3.1 ENGINEERING FUNDAMENTALS

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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.

DETAILED CONTENTS
PART-A

MECHANICAL ENGINEERING

Theory

1. Transmission of Power (8 hrs)

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

PRACTICAL EXERCISES IN MECHANICAL ENGINEERING

1. Study of hydraulic brake
2. Study of various drives for transmission of powers. Models of belts, pulleys, gears, chains and clutches
3. Study of air conditioning system in a building
4. Study of various types of pumps

NOTE: Study will include dismantling and reassembling of actual parts

PART B

ELECTRICAL ENGINEERING

Theory

2. Application and Advantages of Electricity: (4 hrs)

- Difference between AC and DC
- Various applications of electricity
- Advantages of electrical energy over other types of energy

3. Basic Quantities of Electricity: (4 hrs)

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

4. Distribution System (4 hrs)

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

5. Supply from the Poles to the Distribution Board: (4 hrs)

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

6. Domestic Installation: (4 hrs)

- 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
- Common safety measures and earthing
- Introduction to BIS code of safety and wiring installation

7. Electric Motors and Pumps: (6 hrs)

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

8. Measuring Instruments (4 hrs)

Basics of measurement, principles of measurement of DC voltage and DC current, AC voltage and AC current and resistance using a multimeter. Block diagram of a CRO and use for the measurement of voltage (DC and AC), frequency and to study waves shape.

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. 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

4. 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

5. 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

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

7. 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.

8. Measurement of resistors by an ordinary multimeter and their verification on the basis of colour code.

PART C
ELECTRONICS

DETAILED CONTENTS

1. Introduction (12 hrs)

   Introduction to active and passive components, introduction to intrinsic and extrinsic semiconductor, PN junction diode, mechanism of current flow in PN junction, Diode (PN junction) as rectifier; half wave rectifier, full wave rectifier and filter circuits, brief idea and typical application of power diode, zener diode, photo diode. Concept of bipolar transistor – PNP ad NPN, their characteristics and uses. Field effect transistor and single stage CE amplifier circuit

2. Digital Electronics (9 hrs)

   Basic difference between analog and digital signal, binary and hexadecimal number system, binary addition, substraction, multiplication and division. Definition, symbols and truth table of NOT, AND, OR, NAND, NOR, EX-OR Gates, Boolean algebra, Demorgan's theorem

   General principle of A/D and D/A conversion techniques and brief idea of their applications

3. Combinational Circuits (3 hrs)

   Adders, Decoders, Encoders, Multiplexers, Demultiplexers

4. Flip-Flops (2 hrs)
   Hatches, S-R flip-flops, D flip-flops, J-K flip-flops

5. Programmable Logic Controller (2 hrs)

   Basic concept of PLC, its block diagram and applications

LIST OF PRACTICALS

1. Plotting of formal V-1 characteristics of PN junction diode

2. Rectifier circuits using semiconductor diode, measurement of input and output voltage and plotting of input and output wave shape for (i) half wave rectifier (ii) full wave rectifier

3. Plot forward and reverse V-I characteristics for a zener diode

4. Verification and interpretation of truth tables for AND, OR, NOT, NAND, NOR and EX-OR gates

5. Working of a PLC on PLC Trainer

PART D

CIVIL ENGINEERING

Theory

1. Construction Materials (8 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.

2. Foundations (6 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

Practicals

. a) 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
6. Theory of Machines by RC Jindal, Ishan Publications, Ambala

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

Electronics Engineering

1. Electronics Devices and Circuits by NN Bhargava; Tata McGraw Hill Publishing, New Delhi
2. Industrial Electronics by Chute and Chute
3. Basic Electronics by VK Mehta; S Chand and Co., 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 Ghosh; 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

3.2 UNIT OPERATIONS - I

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RATIONALE

A thorough knowledge of Unit Operations is essential for the study of polymer science and plastic processing. This course acquaints the students with the basic principles of stiochometry, fluid and particle mechanics and mechanical operations.

