

### 3.1 FLUID MECHANICS

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#### RATIONALE

Subject of Fluid Mechanics is a science subject and helps in solving problems in the field of Aeronautical, Electronics, Electrical, Mechanical, Metallurgical Engineering subject

The subject deals with basic concepts and principles in hydrostatics, hydrokinematics and hydrodynamics and their application in solving fluid flow problems.

#### DETAILED CONTENTS

#### THEORY

1. Introduction: (4 hrs)
  - 1.1 Fluids: Real and ideal fluids
  - 1.2 Fluid Mechanics, Hydrostatics, Hydrodynamics, Hydraulics
2. Properties of Fluids: (6 hrs)
  - 2.1 Mass density, specific weight, specific gravity, viscosity, surface tension - cohesion, adhesion and , capillarity, vapour pressure and compressibility.
  - 2.2 Units of measurement
3. Hydrostatic Pressure: (8 hrs)
  - 3.1 Pressure, intensity of pressure, pressure head, Pascal's law and its applications.
  - 3.2 Total pressure, resultant pressure, and centre of pressure.
  - 3.3 Total pressure and centre of pressure on vertical and inclined plane surfaces: Rectangular, triangular, trapezoidal
4. Measurement of Pressure: (8 hrs)
  - 4.1 Atmospheric pressure, gauge pressure, vacuum pressure and absolute pressure.
  - 4.2 Piezometer, simple manometer, differential manometer and Bourden gauge

5. Fundamentals of Fluid Flow: (8 hrs)
- 5.1 Types of Flow: Steady and unsteady flow, laminar and turbulent flow, uniform and non-uniform flow
  - 5.2 Discharge and continuity equation (flow equation)
  - 5.3 Types of hydraulic energy: Potential energy, kinetic energy, pressure energy
  - 5.4 Bernoulli's theorem; statement and description (without proof of theorem)
  - 5.5 Venturimeter (horizontal and inclined)
6. Flow Measurements (6 hrs)
- Measurement of velocity of fluid by:
- 6.1 Venturimeter
  - 6.2 Orificemeter
  - 6.3 Plot tube
  - 6.4 Mouthpiece
  - 6.5 Notches and weirs
  - 6.6 Current meters
7. Flow through Pipes: (8 hrs)
- 7.1 Definition of pipe flow; , laminar and turbulent flow - explained through Reynold's experiment
  - 7.2 Reynolds number, critical velocity and velocity distributions in a pipe for laminar and turbulent flows
  - 7.3 Head loss in pipe lines due to friction, sudden expansion and sudden contraction, entrance, exit, obstruction and change of direction (No derivation of formula)
  - 7.4 Hydraulic gradient line and total energy line
  - 7.5 Flow from one reservoir to another through a long pipe of uniform cross section (simple problems)

- 7.6 Pipes in series and parallel
- 7.7 Water hammer phenomenon and its effects (only definition and description)
- 8. Flow through open channels: (10 hrs)
  - 8.1 Definition of an open channel, uniform flow and non-uniform flow
  - 8.2 Discharge through channels using
    - i) Chezy's formula (no derivation)
    - ii) Manning's formula (no derivation)
  - 8.3 Most economical channel sections
    - i) Rectangular
    - ii) Trapezoidal
  - 8.4 Head loss in open channel into friction, transition losses due to graded expansion and contraction, obstruction and change of direction (no derivation)

### **PRACTICAL EXERCISES**

- i) To verify Bernoulli's Theorem
- ii) To find out venturimeter coefficient
- iii) To determine coefficient of velocity ( $C_v$ ), Coefficient of discharge ( $C_d$ ) Coefficient of contraction ( $C_c$ ) of an orifice and verify the relation between them
- iv) To perform Reynold's experiment
- v) To verify loss of head in pipe flow due to
  - a) Sudden enlargement
  - b) Sudden Contraction
- vi) To determine velocity of flow of an open channel by using a current meter
- vii) To determine coefficient of discharge of a rectangular notch/triangular notch.

## **INSTRUCTIONAL STRATEGY**

Hydraulics being a fundamental subject, teachers are expected to lay considerable stress on understanding the basic concepts, principles and their applications. For this purpose, teachers are expected to give simple problems in the class room and provide tutorial exercises so as to develop necessary knowledge for comprehending the basic concepts and principles. As far as possible, the teaching of the subject be supplemented by demonstrations and practical work in the laboratory.

