CBCS SCHEME

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18MR34

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.

Module-1

1 a. Define : (i) Plasticity (ii) Ductility (iii) Brittleness (iv) Toughness (v) Young's modulus **(10 Marks)**

b. A brass bar having a cross-sectional area of 1000 mm^2 is subjected to axial forces as shown in Fig. Q1 (b). Determine the total elongation of the bar if, E = 105 GPa. **(10 Marks)**

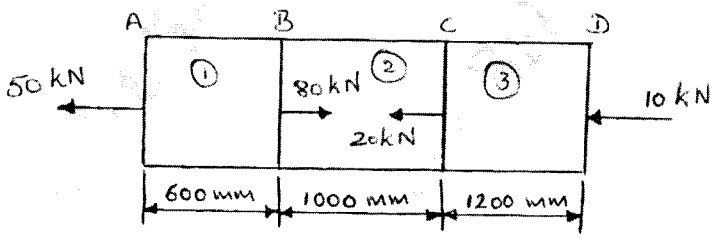

Fig. Q1 (b)

OR

2 a. Derive relation between Young's modulus, modulus of rigidity and Bulk modulus. **(10 Marks)**

b. A steel rod of cross sectional area 1600 mm^2 and two brass rods each of cross sectional area of 1000 mm^2 together support a load of 50 KN as shown in Fig Q2 (b). Find the stresses in the rod. E for steel = 2×10^5 N/mm^2 E for brass = 1×10^5 N/mm^2 **(10 Marks)**

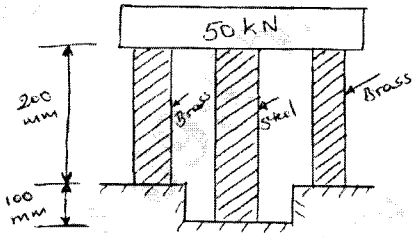

Fig. Q2 (b)

Module-2

3 a. Explain construction of Mohr's circle for stresses. **(08 Marks)**

b. The state of stress in two dimensionally stressed body is shown in Fig. Q3 (b). Determine the principal stresses, principal planes, maximum shear stress and their planes. **(12 Marks)**

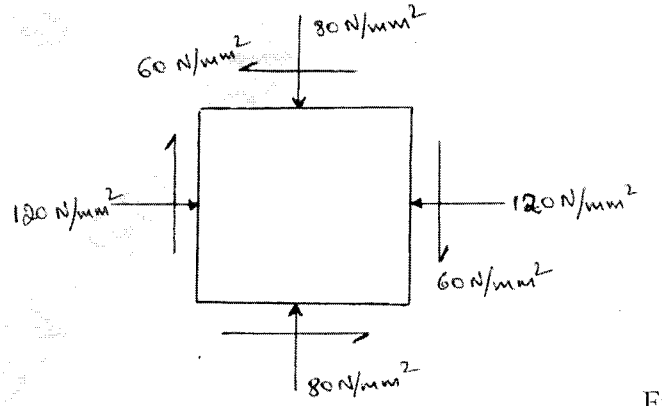

Fig. Q3 (b)

OR

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

b. A pipe of 400 mm internal diameter and 100 mm thickness contains a fluid at a pressure of 80 N/mm^2. Find the maximum and minimum hoop stress across the section. Also sketch the radial pressure distribution and hoop stress distribution across the section. **(10 Marks)**

Module-3

5 a. Derive the relationship between load, shear force and bending moment. **(08 Marks)**

b. A Cantilever of length 5.0 m is loaded as shown in Fig. Q5 (b). Draw the SFD and BMD for the Cantilever. **(12 Marks)**

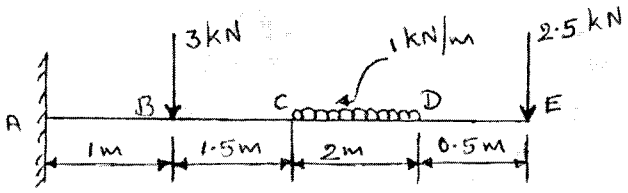

Fig. Q5 (b)

OR

6 a. Draw SFD and BMD for a simply supported beam with a point load at mid point. **(08 Marks)**

b. A simply supported beam AB of span 8 meters carrying concentrated loads of 4 KN, 10 KN and 7 KN at distances of 1.5 m, 4 m and 6 m from the left support. Draw the SFD and BMD. **(12 Marks)**

Module-4

7 a. What are the assumptions made in simple bending? Derive relationship between bending stress and radius of curvature. **(10 Marks)**

b. A beam of an I-section consists of 180mm × 15mm flanges and a web of 280mm × 15mm thickness. It is subjected to a bending moment of 120 kN-m. Sketch the bending stress distribution along the depth of the section. **(10 Marks)**

OR

8 a. Show that for a simply supported beam with point load W at mid span, the maximum deflection is $\frac{WL^3}{48EI}$. **(10 Marks)**

b. A square beam 20mm × 20mm in section and 2 m long is supported at the ends. The beam fails when a point load of 400 N is applied at the centre of the beam. What uniformly distributed load per metre length will break a Cantilever of the same material 40 mm wide, 60 mm deep and 3 m long? **(10 Marks)**

Module-5

9 a. State the assumptions made in pure torsion and derive torsion equations. **(10 Marks)**

b. A solid shaft rotating at 500 rpm transmits 30 kW. Maximum torque is 20% more than mean torque. Allowable shear stress 65 MPa and modulus of rigidity 81 GPa angle of twist in the shaft should not exceed 1° in 1 meter length. Determine suitable diameter. **(10 Marks)**

OR

10 a. Derive the expression of Euler's crippling load for a column when one end of the column is fixed and other end is hinged or pinned. **(10 Marks)**

b. A 1.5 m long column has a circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Take the factor of safety as 3. Calculate the safe load using Rankine's formulae taking yield stress 560 N/mm^2 and $\alpha = \frac{1}{1600}$. Euler's formula, taking $E = 1.2 \times 10^5$ N/mm^2. **(10 Marks)**

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