3.1 STRENGTH OF MATERIALS

L	T	P
4	-	2

RATIONALE

Diploma holders in this course are required to analyze reasons for failure of different components and select the required material for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles in the solution of applied problems to develop the required competencies.

DETAILED CONTENTS

1. Stresses and Strains (08 hrs)

    1.1. Concept of load, stresses and strain

    1.2. Tensile compressive and shear stresses and strains

    1.3. Concept of Elasticity, Elastic limit and limit of proportionality.

        1.3.1. Hook's Law
        1.3.2. Young Modulus of elasticity
        1.3.3. Nominal stress
        1.3.4. Stress strain diagram
        1.3.5. Yield point, plastic stage
        1.3.6. Ultimate strength and breaking stress
        1.3.7. Percentage elongation
        1.3.8. Proof stress and working stress
        1.3.9. Factor of safety
        1.3.10. Poisson's ratio
        1.3.11. Shear modulus

    1.4. Longitudinal and circumferential stresses in seamless thin walled cylindrical shells (derivation of these formulae not required)

2. Resilience (06 hrs)

    2.1 Resilience, proof resilience and modulus of resilience
    2.2 Strain energy due to direct stresses
    2.3 Stresses due to gradual, sudden and falling load.
    2.4 Numerical problems

3 Moment of Inertia (06 hrs)

3.1. Concept of moment of Inertia and second moment of area
3.2. Radius of gyration , section modulus
3.3. Theorem of perpendicular axis and parallel axis (without derivation)
3.4. Second moment of area of common geometrical sections: Rectangle, Triangle, Circle (without derivation) Second moment of area for I,T, L, Z section
3.5 Simple numerical problems.

4. Bending Moment and Shearing Force (10 hrs)

4.1 Concept of beam and type of loading
4.2 Concept of end supports-Roller, hinged and fixed
4.3 Concept of bending moment and shearing force
4.4 B.M. and S.F. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated and U.D.L.
4.5 Simple numerical problems

5. Bending stresses (08 hrs)

5.1 Concept of Bending stresses
5.2. Theory of simple bending
5.3. Use of the equation $f/y = M/I = E/R$
5.4. Concept of moment of resistance
5.5. Bending stress diagram
5.6. Calculation of maximum bending stress in beams of rectangular, circular, and T section.
5.7 Permissible bending stress Section modulus for rectangular, circular and symmetrical I section.
5.8 Simple numerical problems

6 Columns (08 hrs)

6.1. Concept of column, modes of failure
6.2. Types of columns
6.3. Buckling load, crushing load
6.4. Slenderness ratio
6.5. Factors effecting strength of a column
6.6 End restraints
6.7 Effective length
6.8 Strength of column by Euler Formula without derivation
6.9. Rankine Gourdan formula (without derivation)
6.10 Simple numerical problems

7 Torsion (08hrs)

7.1 Concept of torsion- difference between torque and torsion.
7.2 Use of torque equation for circular shaft
7.3 Comparison between solid and hollow shaft with regard to their strength and weight.
7.4 Power transmitted by shaft
7.5 Concept of mean and maximum torque
7.6 Simple numerical problems

8. Springs (10 hrs)

8.1. Closed coil helical springs subjected to axial load and impact load
8.2 Stress deformation
8.3 Stiffness and angle of twist and strain energy
8.4 Proof resilience
8.5 Laminated spring (semi elliptical type only)
8.6 Determination of number of plates
8.7 Simple numerical problems

LIST OF PRACTICALS

1. Tensile test on bars of Mild steel and Aluminium.
2. Bending tests on a steel bar or a wooden beam.
3. Impact test on metals
   a) Izod test
   b) Charpy test
4. Torsion test on specimens of different metals for determining modulus of rigidity.
5. To determine the stiffness of a helical spring and to plot a graph between load and extension.
6. Hardness test on different metals.

INSTRUCTIONAL STRATEGY

1. Expose the students to real life problems.
2. Plan assignments so as to promote problem solving abilities and develop continued learning skills.

