ME-4.1 STRENGTH OF MATERIALS

L	T	P
4	-	2

RATIONALE

Diploma holders in mechanical engineering 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. Hence this subject. 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.

NOTE: Weightage of each topic for external examination is given in brackets

DETAILED CONTENTS

1. **Stresses and Strains** (25%)
   - 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 Yield point, plastic stage
     - 1.3.5 Strain hardening
     - 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 Lateral strain, Poisson's ratio
     - 1.3.11 Volumetric strain
     - 1.3.12 Shear modulus
     - 1.3.13 Strain energy due to direct stresses
     - 1.3.14 Proof resilience and modulus of resilience
     - 1.3.15 Stresses due to gradual, sudden and falling load
     - 1.3.16 Longitudinal and circumferential stresses in seamless thin walled cylindrical shells (derivation of these formulae not required)

2. **Beams and Bending Stress** **(35%)**
   - 2.1 Bending and shearing force
     - 2.1.1 Concept of beam, form of loading
     - 2.1.2 Concept of end supports-Roller, hinged and fixed
     - 2.1.3 Concept of bending moment and shearing force
     - 2.1.4 B.M. and S.F. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated and U.D.L.
   - 2.2 Bending stresses

2.2.2 Theory of simple bending

2.2.3 Use of the equation $\sigma/y = M/I = E/R$

2.2.4 Concept of moment of resistance

2.2.5 Bending stress diagram

2.2.6 Calculation of maximum bending stress in beams of rectangular, circular, I and T section.

2.2.7 Permissible bending stress section modulus for rectangular, circular and symmetrical I section.

2.2.8 Comparison between I, rectangular and circular section with regard to their strength

2.3 Slope and deflection

2.3.1 Simple cases of slope and deflection in simply supported beam with UDL on whole of the length and a point load at the centre

2.3.2 Cantilever with UDL on whole of the length and a point load at the end (without derivation)

2.3.3 Simple problems

2.4 Laminated Spring (Semi elliptical type only)

2.4.1 Determination of number of plates

2.4.2 Maximum bending stress and deflection

2.5 Combined direct and bending stresses

Simple cases of short columns of uniform section subject to eccentric loading with stress diagram

3. Columns **(15%)**

3.1 Concept of column, modes of failure

3.2 Types of columns

3.3 Buckling load, crushing load

3.4 Slenderness ratio

3.5 Factors effecting strength of a column

3.6 End restraints

3.7 Effective length

3.8 Strength of column by Euler Formula without derivation

3.9 Rankin- Gourdan formula (without derivation)

4. Torsion **(15%)**

4.1 Concept of torsion-difference between torque and torsion

4.2 Derivation and use of torque equation $T/J = I/R = G\theta/L$ for circular shaft

4.3 Shear stress diagram for solid and hollow circular shaft

4.4 Comparison between solid and hollow shaft with regard to their strength and weight.

4.5 Power transmitted by shaft

4.6 Concept of mean and maximum torque

5. Helical Springs **(10%)**

Closed coil ... springs subjected ... load

5.3 Stiffness and angle of twist and strain energy

5.4 Falling load on springs

LIST OF PRACTICALS

1. Tensile test on bars of Mild steel and Aluminium.
2. Shear test on specimen of two different metals.
3. Bending tests on a steel bar or a wooden beam.
4. Impact test on metals
   (a) Izod test
   (b) Charpy test
5. Torsion test on specimens of different metals for determining the angle of twist for a given torque.
6. To determine the stiffness of a helical spring and to plot a graph between load and extension.
7. Hardness test on metal and finding the Brinel and Rockwell hardness.

ME-4.2 FLUID MECHANICS AND FLUID MECHINES

L	T	P
4	-	2

RATIONALE

Diploma holders in Mechanical engineering are required to deal with problems of fluid flow and use of hydraulics in power generation. For this purpose, knowledge and skill about fluid mechanics, fluid flow and hydraulic machines are required to be imported for enabling them to perform above functions. This subject aims at development of knowledge and skill about properties of fluid, measurement of various flow parameters and about various hydraulic machines.

Note: Weightage of each topic for external examination is given in the brackets.