## **RECOMMENDED BOOKS**

1. Jagdish Lal, "Fluid Mechanics and Hydraulics" Delhi Metropolitan Book Co. Pvt Ltd.
2. Modi, PN, and Seth, SM; "Hydraulics and Fluid Mechanics", Delhi Standard Publishers Distributors
3. Khurmi RS, "Hydraulics and Hydraulics Machines", Delhi S Chand and Co.
4. Likhi SK., Laboratory Manual in Hydraulics, Delhi Wiley Eastern

### 3.2 GENERAL ENGINEERING

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#### 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 stabiliser 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**

#### Testing of bricks

- a) Shape and size
- b) Soundness test
- c) Water absorption
- d) Crushing strength

#### 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 2<sup>nd</sup> 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

### 3.3 SURVEYING - I

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#### RATIONALE

The important functions of a diploma civil engineer includes the jobs of detailed surveying, plotting of survey data, preparation of survey maps and setting out works

While framing the curriculum for the subject of surveying, stress has been given to the development of the skill in each type of survey like chain surveying, compass surveying and levelling that the Civil Engineering diploma holder will normally be called upon to perform. Plane table surveying, contouring, theodilite surveying, curves and use of minor instruments have been also included in this subject.

Field work should be a selected one so that student can check his work and have an idea of the results the extent of error in the work done by him. As far as possible, the surveys done should be got plotted, as this will also reveal errors in the work and develop skill in plotting.

#### DETAILED CONTENTS

#### THEORY

1. Introduction: (3 hrs)
  - 1.1 Basic principles of surveying
  - 1.2 Concept and purpose of surveying, measurements-linear and angular, units of measurements
  - 1.3 Instruments used for taking these measurements, classification of survey-based on instruments
2. Chain surveying: (3 hrs)
  - 2.1 Purpose of chain surveying, principles of chain surveying
  - 2.2 Obstacles in chain surveying
    - 2.5.1 Errors in chain surveying
    - 2.5.2 Correction for measurements by erroneous length of chain, simple problems on this.

3. Compass surveying: (8 hrs)
- 3.1 Purpose of compass surveying. Construction and working of prismatic compass, use of prismatic compass: Setting and taking observations
  - 3.2 Concept of:
    - a) Meridian - Magnetic and true
    - b) Bearing - Magnetic, True and Arbitrary
    - c) Whole circle bearing and reduced bearing
    - d) Fore and back bearing
    - e) Magnetic dip and declination
  - 3.3 Local attraction - causes, detection, errors and corrections, problems on local attraction, magnetic declination and calculation of included angles in a compass traverse
  - 3.4 Concept of a traverse - Open and closed. Traversing with a compass. Checks for an open and closed traverse, plotting a traverse - By included end deflection angles, concept of closing error, adjustment of traverse graphically by proportionate method,
4. Levelling: (10 hrs)
- 4.1 Purpose of levelling, concept of a level surface, horizontal surface, vertical surface, datum, reduced level and bench marks
  - 4.2 Principle and construction of Dumpy level
  - 4.3 Concepts of line of collimation, axis of the bubble tube, axis of the telescope and vertical axis
  - 4.4 Levelling staff: single piece, folding, invar precision staff, telescopic
  - 4.5 Temporary adjustment: setting up and leveling, adjusting for parallax of Dumpy
  - 4.6 Concept of back sight, foresight, intermediate sight, station change point, to determine reduce levels
  - 4.7 Level book and reduction of levels by
    - 4.7.1 Height of collimation method and
    - 4.7.2 Rise and fall method
  - 4.8 Arithmetic checks, problem on reduction of levels, fly levelling, check leveling and profile levelling (L-section and X-section), errors in levelling,

and precautions to minimize them and permissible limits, reciprocal levelling, testing and adjustment of IOP level. Numerical Problems.

