and constructional details of heat transfer, mass transfer equipments along with pumps, blowers, compressors, crushers and screens.

DETAILED CONTENTS

Schematic representation, uses, types, introduction to the constructional details of following equipments:-

1. Fluid Moving Machinery (10 hrs)

   Pumps; Reciprocating Pumps, Rotary Pumps, Centrifugal Pumps, Vacuum Pump, Fans; Centrifugal fans, Blowers and Compressors; Positive displacement centrifugal blowers, Positive displacement compressors. Jet ejectors

2. Heat transfer equipment (12 hrs)

   Double pipe heat exchanger, shell & tube heat exchanger, direct fired-heater, Reboiler, Condenser, Jacketed kettle, Evaporators; open pan, single effect multiple effect, vertical tube, long-tube, vertical , forced circulation evaporator, tray driver.

3. Mechanical operation (14 hrs)

   Jaw crusher, Gyratory crusher, Ball-mill, Gyrating Screen, electrically vibrated screens, grizzlies. Conveying; belt conveyors, screw conveyor. Fluid solid separator; Settling tank, wet scrubber, crystallizer, rotary filter, cyclone separator, electrostatic precipitator, bag filter, thickener, classifier.

4. Mass transfer equipment (12 hrs)

   Absorption tower, stripper, distillation tower, continuous fractionater. Fluid solid contacting; Fluid bed, moving bed, fixed bed.

RECOMMENDED BOOKS

1. Unit operation of Chemical Engineering by Mc Cabe & Smith Mc Graw Hill, Publication.
2. Outlines of Chemical Technology by Dryden. East-West Press Publishing.
3. Introduction to Chemical Engineering by Badger & Banchero, Mc Graw Hill Publication.
4. Handbook for Chemical Engineers by Perry & Chilton, MC Graw Hill Publication.