DETAILED CONTENTS

1. Introduction to unit operation, unit processes and significance in plastic processing (8 hrs)

2. Fundamentals of material and energy balance in the various processes relevant to plastic technology and simple problems based on polymer industries (12 hrs)

3. Fluid Mechanics (14 hrs)

   - Fundamental of fluid flow
   - Different types of flow (Newtonian and non-Newtonian)
   - Laminar and turbulent flow, Reynolds numbers, friction factor, viscosity, calculation of friction losses
   - Flow of fluids in pipes
   - Various types of pumps, compressors, blowers and their applications
   - Flow measurement devices (venturimeter, rotameter, orificemeter, pitot tube, weirs and notches)

4. Mechanical Operations (14 hrs)

   - Characteristics of solid particles, properties of particulate masses, storage of solids
   - Size reduction – energy and power requirement, Rittinger's Law, Bond's Law, Kick's Law, size reduction equipment, classification, construction and working of Blake, jaw and dodge crusher, roll crusher, ball mill, grinders, ultra fine grinder
   - Particle separation: solid-solid separation, screening and screening equipments and their effectiveness. Solid-liquid separation: filteration, continuous and batch filters. Pressure and vacuum filters, thickner etc. Solid-gas separation: cyclone separators.
   - Mixing of solids and pastes, types of mixers, kneaders, dispersors, masticators, their construction and working.

LIST OF PRACTICALS

1. To verify Bemouilli theorem and to determine the pressure drop due to friction in flow through pipe
2. To determine the Reynolds number and observe the pattern of laminar and turbulent flow
3. To observe the variation in discharge coefficient (Cd) with Reynolds number in venturimeter and orificemeter
4. To study the constructional features of reciprocating and centrifugal pump
5. To draw the discharge characteristics of centrifugal pump by observing the variation head, efficiency and power with capacity
6. To study the sedimentation behaviour of slurry
7. To find the rate of filteration using filter press
8. To carry out the sieve analysis of a product obtained from size reduction equipment such as ball mill, grinder etc.
9. To perform an experiment on cyclone separator
10. To perform an experiment on a mixer for liquid-liquid mixing
11. To perform an experiment on a mixer for solid-liquid mixing

RECOMMENDED BOOKS

1. Chemical Engineering I & II by Coulson & Richardson, Pergamon Press Publication
2. Unit Operation of Chemical Engineering by Mcabe and Smith, McGraw Hill Publication
3. Introduction to Chemical Engineering by Badger & Banchero, McGraw Hill Publication
4. Fluid Mechanics and Hydraulics by RK Bansal
5. Fluid Mechanics and Hydraulics by Modi and Seth
6. Mechanical Operations, Khanna Publication, Delhi

3.3 MECHANICS OF SOLIDS

L	T	P
3	-	2

RATIONALE

The subject of mechanics of solids deals with basic concepts of mechanics like laws of forces, moments, friction, centre of gravity, laws of motion and simple machines, which are required by the students for further understanding of other applied subjects.

DETAILED CONTENTS

1. Forces (4 hrs)

   Concept of forces, Bow's notation, law of forces, triangle law, parallelogram law and polygon law of forces, finding of resultant and equilibrant of forces by graphical and analytical methods, Lami's theorem, simple problems

2. Moments (4 hrs)

   Concept of moment, principle of moments, Varignon's Theorem (statement only), applications of moments, concept of couple, general conditions of equilibrium, simple problems

3. Centre of Gravity and Moment of Inertia (6 hrs)

   Concept of centre of gravity and centroid, centroid of regular lamina, composite and remainder areas. Centre of gravity of regular solids and compound bodies. Concept of moment of inertia and second moment of area, radius of gyration, theorems of parallel and perpendicular axes, second moment of area of common geometrical sections like rectangle, triangle, circle (without derivation), second moment for L, T and I sections, section modulus

4. Friction (4 hrs)

   Concept of friction, laws of friction, limiting friction, angle and coefficient of friction. Friction on horizontal and inclined planes

