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10ME/AU/PM/TL34

Third Semester B.E. Degree Examination, June/July 2014
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer FIVE full questions, selecting at least TWO questions from each part.***
2. Missing data may be suitably assumed.

PART – A

1 a. Define (i) Stress (ii) Hook's law (iii) Elasticity (iv) Lateral strain. **(04 Marks)**

b. Explain stress-strain relationship showing salient points on the diagram. **(06 Marks)**

c. A stepped bar is subjected to an external loading as shown in Fig.Q1(c). Calculate the change in the length of bar. Take E = 200 GPa for steel, E = 70 GPa for aluminium and E = 100 GPa for copper. **(10 Marks)**

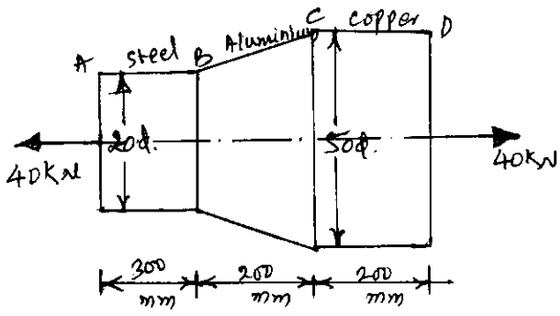

Fig.Q1(c)

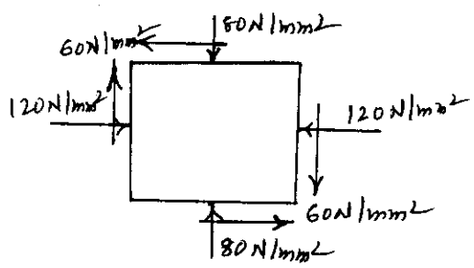

Fig.Q3(c)

2 a. Define (i) Poisson's ratio (ii) Bulk modulus. **(02 Marks)**

b. Derive an expression for establishing the relationship between Young's modulus and modulus of rigidity. **(06 Marks)**

c. A 25 mm diameter steel rod passes concentrically through a bronze tube 400 mm long, 50 mm external diameter and 40 mm internal diameter. The end of the steel rod are threaded and provided with nuts and washers which are adjusted initially so that there is no end play at 20°C. Assuming that there is no change in the thickness of the washers, find the stress produced in the steel and bronze when one of the nuts is tightened by giving it one-tenth of a turn, the pitch of the thread being 2.5 mm. Take E for steel = 200 kN/mm^2 and E for bronze = 100 kN/mm^2. **(12 Marks)**

3 a. Define the principal planes and principal stresses. **(04 Marks)**

b. Explain procedure for constructing Mohr's circle, for an element acted upon by two tensile stresses and shear stresses. **(06 Marks)**

c. The state of stress in two dimensionally stressed body is as shown in Fig.Q3(c). Determine the principal planes, principal stresses, maximum shear stress and their planes. **(10 Marks)**

4 a. Define (i) Strain energy (ii) Work. **(03 Marks)**

b. Prove that volumetric strain in thin cylinder is given by $\frac{Pd}{4tE}(5-4\mu)$, with usual notations. **(07 Marks)**

c. A C.I. pipe has 200 mm internal diameter and 50 mm metal thickness and carries water under a pressure of 5 N/mm^2. Calculate the maximum and minimum intensities of circumferential stress and sketch the distribution of circumferential stress and radial pressure across the section. **(10 Marks)**

PART – B

5 a. Derive the relationship between load, shear force and bending moment. **(05 Marks)**

b. Briefly explain the different types of loads. **(03 Marks)**

c. Draw SFD and BMD for the loading pattern on the beam in Fig.Q5(c). Indicate the point of contraflexure. Also locate the maximum BM with its magnitude. **(12 Marks)**

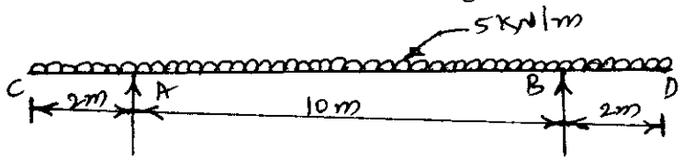

Fig.Q5(c)

6 a. What are the assumptions made in theory of bending? **(04 Marks)**

b. Prove that the maximum shear stress is 1.5 times the average shear stress in a beam of rectangular cross-section. **(06 Marks)**

c. At a given position in a beam of uniform I-section is subjected to a bending moment of 100 kN-m. Plot the variation of bending stress across the section. [Refer Fig.Q6(c)]

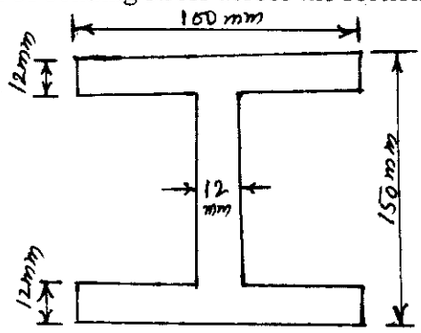

Fig.Q6(c) **(10 Marks)**

7 a. Derive the deflection equation for the beam in the standard form

$$EI\frac{d^2y}{dx^2} = M(x).$$ **(06 Marks)**

b. For the beam loaded as shown in Fig.Q7(b), find the position and magnitude of maximum deflection. Take $I = 4.3\times10^8$ and $E = 200$ kN/mm^2. **(14 Marks)**

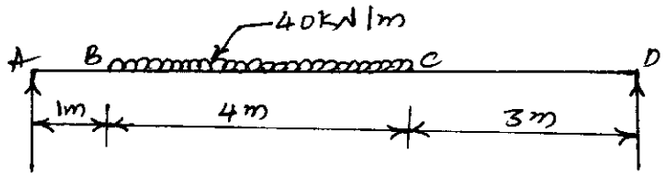

Fig.Q7(b)

8 a. What are the assumptions made in theory of columns? **(03 Marks)**

b. Derive an expression for the critical load in a column subjected to compressive load, when one end is fixed and other end is free. **(07 Marks)**

c. Find the diameter of the shaft required to transmit 60 kW at 150 rpm if the maximum torque is 25% more than the mean torque for a maximum shear stress of 60 MPa. Find also the angle of twist in a length of 4m. Take G = 80 GPa. **(10 Marks)**

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