- 4.9 Computations of Areas of regular figure and irregular figure. Simpson rule: prismoidal formula and graphical method, use of planimeter
5. Plane Table Surveying: (8 hrs)
- 5.1 Purpose of plane table surveying, equipment used in plane table survey:
- (a) Plane table
  - (b) Alidade (Plain and Telescopic)
  - (c) Accessories
- 5.2 Setting of a plane table:
- (a) Centering
  - (b) Levelling
  - (c) Orientation
- 5.3 Methods of plane table surveying
- (a) Radiation,
  - (b) Intersection
  - (c) Traversing
  - (d) Resection
- 5.4 Two point problem
- 5.5 Three point problem by
- a) Mechanical Method(Tracing paper)
  - b) Bessel's Graphical Method
  - c) Trial and error method and Lehman's Rules
- Errors in plane table survey and precautions to control them. Testing and adjustment of plane table and alidade

## **PRACTICAL EXERCISES**

- I. Chain surveying:
- i)
    - a) Ranging a line
    - b) Chaining a line and recording in the field work
    - c) Testing and adjustment of chain
    - d) Taking offsets - perpendicular and oblique (with a tape only)
    - e) Setting out right angle with a tape
  - ii)
    - a) Chaining of a line involving reciprocal ranging
    - b) Taking off sets and setting out right angles, with cross staff and Indian optical square

- iii) Chain survey of a small area (field work and plotting)
  - iv) Chaining a line involving obstacles to ranging
- II. Compass Surveying:
- i)
    - a) Study of prismatic compass
    - b) Setting the compass and taking observations
    - c) Measuring angles between the lines meeting at a point
  - ii) Traversing with the prismatic compass and chain (Recording and plotting by included angles)
- III. Levelling:
- i)
    - a) Study of dumpy level and levelling staff
    - b) Temporary adjustments of a Dumpy level
    - c) Taking staff readings on different stations from the single setting and finding differences of level between them
  - ii)
    - a) Study of IOP level
    - b) Its temporary adjustments
    - c) Taking staff readings on different stations from the single setting and finding differences of level between them
  - iii) Longitudinal and cross sectioning of a road/railway/canal
  - iv) Setting a gradient by dumpy and IOP level
- IV. Plane Table Surveying:
- i)
    - a) Study of the plane table survey equipment
    - b) Setting the plane table
    - c) Marking the North direction
    - d) Plotting a few points by radiation method
  - ii)
    - a) Orientation by
      - Trough compass
      - Back sighting
    - b) Plotting few points by intersection method
  - iii) Traversing an area with a plane table (at least five lines)
  - iv)
    - a) Two point problem
    - b) Three point problem by

- Tracing paper method
  - Bessel's graphical method
  - Trial and Error method
- v) Setting and checking grades with abney level. Setting and checking grades with Ceylon Ghat Tracer
- vi) Finding heights by Indian Pattern Clinometer (Tangent Clinometer)  
Enlargement/ reduction of a plan by the use of pentagraph
- vii) Use of planimeter for computing areas

### **INSTRUCTIONAL STRATEGY**

This is highly practice-oriented course. While imparting theoretical instructions, teachers are expected to demonstrate the use of various instruments in surveying, stress should be laid on correct use of various instruments so as to avoid/minimize errors during surveying. It is further recommended that more emphasis should be laid in conducting practical work by individual students

### **RECOMMENDED BOOKS**

- i) Narinder Singh; "Surveying"; New Delhi, Tata McGraw Hill Publishing Co Ltd.
- ii) Hussain, SK and Nagraj, MS; "Text Book of Surveying"; New Delhi, S Chand and Co Ltd.
- iii) Deshpande, RS; "A Text Book Surveying and Levelling"; Poona, United Book Corporation
- iv) Kocher, CL; "A Text Book of Surveying"; Ludhiana, Katson Publishing House
- v) Kanetkar, TP and Kulkarni, SV., "Surveying and Leveling", Poona, AVG Parkashan
- vi) Kanetkar, TP; and Kulkarni, SV; "Surveying and Leveling-Vol.2" Poona, AVG Prakashan
- vii) Punmia, BC; "Surveying and Leveling - Vol. 2", Delhi Standard Publishers Distributors, Delhi
- viii) Shahai, PB; "A Text Book of Surveying Vol. 2", Oxford and IBH Publishing Co.

### 3.4 CONSTRUCTION MATERIALS

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#### RATIONALE

Civil Engineering diploma holders have to supervise construction of various types of civil works involving use of various materials like stones, bricks and tiles, cement and cement based products, lime, timber and wood based products, paints and varnishes metals and other miscellaneous materials. The students should have requisite knowledge regarding characteristics, uses and availability of various building materials and skills in conducting tests to determine suitability of materials for various construction purposes. In addition specifications of various materials should also be known (PWD/BIS) for effective quality control.

