CBCS SCHEME

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17AU34

Third Semester B.E. Degree Examination, Feb./Mar.2022
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Define following terms:
(i) Stress (ii) Strain (iii) Young's modulus.
(iv) Poisson's ratio (v) Hooke's law. **(05 Marks)**

b. Derive expression for the elongation of circular tapered bar subjected to axial load. **(05 Marks)**

c. A stepped bar is subjected to loads as shown in Fig. Q1 (c). Calculate the change in the length of the bar. Take E = 200 GPa for steel, E = 70 GPa for aluminium and E = 100 GPa for copper.

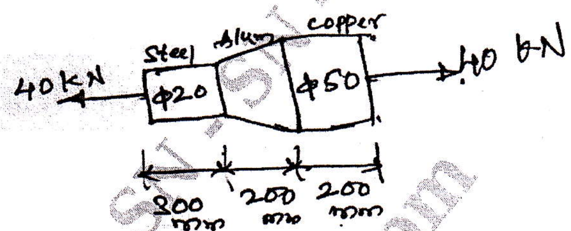

Fig. Q1 (c) **(10 Marks)**

OR

2 a. How stress-strain diagram of brittle material differ from ductile material? Explain. **(10 Marks)**

b. Derive relation between Young's modulus and modulus of rigidity. **(10 Marks)**

Module-2

3 The state of stress in two dimensional stressed body is shown in Fig. Q3. Determine principal stresses, principal planes and maximum shear stress. Also determine normal and tangential stresses on plane AC. Verify results with Mohr's circle. **(20 Marks)**

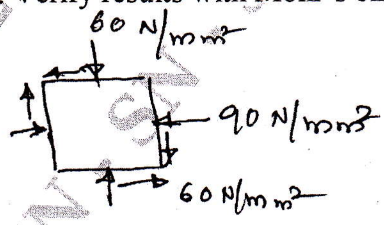

Fig. Q3

OR

4 a. Derive expression for circumferential and longitudinal stresses for a thin cylinder. **(10 Marks)**

b. A cylindrical pressure vessel of 1 m inner diameter and 1.5 m length is subjected to an internal pressure P. Thickness of the cylinder wall is 15 mm. Allowable stress of material is 90 MPa. Determine (i) Magnitude of maximum internal pressure P that vessel can withstand. (ii) Change in dimensions.
Take E = 200 GPa and $\mu = 0.3$ **(10 Marks)**

Module-3

5 a. Explain different types of beams and loads. **(05 Marks)**

b. Draw SFD and BMD for beam shown in Fig. Q5 (b). **(15 Marks)**

SFD – Shear Force Diagram
BMD – Bending Moment Diagram

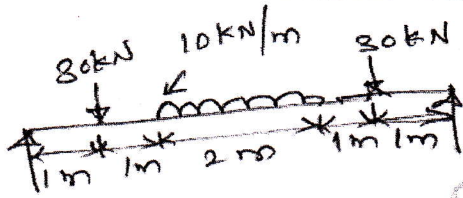

Fig. Q5 (b)

OR

6 a. Prove the relation $\frac{M}{I} = \frac{\sigma}{Y} = \frac{\in}{R}$ with usual notations. **(10 Marks)**

b. A 2 m long beam with rectangular section (100 mm × 50 mm) is simply supported at its ends and is subjected to a point load of 10 kN at its midspan. Show the bending stress distribution along the depth under maximum bending moment. **(10 Marks)**

Module-4

7 a. Derive equation of torsion for a circular shaft with assumptions. **(10 Marks)**

b. A 2 meters long hollow shaft has 80 mm outer diameter and 10 mm wall thickness when the torsional load on the shaft is 6 kN-m, determine (i) Maximum shear stress induced and (ii) Angle of twist. Draw the distribution of shear stress on the wall. Take G = 80 GPa. **(10 Marks)**

OR

8 a. Derive Euler's formula for critical load of column with both ends hinged. **(10 Marks)**

b. A 1.5 m long column with circular section of 30 mm diameter has (i) Both ends hinged (ii) Both ends fixed. Discuss regarding the stability of column when it is subjected to axial load of,

- W = 20 kN
- W = 35 kN
- W = 44 kN.

Take E = 200 GPa **(10 Marks)**

Module-5

9 a. Define strain energy and obtain expression for strain energy stored due to axial loading. **(08 Marks)**

b. A hollow circular shaft of 2 m long is required to transmit 1000 kW power when running at a speed of 3000 rpm. If the outer diameter of the shaft is 150 mm and inner diameter is 120 mm. Find the maximum shear stress and strain energy stored in the shaft. Take G = 80 GPa. **(12 Marks)**

OR

10 a. Explain (i) Maximum Principal stress theory and (ii) Maximum shear stress theory. **(10 Marks)**

b. Stress induced at a critical point in a machine component made of steel are as follows. If the yield stress is 380 MPa, calculate factor of safety using (i) Maximum principal stress theory (ii) Maximum shear stress theory.

$\sigma_x = 100\ N/mm^2$, $\sigma_y = 40\ N/mm^2$, $\tau_{xy} = 80\ N/mm^2$. **(10 Marks)**

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