CBCS Scheme

USN 15MR34

Third Semester B.E. Degree Examination, June/July 2017
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define : (i) Poisson's ratio (ii) Bulk modulus (iii) Factor of safety and (iv) Young's modulus **(04 Marks)**

b. A compound bar is made of a bronze bar of 300 mm^2 cross sectional area and a steel bar of 200 mm^2 cross sectional area connected in series. The lengths of bronze and steel potions are 300 mm and 200 mm respectively. Determine the maximum force P that can be applied on the compound bar. Taking allowable stress for bronze and steel as σ_B = 90 MPa and σ_S = 130MPa. Also determine the net deformation in the compound bar. Take E_B = 85 GPa and E_S = 200 GPa (Refer Fig. Q1 (b)). **(12 Marks)**

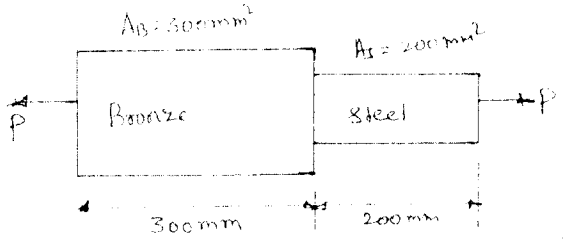

Fig. Q1 (b)

OR

2 a. Derive the relationship between Young's modulus of rigidity and bulk modulus. **(04 Marks)**

b. A steel bar is placed between two copper bars each having the same area and of length L as the steel bar at 15°C. At this stage, they are rigidly connected together at both the ends. The length of composite bar is also L. When the temperature is raised to 315°C, the length of the bar increases by 1.5 mm. Determine the original length and find the stresses in the bars. Take E_S = 2.1×10^5 N/mm²; E_C = 1×10^5 N/mm²; α_S = 0.0000125/°C; α_C = 0.0000175/°C **(12 Marks)**

Module-2

3 a. Derive an expression for normal and tangential stress on a plane inclined at 'θ' to the plane of stress in X-direction in a general two dimensional stress system. **(08 Marks)**

b. The state of stress in a two dimensional stressed body as shown in Fig. Q3 (b). Determine the principal planes, principal stress, maximum shear stress and their planes, by using Mohr's circle method. **(08 Marks)**

OR

4 a. Derive an expression for circumferential stress and longitudinal stress for thin cylinder. **(06 Marks)**

b. A thick walled cylindrical pressure vessel has inner radius of 150 mm and outer radius of 185 m. Draw a sketch showing the radial pressure and hoop stress distribution in the section of the cylinder wall, when an internal pressure of 10 MN/m^2 is applied. **(10 Marks)**

Module-3

5 a. Explain with simple sketches, different types of beams subjected to different types of loads. **(06 Marks)**

b. Draw the shear force and bending moment diagrams for a beam subjected to load as shown in Fig.Q5 (b). **(10 Marks)**

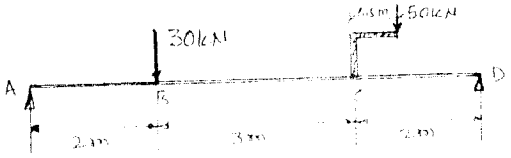

Fig. Q5 (b)

OR

6 A beam ABCDE is 12 m long simply supported at points B and D. span AB = DE = 2 m is over hanging BC = CD = 4 m. The beam supports a U.D.L. of 10 kN/m over AB and 20 kN/m over CD. In addition it also supports concentrated load of 10 kN at E and a clockwise moment of 16 kN-m at point C. Sketch SFD and BMD. **(16 Marks)**

Module-4

7 a. Prove the relations $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ with usual notations. **(08 Marks)**

b. T section of a beam has flange of size (b × 10mm) and web of size (150 mm × 10 mm) considering that the ratio of maximum compressive stress and maximum tensile stress induced is 5 to 3. Determine the width 'b' of the flange. Assume that the section is subjected to hogging moment. **(08 Marks)**

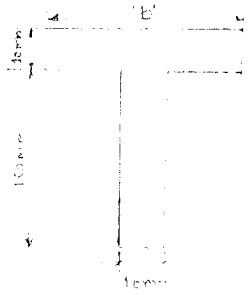

Fig. Q7 (a)

OR

8 a. Define : (i) Pure bending (ii) Deflections (iii) Deflection curve and (iv) Slope **(04 Marks)**

b. Using double integration method, determine the slope and deflection for a Cantilever beam subjected to UDL. **(12 Marks)**

Module-5

9 a. Explain the slenderness ratio. **(04 Marks)**

b. Compare the mass of solid shaft with that of hallow shaft of same length, when they are made of same material and are to transmit same power at same speed. The outer diameter of hallow shaft is 1.4 times it's inner diameter. Maximum shear stresses induced in both cases are equal. **(12 Marks)**

OR

10 a. State the assumptions made in pure torsion and derive the relationship between angle of twist and shear stress. **(08 Marks)**

b. Derive an expression for the critical load in a column subjected to compressive load, when both the ends are hinged. **(08 Marks)**

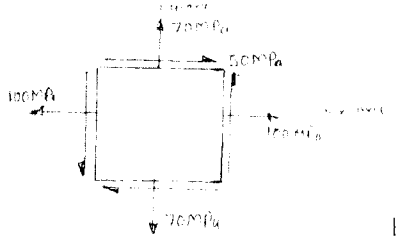

Fig. Q3 (b)