#### DETAILED CONTENTS

#### THEORY

1. Building Stones: (4 hrs)
  - 1.1 Classification of Rocks: (General Review)
    - 1.1.1 Geological classification: Igneous, sedimentary and metamorphic rocks
    - 1.1.2 Chemical classification; Calcareous, argillaceous and siliceous rocks
    - 1.1.3 Physical classification: Unstratified, stratified and foliated rocks
  - 1.2 General characteristics of stones – Marble, Granite, Sand stone, Lime stone and Slate
  - 1.3 Requirements of good building stones
  - \*\*1.4 Identification of common building stones
  - 1.5 Various uses of stones in construction
  - 1.6 Kota stone, marble
2. Bricks and Tiles: (10 hrs)
  - 2.1 Introduction to bricks

- 2.2 Raw materials for brick manufacturing and properties of good brick making earth
- 2.3 Manufacturing of bricks
  - 2.3.1 Preparation of clay (manual/mechanically)
  - \*\*2.3.2 Moulding: hand moulding and machine moulding, hand moulding brick table; drying of bricks, burning of bricks, types of kilns (Bull's Trench Kiln and Hoffman's Kiln), process of burning, size and weight of standard brick; traditional brick, refractory brick, clay-flyash bricks, sun dried bricks, only line diagram of kilns
- 2.4 Classification and specifications of bricks as per BIS: 1077
- 2.5 Testing of common building bricks as per BIS: 3495
  - Compressive strength, water absorption – hot and cold water test, efflorescence, Dimensional tolerance
- 2.6 Tiles
  - 2.6.1 Building tiles; Types of tiles-wall, ceiling, roofing and flooring tiles
  - 2.6.2 Ceramic, linoleum, terrazo and PVC tiles, their properties and uses
- 2.7 Stacking of bricks and tiles at site
- 3. Cement: (7 hrs)
  - \*\*3.1 Introduction, raw materials, flow diagram of manufacturing of cement, by wet process
  - 3.2 Various types of Cements and their uses: Ordinary portland cement, rapid hardening cement, low heat cement, high alumina cement, blast furnace slag cement, white and coloured cement, portland pozzolana cement, super sulphated cement
  - 3.3 Properties of cement
  - 3.4 Storage of Cement
- 4. Lime: (4 hrs)
  - 4.1 Introduction: Lime as one of the cementing materials

- 4.2 Definition of terms; quick lime, fat lime, hydraulic lime, hydrated lime, lump lime
- 4.3 Calcination and slaking of lime
- 4.4 IS classification of lime
  
- 5. Timber and Wood Based Products: (7 hrs)
  - 5.1 Identification of different types of timber: Teak, Deodar, Shisham, Sal, Mango, Kail and Chir
  - \*\* 5.2 Market forms of converted timber as per BIS
  - 5.3 Seasoning of timber: Purpose, methods of seasoning, kiln seasoning as per BIS
  - 5.4 Defects in timber, decay in timber
  - 5.5 Preservation of timber and methods of treatment as per BIS
  - 5.6 Properties of timber and specifications of structural timber
  - \*\*5.7 Common timbers in India, their uses - Teak, Deodar, Chir, Kail, Shisham, Sal and Mango, Plywood; Veneers and veneering, manufacturing of plywood (brief description only), uses of plywood.
  - 5.8 Other wood based products, their brief description of manufacture and uses: laminated board, black board, fibre board, hard board
  
- 6. Paints and Varnishes: (6 hrs)
  - 6.1 Purpose and use of paints
  - 6.2 Different types of paints: oil paints, water paints and cement paints
    - 6.2.1 Cement paints - commonly available cement paints, their properties and uses. Application of Cement paints
    - 6.2.2 Varnishes and polish-types, properties and their uses.
    - 6.2.3 Lacquers and enamels - their properties and uses.
    - 6.2.4 Oil paints: their properties and uses
  
- 7. Metals: (4 hrs)
  - 7.1 Ferrous metals: Composition, properties and uses of cast iron, steel (mild and high tension steel), requirements of mild steel as per BIS.