RECOMMENDED BOOKS

1. SOM by Birinder Singh,; Katson Publishing House, New Delhi.
2. SOM by RS Khurmi; S.Chand & Co; New Delhi
3. Elements of SOM by D.R. Malhotra & H.C.Gupta; Satya Prakashan, New Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	08	12
2	06	10
3	06	10
3	10	16
4	08	12
5	08	12
6	08	12
7	10	16
Total	**64**	**100**

3.2 ELEMENTS OF MECHANICAL ENGINEERING

L	T	P
4	-	-

RATIONALE

A diploma holder has to assist in activities of installation, operation and maintenance of hydraulic devices, compressors and air-conditioning equipment. This subject has been included to impart basic knowledge of hydraulic and thermal engineering to the students.

DETAILED CONTENTS

A. Hydraulics

1. Introduction (04 hrs)

   1.1 Fluids and non-fluids, Liquid, gas and vapour
   1.2 Properties of fluids: Mass density, specific weight, pressure, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension, capillarity

2. Fluid statics (06 hrs)

   2.1 Pascal's law
   2.2 Concept of pressure: atmospheric pressure, gauge pressure, vacuum, absolute pressure
   2.3 Pressure head
   2.4 Measurement of pressure: Single tube manometer, U - tube manometer, Differential manometer, bourdon gauge

3. Flow of Fluids (08 hrs)

   3.1 Types of fluid flow: steady and unsteady, uniform and non - uniform, laminar and turbulent
   3.2 Rate of flow and its units
   3.3 Continuity equation of flow
   3.4 Bernoulli's theorem (without proof) and its applications
   3.5 Simple problems

4. Hydraulic Devices (08 hrs)

   4.1 Description, operation and application of hydraulic machines – hydraulic ram, hydraulic jack, hydraulic brake, hydraulic accumulator, hydraulic press, reciprocating pump, centrifugal pump,

B. Thermal Engineering

5. Introduction (06 hrs)

5.1 Energy, work and heat
5.2 Thermodynamic state and system, boundary, surrounding, universe
5.3 Types of thermodynamic systems: closed, open, isolated, adiabatic
5.4 Thermodynamic properties: pressure, volume, temperature, enthalpy, internal energy, entropy
5.5 p-v diagram, T-s diagram

6. Gas Laws (04 hrs)

6.1 Boyle's law, charle's law, joule's law,
6.2 Characteristics equation, gas constant, universal gas constant.

7. Law of Thermodynamics (06 hrs)

7.1 Zeroth, first and second law of thermodynamics (concept only).
7.2 Constant volume, constant pressure, isothermal, hyperbolic, adiabatic, polytropic, throttling and free expansion processes

8. Air Cycles (without derivation) (06 hrs)

8.1 Carnot cycle
8.2 Otto cycle
8.3 Diesel cycle
8.4 Dual combustion cycle

9. Fuels and Combustion (06 hrs)

9.1 Definition of fuel, Types of Automotive fuels, Properties of fuel, Calorific value
9.2 Fuel combustion
9.3 Air requirement for complete combustion of fuel
9.4 Analysis of exhaust gases with the help of electronic analysers.

10. Air Compressor (06 hrs)

10.1 Reciprocating air compressor: Working of single stage and double stage compressor and applications.
10.2 Working of super charger and turbo charger.

11. Introduction to air conditioning system (04 hrs)

11.1 Components of automobile air conditioning system and their function

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on basic principles and use charts in class, visits to labs. and industry may be arranged to demonstrate certain materials and practices.