5. Simple Machines (4 hrs)

   Concept of machine, mechanical advantage, velocity ratio and mechanical efficiency and their relationship, law of machine. Mechanical advantage, velocity ratio and mechanical efficiency (without proof) for the following simple machines. Lever, worm and worm wheel and screw jack

6. Stress and Strain (6 hrs)

Concept of load, stress and strain, tensile, compressive and shear stress and strains. Elasticity, elastic limit, limit of proportionality, Hook's law, Young's Modulus of elasticity, nominal stress, yield point, plastic stage, ultimate strength and breaking stress, percentage elongation, proof stress, working stress, factor of safety

7. Cylindrical Thin Shells (6 hrs)

Longitudinal and circumferential stresses in seamless thin walled shells. Change in volume

8. Theory of Simple Bending (6 hrs

Concept of bending stress by moment of resistance, bending equation (without proof) $M/I=f/y=E/R$

Calculation of maximum bending stress in beams of rectangular, circular and T-sections, permissible bending stress, section moduli of rectangular, circular and symmetrical I-sections

Note: Load on beams: Only U.D.L. and point load at centre

9. Torsion 8 hrs)

Concept of torsion. Torsion equation for solid and hollow shafts. $T/J=fs/r=C\phi/I$ (without proof). Comparison between solid and hollow shafts with regard to their strength and weight, power transmitted by shafts. Concept of mean and maximum torque. Simple problems on power calculations of shafts

LIST OF PRACTICALS

1. Tensile test on bar of mild steel to find elastic limit, yield point and breaking point for the bar and plot:

   - Load versus elongation
   - Stress versus strain and compare with the standard value

2. Torsion test on mild steel shaft to find the shear stress of the given metal and compare with standard value

3. Impact test on metals using Izod and Chary apparatus and compare with the standard value
4. To find the Brinell hardness of different materials and compare with the standard value
5. To find the stiffness of different springs on both compression and tension
6. To find the mechanical advantage and velocity ratio of simple machine like screw jack, hydraulic press, foot lever
7. To detect the crack on the given surface

RECOMMENDED BOOKS

1. Engineering Mechanics by RS Khurmi
2. Applied Mechanics by IB Prasad
3. Strength of Materials by RS Khurmi
4. Strength of Materials by Sadhu Singh
5. Strength of Materials by Ramamurthan

3.4 POLYMER SCIENCE

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RATIONALE

The subject is designed to enable the students to acquire basic knowledge of polymer chemistry and polymer physics for better understanding of polymer related subjects. This will help the students in identifying different polymeric materials to be processed in the industry and determine their quality based on physical and chemical properties.

DETAILED CONTENTS

1. Degree of polymerization, molecular weight and molecular weight distribution, ploydispersity, measurement of molecular weight by dilute solution, viscometry, membrane osmometry, vapourphase osmometry, cryoscopy, ebulliometry, light scattering, centrifugation, Gel. permeation chromatography. (10 hrs)

2. Physical states of polymers – amorphous and crystalline behaviour. Polymer dissolution – dissolution and solvent selection for polymers, thermodynamics of polymer solutions, solubility parameter (6 hrs)

3. Thermal transmissions in polymer – Glass transition temperature, its importance and the factors which influence it, techniques for its determination, melting temperature, relationship of polymer properties with structure (6 hrs)

4. Concept of functionality and Carother's equation for condensation, polymerization, relation between conversion and degree of polymerization, gel phenomenon (3 hrs)

5. Free radical polymerization, different types of initiators, inhibition, retardation, chain transfer agents etc. Auto-acceleration, ceiling temperature, ionic polymerization. Siegler-Natta polymerization (4 hrs)

6. Importance of copolymers, different types of copolymers, copolymer equation, reactivity ratios (3 hrs)

7. Techniques of polymerization: bulk, solution, emulsion and suspension, their relative advantages and disadvantages, introduction to Rheology and Visco-elasticity, time dependent and time independent viscosity behaviour; power law fluids; Zero sheer viscosity, Maxwelll and Voigt models of visco-elastic materials (8 hrs)