- 7.2 Non Ferrous metals: properties and uses of the following non ferrous metals in Civil Engineering works - copper, lead, zinc, tin and aluminium
- 7.3 Commercial forms of ferrous and non ferrous metals.
8. Miscellaneous Materials: (6 hrs)
- 8.1 Plastics: Important commercial products of plastics used in Civil Engineering construction.
- 8.2 Asbestos based products: Commercial forms and their uses (Asbestos tiles, fibre boarded, cellotex)
- 8.3 Insulating materials for Sound and Thermal Insulation
- 8.4 Construction chemicals like: water proofing components, epoxies, sulphides, polymers.
- 8.5 Glass: Types of glasses, their properties, Commercial forms and uses: plate glass, wired glass, bullet resisting glass, coloured glass, fibre glass, foamed glass, glass wool, Float glass, glass reinforced plastic.
- 8.6 Water proofing materials; Bitumen sheets and felts, chemical admixtures
- \*\*8.7 Finishings Materials: Homogenous laminated fibres, panel boards, wall boards, wall papers etc

NOTE: \*\*A field visit may be planned to explain and show the relevant things

**PRACTICAL EXERCISES:**

- i) To identify different types of stones
- ii) To determine the crushing strength of bricks
- iii) To determine the water absorption of bricks
- iv) To identify various types of timbers such as: Teak, Sal, Chir, Sissoo, Deodar, Kail & Hollock
- v) To determine fineness (by sieve method) of cement
- vi) To determine normal consistency of cement
- vii) To determine initial and final setting times of cement

- viii) To determine soundness of cement
- ix) To determine compressive strength of cement

### **INSTRUCTIONAL STRATEGY**

Teachers are expected to physically show various materials while imparting instructions. Field-visits should also be organized to show manufacturing processes and use of various materials in Civil engineering works. Students should be encouraged to collect sample of various building materials so as to create a museum of materials in the polytechnic.

### **RECOMMENDED BOOKS**

- 1) TTTI, Chandigarh "Civil Engineering Materials:" Tata McGraw Hill Publication
- 2) Surendra Singh; "Engineering Materials;" New Delhi, Vikas Publishing House Pvt. Ltd.
- 3) Chowdhuri, N; "Engineering Materials;" Calcutta, Technical Publishers of India.
- 4) Bahl, SK; "Engineering Materials;" Delhi, Rainbow Book Co.
- 5) Sharma, SK; and Mathur, GC; "Engineering Materials;" Delhi-Jalandhar, R. Chand and Co.
- 6) Kulkarni, GJ; "Engineering Materials;" Ahmedabad, Ahmedabad Book Depot.
- 7) Shahane; Engineering Materials; Poona, Allied Book Stall.
- 8) Gurcharan Singh; Engineering materials, Standard Publishers Distributors

### 3.5 BUILDING CONSTRUCTION

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#### RATIONALE

Diploma holders in Civil Engineering are supposed to supervise construction of buildings. To perform above task, it is essential that students should have knowledge of various sub components of buildings like foundations, walls, roofs, stair cases, floors etc., and their constructional details. Therefore, the subject of Building Construction is very important for Civil Engineering diploma holders.

#### DETAILED CONTENTS

##### THEORY:

1. Introduction: (1 hr)
  - 1.1 Definition of a building, classification of buildings based on occupancy
  - 1.2 Different parts of a building
2. Foundations: (4 hrs)
  - 2.1 Concept of foundation and its purpose
  - 2.2 Types of foundation-shallow and deep
    - \*\*2.2.1 Shallow foundation - constructional details of: Spread foundations for walls, thumb rules for depth and width of foundation and thickness of concrete block, stepped foundation, masonry pillars and concrete columns, raft foundation,
    - 2.2.2 Deep foundations; Pile foundations - their suitability  
(This topic may be demonstrated with the help of transparencies)
  - 2.2 Earthwork
    - 2.3.1 Surface excavation, definition, setting out, cutting, filling and blasting
    - 2.3.2 Excavation of foundation, trenches, shoring, timbering and de-watering
3. Walls: (4 hrs)
  - 3.1 Purpose of walls
  - 3.2 Classification of walls - load bearing, non-load bearing, dwarf, retaining, breast walls and dhaji walls