RECOMMENDED BOOKS

1. Hydraulics and Hydraulic Machines by RS Khurmi; S. Chand & Co. Ltd., New Delhi.
2. Hydraulics and Fluid Mechanics by Jagdish Lal; Metropolitan Book Company Ltd., Delhi.
3. Fluid Mechanic, Hydraulics and Hydraulic Machines by K.K. Arora; Standard Publishers Distributors, Delhi.
4. Engineering Thermodynamics by PK Nag; Tata McGraw Hill, Delhi
5. Basic Engineering Thermodynamics by Roy Chaudhary; Tata McGraw Hill, Delhi
6. Basic Thermodynamics by PB Joshi and US Tumne; Pune Vidyarthi Grah Prakashan
7. Engineering Thermodynamics by CP Arora; Tata McGraw Hill, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	04	06
2	06	10
3	08	12
4	08	12
5	06	10
6	04	05
7	06	10
8	06	10
9	06	10
10	06	10
11	04	05
Total	**64**	**100**

3.3 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P
3	-	2

RATIONALE

The objective of this subject is to impart fundamental knowledge and skills regarding basic electrical and electronics engineering, which diploma holders will come across in their professional life. This course will provide the students to understand the basic concepts and principles of d.c. and a.c. fundamentals, electromagnetic induction, transformers, motors distribution system, domestic installation, electrical safety etc. The students will also learn basic electronics including diodes and transistors and their applications.

DETAILED CONTENTS

1. Application and Advantage of Electricity (04 hrs)

   Difference between ac and dc, various applications of electricity, advantages of electrical energy over other types of energy

2. Basic Electrical Quantities (04 hrs)

   Definition of voltage, current, power and energy with their units, name of instruments used for measuring above quantities

3. Electromagnetic Induction (04 hrs)

   Production of e.m.f., idea of a transformer and its working principle

4. Transmission and Distribution System (08 hrs)

   Key diagram of 3 phase transmission and distribution system, Brief functions of accessories of transmission line. Difference between high and low voltage distribution system, identification of three-phase wires, neutral wire and earth wire in a low voltage distribution system. Identification of voltages between phases and between one phase and neutral. Difference between three-phase and single-phase supply. Arrangement of supply system from pole to the distribution board, function of service line, energy meter, main switch, distribution board

5. Domestic Installation (08 hrs)

   Various types of domestic circuits, various accessories and parts of domestic electrical installation. Identification of wiring systems, staircase installation

6. Electric Motors and Pumps (10 hrs)

Definition and various applications of single-phase and three-phase motors. Connection and starting of three-phase induction motors by star-delta starter. Conversion of horse power in watts or kilowatts, Type of pumps and their applications, difference between direct online starter and star delta starter, characteristics and applications of servo motors.

7. Electrical Safety (04 hrs)

Electrical shock and precautions against shock, treatment of electric shock, concept of fuses and their classification, selection and application, concept of earthing and various types of earthing, applications of MCBs and ELCBs

8. Basic Electronics (06 hrs)

Basic idea of semiconductors – P and N type; diodes, zener diodes and their applications, transistor – PNP and NPN, symbols, identification of terminals of transistor, current flowing in a transistor, its characteristics and uses. Characteristics and applications of a thyristor

LIST OF PRACTICALS

1. Connection of a three-phase motor and starter with fuses and reversing of direction of rotation
2. Connection of a single-phase induction motor with supply and reversing of its direction of rotation
3. To test a battery for its charged and discharged condition.
4. Identify the different faults in a domestic wiring system
5. Connection and reading of an electric energy meter with supply and load using ammeter, voltmeter, wattmeter
6. Study of a distribution board for domestic installation
7. Ohm's law verification
8. Verification of law of resistance in series
9. Verification of law of resistance in parallel
10. Draw V-I characteristics of P-N junction diode
11. Draw input and output characters of a transistor
12. Draw reverse break down characteristics of a zener diode

INSTRUCTIONAL STRATEGY

The teacher should give emphasis on understanding of concept and various terms used in the subject. Practical exercises will reinforce various concepts.