DETAILED CONTENTS

1. Introduction **(5%)**

1.1 Concept of fluid, fluid mechanics and hydraulics.

1.2 Properties of fluid (viscosity, specific weight, specific volume, specific gravity) with their units.

1.3 Concept of capillarity

2. Static Pressure **(5%)**

2.1 Pascal's law

2.2 Concept of static pressure, intensity of pressure and pressure head

2.3 Total pressure on a plane surface and centre of pressure

3. Measurement of Pressure **(10%)**

3.1 Concept of atmospheric pressure, gauge pressure, absolute pressure, vacuum and differential pressure.

3.2 Pressure measurement by: Piezometer tube, simple manometer, differential manometer, bourdon pressure gauge

4. Flow of Liquids **(15%)**

4.1 Types of flow – Laminar and turbulent, steady and unsteady, uniform and non-uniform.

4.2 Concept of Reynolds's number

4.3 Rate of discharge

4.4 Equation of continuity

4.5 Energy of fluid – datum, pressure, velocity head and total head.

4.6 Bernoulli's theorem (without proof) and its applications.

4.7 Discharge measurement by venturimeter and orifice meter.

4.8 Pitot tube.

5. Flow through Orifices

5.1 Types of orifices **(10%)**

5.2 Coefficient of orifice (Cc, Cv, Cd)

5.4 Discharge through a large rectangular orifices under a submerged, partially submerged and free-conditions.

5.5 Time of emptying a tank of uniform area through an orifice at the bottom.

6. **Flow through Pipes** **(15%)**

6.1 Concept of flow through pipes

6.2 Loss of energy due to friction

6.3 Factors influencing the loss due to friction

6.4 Darcy's equation for loss of energy and Chezy's equation (without proof)

6.5 Loss of head due to sudden enlargement, contraction, obstruction and bend (without proof)

6.6 Hydraulic gradient line and total energy line.

6.7 Pipes in series, parallel and branch pipes.

6.8 Application of flow through pipes.

6.9 Flow through siphon pipe.

6.10 Concept of water hammer.

7. **Hydraulic Turbines** **(15%)**

7.1 Concept of a turbine

7.2 Types of turbines-Impulse and reaction type (concept only)

7.3 Construction and working of Pelton wheel, Francis turbines and Kaplan turbine.

8. **Pumps** **(15%)**

8.1 Concept of hydraulic pump

8.2 Single acting reciprocating pump-construction, operation and application

8.3 Vane, screw and gear pumps-construction and working

8.4 Construction, working and operation of single stage centrifugal pump.

8.5 Work done, efficiencies and specifications of a centrifugal pump.

8.6 Power requirements of reciprocating pump and single stage centrifugal pump.

8.7 Common defects in the pumps and remedial measures.

9. **Hydraulic Devices** **(10%)**

Working Principles, description and applications of:

9.1 Hydraulic accumulator

9.2 Intensifier

9.3 Hydraulic jack

9.4 Hydraulic press

9.5 Hydraulic ram

Note:

* - An expert may be invited from the industry to deliver the lecture.

** - An industrial visit may be arranged to explain and show the relevant things.

LIST OF PRACTICALS

1. Measure the pressure head of water in a pipe line by:
   - 1.1 Piezometer tube
   - 1.2 U-tube
   - 1.3 Bourden Gauge
2. To verify Bernoulli's theorem
3. To find the value of the coefficient of discharge for a venturimeter.
4. To find Cc, Cv and Cd for small circular orifice.
5. To find Cc, Cv and Cd for small triangular orifice
6. To find Cc, Cv and Cd for small rectangular orifice
7. To determine the coefficient of fraction (Darcy's 'f') for commercial pipes.
8. To dismantle a single stage centrifugal pump with a view to study its constructional details.
9. To study a single-stage, centrifugal pump with a view to acquaint the students with common troubles and their remedial measures.
10. To plot the following characteristics curves for a single stage centrifugal pump running at a constant speed.
    - 10.1 Discharge v/s Head
    - 10.2 Discharge v/s Horse Power
    - 10.3 Discharge v/s efficiency
11. To study the hydraulic circuit of any available machines.
12. To study the working models of
    - 12.1 Pelton wheel
    - 12.2 Francis turbine
13. To determine maximum head developed by a centrifugal pump
14. Operation and maintenance of centrifugal pump.