LIST OF PRACTICALS

1. To identify at least 3 given polymers by following methods:

    - Visual examination
    - Specific gravity test
    - Melting and odour test
    - Burning test
    - Solubility test
    - Softening and melting point test
    - End group analysis

2. To determine boiling point of at least 2 given monomers (such as styrene)
3. To determine refractive index of 2 given monomers to establish its purity
4. To determine melting point of 3 given polymers
5. To determine water absorption of various plastics (at least 3 samples)
6. To determine the bulk density of 2 given polymers
7. To form phenol formaldehyde resin and to determine its gel time
8. To determine viscosity and average molecular weight by dilute solution viscometry

RECOMMENDED BOOKS

1. Polymer Chemistry by Paave
2. Test Book of Polymer Science by Billmeyer
3. Polymer Science and Technology by Joel R.
4. Polymer Science by Gowariker Fried
5. Principles of Polymerization by Odian

3.5 POLYMERIC MATERIALS AND PROPERTIES

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RATIONALE

This subject gives a detailed description of polymeric materials in the category of thermoplastics, thermosets and elastomers. This subject enables the students in acquiring the knowledge for selection of right type of materials for processing in order to make the product

DETAILED CONTENTS

1. General characteristics of thermoplastics, thermosets and elastomers. Crystalline and amorphous polymers and their relation to processing and applications (6 hrs)

2. Thermoplastics (20 hrs)

   Synthesis, general properties and applications of the following:

   - PE – Linear low density polyethylene (LLDPE), low density
   - Polythylene (LDPE), high density polyethylene (HDPE)
   - UHMWHDPE
   - PVC and major vinyl chloride co-polymers
   - PP
   - PS-GPPS, HIPS
   - Nylons – Nylons 6, 66
   - Acrylics – PMMA and co-acrylates
   - ABS, SAN
   - Cellulose plastic
   - PET

3. Thermosetting resins (12 hrs)

   Synthesis, general properties and applications of phenol resins, urea, melamine resins, unsaturated polyesters, alkyd and epoxy resin

4. Elastomers (10 hrs)

   Synthesis, general properties and applications of NR, SBR, polysoprene, chloroprene, polybutadiene, EPDM, nitrile rubber, silicone rubber and elastomers

RECOMMENDED BOOKS

1. Plastics Materials by Boydson
2. Organic Chemistry of Polymers by Saunders
3. Polymer Science and Technology by P Ghosh
4. Polymer Materials – I Ed. Polymer Research Centre, Bangalore
5. Polymer Materials – II Ed. Polymer Research Centre, Bangalore

3.6 AUTOCAD

L	T	P
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RATIONALE

This subject enables the students to make drawings using computer software, take prints/plots

DETAILED CONTENTS

Introduction to AutoCAD

1. Starting up, practice on – how to create a new drawing file, setting drawing limits and saving a file, drawing lines in different ways using absolute co-ordinates, user co-ordinates, WCS, UCS, drawing lines, circles, arcs, ellipses, polygons, splines, polylines, zoom commands

2. Practice on Edit commands such as erase, copy, mirror, array, offset, rotate, oops, undo, redo, scale, stretch, trim, break, extend, chamfer, fillet

3. Practice on text commands, single line text, paragraph text, editing text, text size, text styles, changing properties commands

4. Practice on layer commands, creating layer, freeze, layer on/off colour assigning, making a layer, current layer, load line type, lock and unlock layer, move from one layer to other.

5. Practice on Hatching-Hatch pattern selection

6. Practice on dimensioning – linear dimensioning, angular dimensioning radius/diameter dimensioning, O-snap command, aligned dimensioning, editing of dimensioning, tolerances in dimensioning

7. Blocks and X-refs - How to make a block, how to insert a block, using block in any drawing, working with x-refs, x-ref options

8. Practice on print/plot commands. Export/import commands

9. Practice on making complete drawings of components by doing exercises

RECOMMENDED BOOKS

1. AutoCad by RW Leigh, Galcotia, N.D.

2. Engineering Drawing with AutoCAD 2000 by T. Jaypooran, Vikas Publishing House