RECOMMENDED BOOKS

1. Basic Electrical Engineering by PS Dhogal; Tata McGraw Hill Publishers, New Delhi
2. A Text Book of Electrical Technology, Vol. I and II by BL Thareja; S Chand and Co., New Delhi
3. Basic Electricity by BR Sharma; Satya Prakashan, New Delhi
4. Basic Electrical Engineering by JB Gupta, S Kataria and Sons, Delhi
5. Experiments in Basic Electrical Engineering by SK Bhattacharya and KM Rastogi, New Age International Publishers Ltd., New Delhi
6. Basic Electronics by VK Mehta; S Chand and Co., New Delhi
7. Electrical Machines by SK Bhattacharya; Tata McGraw Hill, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	4	10
2	4	10
3	4	10
4	8	15
5	8	15
6	10	18
7	4	10
8	6	12
Total	**48**	**100**

3.4 MANUFACTURING TECHNOLOGY - I

L	T	P
4	-	4

RATIONALE

The knowledge of manufacturing techniques in the area of foundry, machine shop (fitting shop, lathe machines and shaping), inspection and gauging and in coating both on metallic and non-metallic is essential at the first stage for understanding technology. Hence the following topics are included.

DETAILED CONTENTS

1. Fitting (12 hrs)

   Fits, limits and tolerances and their applications, unilateral and bilateral tolerances, gauges, gauge tolerances, micrometer, vernier, height gauges, dial comparator, straight edge, surface plate. Metal cutting, metal shear, metal sawing, metal bending.

2. Metallic and Non-metallic Coatings (12 hrs)

   Necessity of metallic and non-metallic coatings, principles and processes of electroplating, galvanizing, vacuum zing, metal spraying, painting and their applications, preparation of base materials. Uses of primers, paints and finish coatings, powder coating and its advantages.

3. Foundry (12 hrs)

   Introduction, types of patterns, pattern materials, cores and core boxes, core materials, preservation and storage of patterns,. Introduction to moulding, types of moulding, types of moulds, preparation of cores, defects in moulds and their remedies, casting defects and their remedies.

4. Lathe (12 hrs)

   Introduction, types of lathes, specifications, description and functions of lathe parts, feed mechanism, drives and transmission, work holding devices, turning tools

   Lathe operations – plain turning, facing, centring, parting off, undercutting, taper turning, eccentric turning, drilling, reaming, thread cutting and knurling, speeds and feeds of cut.

   Introduction to capstan and turret lathes, copying lathe and their attachments, difference between capstan and turret lathes and heads, tool holders and tool layout, tool geometry and use of throwaway tips, brazed tools and HSS tools.

5. Shaper (04 hrs)

Operation and mechanism

6. Inspection Instruments and Gauges (12 hrs)

Height gauge, depth gauge, bore gauge, slip gauge, sine bar, measurement of taper by use of slip gauges, interchangeability, Go and Not-Go gauges, screw thread micrometer, thread gauge, radius gauge, dial gauge, and gear tooth vernier, hardness checking instruments, coating thickness checking instruments, surface finish checking instruments. Quality Control, concept of control chart.

LIST OF PRACTICALS

1. Fitting shop

Bench work and fittings; simple male-female fitting (fitting of pulley, bearings, gears on shafts), scraping, pipe fittings with leak proof joints, checking alignment and centre distance

2. Pattern making and foundry shop

- To prepare pattern of rectangular block, 'V' block, step pulley with core box, split pattern
- Preparation of open floor mould of solid pattern, cope drag mould using split pattern
- Visit to foundry to see castings of cast iron, steel, non-ferrous materials, hand moulding, machine moulding and melting furnaces. Induction heating and gas fired furnaces

3. Lathe

- Introduction to turning machine and allied services like cutting tool grinding, general shop layout including maintenance, oils, tools and gauge stores.
- Different exercises in turning like plain turning, step-turning, facing, chamfering, knurling, parting off and thread cutting, use of compound slide and tailstock, tool grinding, selection of coolant and lubricants and speed and feeds. Use of safety goggles.

INSTRUCTIONAL STRATEGY

1. Teachers should lay emphasis on making the students conversant with concepts, principles, procedures and practices related to various manufacturing processes.