- 3.3 Classification of walls as per materials of construction: brick, stone, reinforced brick, reinforced concrete, precast, hollow and solid concrete block and composite masonry walls
- 3.4 Partition walls: Constructional details, suitability and uses of brick and wooden partition walls
- 3.5 Mortars: types, selection of mortar and its preparation
- 3.6 Scaffolding, construction details and suitability of mason's brick layers and tubular scaffolding, shoring, underpinning
- 4. Masonry (8 hrs)
  - 4.1 Brick Masonry: Definition of terms, bond, facing, backing, hearting, column pillar, jambs, reveals soffit, plinth masonry, header, stretcher, bed of bricks bat, queen closer, king closer, frog and quoin
    - 4.1.1 Bond – meaning and necessity; English and flemish bond
    - 4.1.2 Construction of brick walls –methods of laying bricks in walls, precautions observed in the construction of walls, methods of bonding new brick work with old (toothing, racking, back and block bonding), Expansion and contraction joints
  - 4.2 Stone Masonry
    - 4.2.1 Glossary of terms – natural bed, bedding planes, string course, corbel, cornice, block in course grouting, moulding, templates throating, thorough stone parapet, coping, plaster and buttress
    - 4.2.2 Types of stone masonry, rubble masonry, random and coursed ashlar masonry, principles to be observed in construction of stone masonry walls
- 5. Arches and Lintels: (4 hrs)
  - 5.1 Meaning and use of arches and lintels:
  - 5.2 Glossary of terms used in arches and lintels - abutment, peir, arch ring, intrados, soffit, extrados, voussoiers, springer, springing line, crown, key stone, skew back, span, rise, depth of an arch, haunch, spandril, jambs, bearing, thickness of lintel, effective span
  - 5.3 Arches:
    - 5.3.1 Types of Arches - Semi circular, segmental, elliptical and parabolic, flat, inverted and relieving

- 5.3.2 Stone arches and their construction
- 5.3.3 Brick arches and their construction
- 5.4 Lintels
  - 5.4.1 Purpose of lintel
  - 5.4.2 Materials used for lintels: RCC, RBC, stone, steel and timber
  - 5.4.3 Cast-in-situ and pre-cast lintels
  - 5.4.4 Lintel along with sun-shade or chhajja
- \*\*6. Doors, Windows and Ventilators: (2 hrs)
  - 6.1 Glossary of terms
  - 6.2 Classification and their suitability for different situations
- \*7. Damp Proofing and Water Proofing (6 hrs)
  - 7.1 Dampness and its ill effects on bricks, plaster, wooden fixtures, metal fixtures and reinforcement, damage to aesthetic appearance, damage to heat insulating materials, damage to stored articles and health, sources and causes of dampness
  - 7.2 Types of dampness - moisture penetrating the building from outside e.g. rainwater, surface water, ground moisture
  - 7.3 Moisture entrapped during construction i.e. moisture in concrete, masonry construction and plastering work etc.
  - 7.4 Moisture which originates in the building itself i.e. water in kitchen and bathrooms etc.
  - 7.5 Damp proofing materials and their specifications: rich concrete and mortar, bitumen, bitumen mastic, polymer coating, use of chemicals
  - 7.6 Damp proofing of : basement, ground floors, plinth and walls, special damp proofing arrangements in bathrooms, WC and kitchen, damp proofing for roofs and window sills
- \*\*8. Floors (6 hrs)
  - 8.1 Glossary of terms-floor finish, topping, under layer, base course, rubble filling and their purpose
  - 8.2 Types of floor finishes - cast-in-situ, concrete flooring (monolithic, bonded) Terrazo tile flooring, stone (marble and kota) flooring, PCV

flooring, Terrazo flooring, Timber flooring, description with sketches of the methods of construction of the floors and their specifications

9. Roofs (6 hrs)
  - 9.1 Glossary of terms for pitched roofs - batten, eaves, barge, fascia board, gable, hip, lap, purlin, rafter, rag bolt, valley, ridge
  - 9.2 Types of roofs, concept of flat, pitched and arched roofs
  - 9.3 Ceilings – Gypsum, plaster boards, cellotex, fibre boards
10. Stairs (4 hrs)
  - 10.1 Glossary of terms: Staircase, winders, landing, stringer, newel, baluster, riser, tread, width of staircase, hand-rail, nosing
  - 10.2 Classification of staircase on the basis of material – RCC, timber, steel, Aluminium
  - 10.3 Planning and layout of staircase: Relations between rise and tread, determination of width of stair, landing etc
  - 10.4 Various types of layout - straight flight, dog legged, open well, quarter turn, half turn (newel and geometrical stairs), bifurcated stair, spiral stair
11. Surface Finishes (6 hrs)
  - 11.1 Plastering - classification according to use and finishes like grit finish, rough cast, pebble dashed, concrete and stone cladding, plain plaster etc., dubbing, proportion of mortars used for different plasters, techniques of plastering and curing
  - 11.2 Pointing - different types of pointing and their method
  - 11.3 Painting - preparation of surface priming coat and application of paints on wooden, steel and plastered wall surfaces
  - 11.4 White washing, colour washing and distempering, polishing, application of cement and plastic paints
  - 11.5 Commonly used water repellent for exterior surfaces, their names and applications