ME-4.3 THERMAL ENGINEERING-II

L	T	P
4	-	2

RATIONALE:

A diploma holder in this course is supposed to know about testing of IC Engines, fuel supply, ignition system, cooling and lubrication.

Note: Weightage of each topic for external examination is given in the brackets.

DETAILED CONTENTS

1. **Air cycles:** **(10%)**
Thermodynamic cycles, concept of reversibility of cycle, thermal efficiency and air standard efficiencies, Carnot cycle – efficiency and its implications Otto, Diesel and dual combustion cycles – calculation of air standard efficiencies. Effect of compression ratio.

2. **Principles of I.C. Engines:** **(10%)**
Identification, location, functions and material of main parts of IC engine, concept of terms like bore, stroke, dead centers, crank-throw, piston, displacement, mean piston speed, compression ratio, clearance volume. Working of two stroke and four stroke petrol and diesel engines-single cylinder and multi cylinder engines, valve timing diagrams, classifications and application of I.C. Engines. Introduction to Rotary Wankle engine.

3. **Fuel System:** **(15%)**
Carburetion: Concept of carburetion, requirements of air fuel mixtures at various load conditions, simple carburetor and its limitations, modifications required in a simple carburetors to overcome the limitations (choke, idling devices, compensating jet, air bleed, MPFI system, CDRI, accelerating pump, principle and methods of fuel injection in diesel engines, control of fuel supply and types of nozzles. Working of a fuel injection pump. Fuel filters and mechanical fuel lift pump.

4. **Ignition Systems:** **(10%)**
Importance of Ignition timing and ignition advance, battery ignition and Magneto ignition, Modern ignition system.

5. **Cooling of I.C. Engines:** **(10%)**
Necessity of cooling, cooling systems, functions of thermostat, anti-freezing mixtures.

6. **Lubrication of IC Engines** **(10 %)**
Necessity of Lubrication, types and properties of lubricants (excluding testing of properties) Lubrication systems of IC Engines, gear type oil pump, oil filters, crank case ventilation, sludge formation.

7. **IC Engine Testing** **(10 %)**
Calculation of IHP, BHP and efficiencies –Mechanical, thermal, overall, relative:

control, norms for two and four wheelers - BIS I, II, III, IV and Euro - V, Methods of reducing pollution in IC engines, alternative fuels like CNG and LPG.

(15 %)

8. **Air Compressors**

Uses of compressor air, classification of air compressor, working principle of single and two stage reciprocating compressor, intercooling and aftercooling. Calculation of Horse power required to drive a compressor. Introduction to Rotary compressor, working of root-blower, vane type and centrifugal type compressor. Difference between fans blowers and compressor.

(10%)

9. **Gas Turbines**

Introduction to gas turbines, working principles of constant volume and constant pressure type gas turbines. Open cycle and closed cycle gas turbines. Applications of gas turbines.

LIST OF PRACTICALS

1. Study of various parts of IC Engines.
2. Draw the valve timing diagram of a diesel engine-single cylinder.
3. Study the working of a carburetor used in scooter/motor cycle. Study of MPFI.
4. Study a fuel injection pump, injector by dismantling it.
5. Study a distributor of a four – cylinder petrol engine.
6. Locate and draw the cooling circuit of multi-cylinder engine and study the construction of the radiator and locate and draw the lubricating circuit of a single cylinder diesel engine.
7. To find out IHP, BHP and specific fuel consumption, specific fuel consumption and mechanical efficiency.
8. Study the construction and working of a reciprocating air compressor.
9. Study of following Automotive Parts, Front axle and Real axle.
10. Study of following Automotive systems
    - 10.1 Elements of Transmission systems- Differential, Gear Box, Clutch
    - 10.2 Braking System
11. To study a gas turbine plant by local visit

ME-4.4 MACHINE DRAWING II

L	T	P
1	-	7

NOTE: - Weightage of each topic for external examination is given in the brackets. Third angle projection should be followed.