2. Focus should be laid in preparing jobs using various machines in the workshop.

RECOMMENDED BOOKS

1. Workshop Technology by BS Raghuwanshi, Dhanpat Rai & Sons, Delhi

2. Elements of Workshop Technology by SK Choudhary & Hazara, Asia Publishing House

3. Principles of Foundry Technology by Jain, Tata McGraw Hill, New Delhi

4. Workshop Technology, Vol-I, II & III by Chapman, Standard Publishers Distributors, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	12	18
2	12	18
3	12	18
4	12	18
5	04	10
6	12	18
Total	**64**	**100**

3.5 AUTOMOBILE ENGINEERING DRAWING

L	T	P
-	-	6

RATIONALE

An Automobile Engineering diploma holder, irrespective of his field of operation in an industry or transport undertaking, is expected to possess a thorough understanding of engineering drawing, which includes clear spatial visualization of the subject and the proficiency in reading and interpreting a wide variety of drawings. Besides this, he is also expected to have a certain degree of drafting skills depending upon his job functions to perform his day-to-day activities e.g. communicating and discussing the ideas with his superiors and passing on instructions to his subordinates in an unambiguous way. The teachers are recommended to lay emphasis on showing automobile components to students.

DETAILED CONTENTS

Assembly Drawings of the following automotive components:

1. Joints and Bearings (04 sheets)

- Universal joint,
- Slip joint
- Bush bearing
- Ball bearing
- Roller bearing

2. Engine Components (06 sheets)

- Four Stroke Petrol Engine Piston
- Four Stroke Diesel Engine Piston
- Connecting rod
- Crank shaft – 4 cylinder Engine
- Spark Plug

3. Gears (03 sheets)

- Nomenclature of gears
- Profile of spur gear by ‘Approximate method’
- Profile of spur gear by “Unwin’s Method’

4. Cam Profile (03 sheets)

- Different types of cams and followers
- Drawing of cam profile for following motion of follower (without offset)
    a. Uniform velocity motion
    b. Simple harmonic motion (SHM)
    c. Uniformly accelerated and retarded motion.

INSTRUCTIONAL STRATEGY

Teacher should make use of models while explaining the details of drawing of various automobile parts and components. Emphasis should be laid on cleanliness and quality of drawings.

RECOMMENDED BOOKS

1. Auto Engineering Drawing by RB Gupta; Satya Parkashan, New Delhi

2. Automobile Engg. Drawing by Raj Kumar, North Publication, Jalandhar

3. Machine Drawing by PS Gill; BD Kataria and Sons, Ludhiana

4. Machine Drawing by Lakshminarayan; Jain Brothers, New Delhi

5. Automobile Engineerig- Vol. I and II by Dr. Kirpal Singh, Standard Pulishers Distributors, Delhi

3.6 AUTO WORKSHOP

L	T	P
-	-	6

RATIONALE

The automobile workshop practice inducts practical attitudes amongst the automobile engineering technician, supervisor/manager in transport undertaking/private sector has to deal with fabrication, repair and maintenance of vehicle such as patching, painting etc. Therefore, for a automobile technician, it is necessary to develop the skills of handling and use of tools and maintenance of the vehicle. As a proprietor of a service station, the knowledge of car washer, hydraulic hoist is essential as lot of repair work of light commercial vehicles has to be carried out on hydraulic hoist.

DETAILED CONTENTS

1. Identification and sketching of general tools of automobile workshop and practice to use them
2. Identification and sketching of special tools and gauges of automobile workshop and practice to use them
3. Identification and sketching of major components in the layout of chassis of a scooter/motor cycle/3 wheeler
4. Identification and sketching of major components in layout of chassis of a car/jeep, truck/bus
5. Removal and fitting of wheels and tyres of car/jeep and rotation of tyres, tyre pressure, use of gauges
6. Removal and fitting of wheels and tyres of a two wheeler and repairing of punctures.
7. Cleaning, greasing, checking as per maintenance schedule of two wheelers
8. Cleaning, greasing, checking as per maintenance schedule for washing, wiping and polishing of jeep/car
9. Flushing out water jackets, cleaning of radiator and refitting in vehicle, adjustment of fan belt tension.

RECOMMENDED BOOKS

1. Car maintenance and repair by Arthur W. Judge
2. Carburetors and Fuel Injection System by Arthur W. Judge