12. Anti Termite Measures (As per IS 6313 –I – III) (4 hrs)
- 12.1 Introduction, site preparation and chemicals used in anti-termite treatment
  - 12.2 Treatment of masonry foundation
  - 12.3 Treatment of RCC foundation
  - 12.4 Treatment of top surface of earth filling
  - 12.5 Treatment of junction of walls and floors
  - 12.6 Treatment along external perimeter of building
  - 12.7 Treatment and selection of timber
  - 12.8 Treatment in existing buildings
13. Building Planning (4 hrs)
- 13.1 Site selection: Factors to be considered for selection of site for residential, commercial, industrial and public building
  - 13.2 Basic principles of building planning, arrangement of doors, windows, cupboards etc for residential building
  - 13.3 Orientation of building as per IS: 7662 in relation to sun and wind direction, rains, internal circulation and placement of rooms within the available area.
  - 13.4 Planning of building services
14. Repair and Maintenance of Buildings (4 hrs)
- 14.1 Introduction
  - 14.2 Importance of repair and maintenance of buildings
  - 14.3 Common repair problems and their solutions
  - 14.4 Cracks in buildings
  - 14.5 Repair of DPC against rising dampness
  - 14.6 Repair and maintenance of public health services
  - 14.7 Types of materials for building repairs

**Note** \* An expert may be invited from field/industry for extension lecture  
\*\* A field visit may be planned to explain and show the relevant things

**Demonstration and site visits should be done for following:**

- i) Demonstration of tools and plants used in building construction
- ii) Layout of a building: two rooms building with front verandah
- iii) To construct brick bonds (English bond only) in one, one and half and two brick thick: (a) Walls for L, T and cross junction (b) Columns
- iv) Demonstration of pre-construction and post-construction termite treatment of building and woodwork
- v) Demonstration of following items of work at construction site:
  - a) Timbering of excavated trenching
  - b) Damp proof courses
  - c) Construction of masonry walls
  - d) Flooring: Laying of flooring on an already prepared lime concrete base
  - e) Plastering and pointing
  - f) White and colour washing
  - g) Use of special type of shuttering/cranes/heavy machines in construction work
  - h) RCC work

**INSTRUCTIONAL STRATEGY**

While imparting instructions in this subject, teachers are expected to take students to work site and explain constructional process and special details for various sub-components of a buildings. It is also important to make use of audio visual aids/video films (if available) to show specialised operations. The practical work should be given due importance and efforts should be made that each student should perform practical work independently. For carrying out practical works, polytechnics should have building yard where enough raw materials is made available for students to perform practical work

**RECOMMENDED BOOKS**

1. Gupta, Sushil Kumar, Singla, DR, and Juneja BM; "A Text Book of Building Construction"; Ludhiana, Katson Publishing House.
2. Deshpande, RS and Vartak, GV; "A Text Book of Building Construction"; Poona, United Book Corporation.
3. Rangwala, SC: "Building Construction"; Anand, Charotar Book Stall
4. Kulkarni, GJ; "A Text Book of Building Construction"; Ahmedabad Book Depot

5. Arora, SP and Bindra, SP; "A Text Book of Building Construction"; New Delhi Dhanpt Rai and Sons.
6. Sharma,SK and Kaul, BK; "A Text Book of Building Construction"; Delhi, S Chand and Co.
7. Sushil Kumar; "Building Construction"; Standard Publishers Distributors, Delhi
8. Moorthy, NKR; "A Text Book of Building Construction"; Poona, Engineering Book Publishing Co.
9. SP – 62 Hand Book of BIS
10. Singh Gurcharan, "Building Materials", Standard Publishers Distributor, Delhi
11. B.I.S. – 6313 Part 1, 2, 3

### 3.6 BUILDING DRAWING

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#### RATIONALE

Drawing is the language of engineers. Engineering is absolutely incomplete without a thorough knowledge of drawing. A Civil Engineering diploma holder must be capable of sketching detailed constructional drawing of various components of building for the purpose of communication with the craftsman. Planning of small buildings, developing a line plan, dimensioning, key plan, drainage plan should be a part of curriculum. The diploma engineer must be conversant with reading and interpretation of drawing for execution of work.