1. Lecture on Steam Stop Valve, Blow off Cock, Spring Loaded safety Valve Sheet # 1,2 & 3. **(20%)**
2. Lecture on Cams and Followers: Sheet # 4, 5, 6 (Uniform motion, simple harmonic motion) **(20%)**
3. Lecture on Jigs and Fixtures: Sheet # 7 Drill Jig, a typical fixture **(20%)**
4. Lecture on different types of gears. Sheet # 8 Spur Gear with actual representation of profile, #9 Conventional representations of bevel gear, worm and worm wheel. **(20%)**
5. Lecture on Clutch. Sheet #10 Assembly of single plate clutch. **(20%)**

ME-4.5 MANUFACTURING TECHNOLOGY-II

L	T	P
4	-	-

RATIONALE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various machining processes, modern machining methods, processing of plastic, tools, jigs and fixtures and processing of plastics is required to be imparted.

NOTE: Weightage of each topic for external examination is given in brackets

DETAILED CONTENTS

1. Drilling **(15%)**

1.1 Principle of drilling.

1.2 Classification of drilling machines and their description.

1.3 Various operation performed on drilling machine – drilling, spot facing, reaming, boring, counter boring, counter sinking, hole milling, tapping.

1.4 Speeds and feeds during drilling, impact of these parameters on drilling, machining time.

1.5 Types of drills and their features, nomenclature of a drill

1.6 Drill holding devices.

2. Boring **(10%)**

2.1 Principle of boring

2.2 Classification of boring machines and their brief description.

2.3 Boring bars and boring heads.

3. Shaping, Planing and Slotting **(15%)**

3.1 Working principle of shaper, planer and slotter.

3.2 Type of shapers.

3.3 Type of planers.

3.4 Types of operations performed on shaper, planer and slotter.

3.5 Work holding devices.

3.6 Speeds and feeds in above processes.

4. Broaching **(10%)**

4.1 Introduction

4.2 Types of broaching machines – Single ram and duplex ram horizontal type, vertical type pull up, pull down, push down.

4.3 Elements of broach tool, broach tooth details – nomenclature, types, and tool material.

5. Jigs and Fixtures **(20%)**

5.1 Importance and use of jigs and fixture

5.4 Clamping devices

5.5 Applications of jigs and fixtures

6. **Cutting Fluids and Lubricants** (10%)

6.1 Function of cutting fluid

6.2 Types of cutting fluids

6.3 Difference between cutting fluid and lubricant

6.4 Selection of cutting fluids for different materials and operations

6.5 Common methods of lubrication of machine tools.

7. **Plastic Processing** **(20%)**

7.1 Industrial use of plastics, situation where used.

7.2 Compression moulding-principle, and working of compression moudling machine.

7.3 Transfer Moulding

7.4 Injection moulding-principle, working of injection moulding machine.

7.5 Potential and limitations in the use of plastics

INSTRUCTIONAL STRATEGY

1. Teachers should lay emphasis in making students conversant with concepts and principles of manufacturing technologies.

L T P
- - 8

PRACTICAL EXERCISES

Turning Shop

Job 1. Grinding of Single Point Cutting Tool

Job 2. A composite job involving, boring, taper turning, external thread cutting and knurling.

Fitting Shop

Job 1. Exercise on drilling, reaming, counter boring, counter sinking and taping

Job 2. Dove tail fitting in mild steel

Job 3. Internal Threading by Hand Tapping Practice.

Machine Shop

Job 1. Prepare a V-Block up to ± 0.5 mm accuracy on shaper machine

Job 2. Exercise on key way cutting and spline cutting on shaper machine.

Job 3. Exercise on drilling practice on drilling machine

Advance Pattern Making Shop

Job 1. Advance Exercise on solid pattern.

Job 2. Advance Exercise on split pattern with provision of core print.

Job 3. Colour coding of Pattern and preservation of pattern.

Advance foundary shop

Introduction of Cupola Furnace and Oil Fired Furance.

Job 1. Advance Exercise in Foundry Shop using core in the mould.

Job 2. Casting of mould as indicated above under job 1

Sheet Metal Shop

Introduction and demonstration of various types of stakes, snips and marking tools.

Job 1. Method for developing the surface of cone.

Job 2. Preparation of Conical object like-Funnel.

Job 3. Preparation of any utility item like-tray.