#### DETAILED CONTENTS

##### Section-I

##### Drawing No. 1:

Details of spread footing foundations for load bearing and non-load bearing wall for given thickness of walls with the help of given data or rule of the thumb, showing offsets, position of DPC; details of basement showing necessary damp proofing. (3 x 3 = 9)

##### Drawing No. 2:

Plans of 'T' and Corner junction of walls 1 Brick, 1-1/2 Brick and 2 brick thick in English bond (2 x 4 = 8)

##### Drawing No. 3:

Elevation, sectional plan and sectional side elevation of flush door, panelled door, panelled and glazed door, edged, battened and braced-door, steel windows and aluminium windows (2 x 4 = 8)

##### Section-II

##### Drawing No. 4:

Steel roof truss (king post, queen post) showing details of joints, fixation of roof coverings, eaves and gutters. (2 x 4 = 8)

##### Drawing No. 5:

Drawing plan, elevation of a small building by measurement. (2 x 4 = 8)

**Drawing No. 6:**

Drawing detailed plan, elevation and section of a two room residential building from a given line plan, showing details of foundations, roof and parapet using AutoCAD

(3 x 4 = 12)

**Drawing No. 7:**

Drawings of following floors

- a) Cement concrete floors on ground and at first floor
  - i) Conglomerate
  - ii) Bonded cement concrete flooring
  - iii) Terrazo flooring
- b) Wooden floors
  - i) Single wooden floors
  - ii) Double wooden floors on ground and first floor (3 x 4 = 12)

**Section-III****Drawing No. 8:**

Drawing plan and section of a dog legged stair (RCC), quarter turn stair in a given room

(2 x 4 = 8)

**Drawing No. 9:**

Drawing a small double storey building with a RCC slab roof, sloping roof showing position of sanitary fittings house drainage and electrical fittings

(4 x 4 = 16)

**Drawing No. 10:**

Drawing details of damp proofing arrangement of roofs, floors, basement and walls as per BIS Code

NOTE:

- a) All drawings should be as per BIS code and specifications in SI Units
- b) Intensive practice of reading and interpreting building drawings should be given

**RECOMMENDED BOOKS**

1. Civil Engineering Drawing by RS Malik
2. Civil Engineering Drawing by NS Kumar; IPH, New Delhi
3. Principles of Building Drawing by MG Shah and CM Kale, MacMillan, Delhi
4. Building Construction by Moorthy NRK
5. Building Construction by Mitchell
6. Building Construction by Meckay and Meckay
7. Civil Engineering Drawing by Layal and Kumar Vol. I, II, IPH, Jalandhar
8. S.P. : 20

## **ECOLOGY AND ENVIRONMENTAL AWARENESS CAMP**

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the eco system and controlling pollution by pollution control measures. He should also be aware of environmental laws related to the control of pollution.

This is to be organized at a stretch for 3 to 4 days. Lectures will be delivered on following broad topics. There will be no examination for this subject.

1. Basics of ecology, eco system and sustainable development
2. Conservation of land reforms, preservation of species, prevention of advancement of deserts and lowering of water table
3. Sources of pollution - natural and man made, their effects on living and non-living organisms
4. Pollution of water - causes, effects of domestic wastes and industrial effluent on living and non-living organisms
5. Pollution of air-causes and effects of man, animal, vegetation and non-living organisms
6. Sources of noise pollution and its effects
7. Solid waste management; classification of refuse material, types, sources and properties of solid wastes, abatement methods
8. Mining, blasting, deforestation and their effects
9. Legislation to control environment
10. Environmental Impact Assessment (EIA), Elements for preparing EIA statements
11. Current issues in environmental pollution and its control
12. Role of non-conventional sources of energy in environmental protection