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06ME34

Third Semester B.E. Degree Examination, June/July 2011
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions selecting at least TWO questions from each part.***

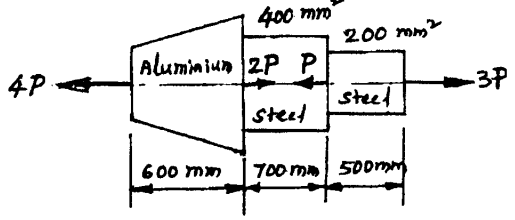
PART – A

1 a. Define the following terms :
i) Hooke's law ; ii) True stress ; iii) Proof stress ; iv) Poisson's ratio. **(04 Marks)**

b. Derive an expression for the extension of a tapering bar whose diameter d_1 at one end tapers linearly to a diameter d_2 at the other end in a length L, under an axial pull P and the elastic modulus of its material is E. **(08 Marks)**

c. A round bar with stepped portion is subjected to the forces as shown in Fig.Q.1(c). Determine the magnitude of force P such that net deformation in the bar does not exceed 1mm. E for steel is 200 GPa and that for aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40 mm and 12.5 mm respectively. **(08 Marks)**

Fig.Q.1(c).



2 a. Explain volumetric strain and obtain the expression for volumetric strain for a circular bar. **(05 Marks)**

b. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(07 Marks)**

c. A steel rod of 20mm diameter passes centrally through a copper tube of 50mm external diameter and 40mm internal diameter. The tube is enclosed at each end by rigid plates of neglible thickness. The nuts are tightened lightly on the projecting parts of the rod. If the temperature of the assembly is raised by 50°C, calculate the stress developed in the copper and steel members. Take E for steel and copper as 200 GPa and 100 GPa respectively. Coefficient of expression for steel and copper are 12×10^{-6} /°c and 18×10^{-6} /°c respectively. **(08 Marks)**

3 a. Derive an expression for the normal stress and shear stress on a plane inclined at 'θ' to the vertical axis in a biaxial stress system with shear. Also prove that the sum of normal stresses on any two mutually perpendicular planes are always constant. **(12 Marks)**

b. At a point in a loaded elastic member, there are normal stresses of 60 MPa and 40 MPa (both tensile) respectively, at right angles to each other with positive shearing stress of 20 MPa. Draw the Mohr's circle diagram and find : i) Principal stresses and their planes ; ii) Maximum shear stress and its plane. **(08 Marks)**

4 a. A thin cylinder of diameter d, thickness t, is subjected to an internal pressure of P. Prove that the change in volume, $dV = \frac{pd}{4tE}(5-4\mu)V$ where, E = Young's modulus, μ = Poisson's ratio and V = Volume of the cylinder. **(08 Marks)**

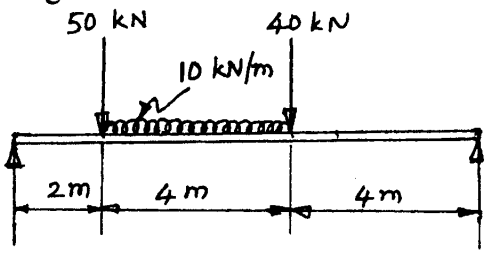
b. A thick cylinder of 500 mm inner diameter is subjected to an internal pressure of 9 MPa. Taking the allowable stress for the material of the cylinder as 40 MPa, determine the wall thickness of the cylinder. Also plot the stress distribution across the wall thickness of the cylinder. **(12 Marks)**

PART – B

5 a. Define shear force and bending moment. **(04 Marks)**

b. Draw the shear force and bending moment diagrams for the beam shown in Fig.Q.5(b). Also calculate the maximum bending moment. **(16 Marks)**

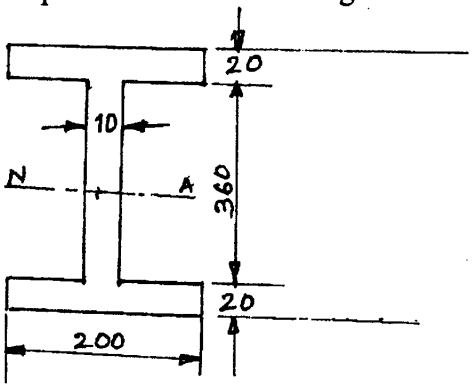
Fig.Q.5(b).



6 a. Derive an expression for the bending stress and radius of curvature for a straight beam subjected to pure bending. Also state the assumptions made in the theory of simple bending. **(12 Marks)**

b. A simply supported beam of I section carries a uniformly distributed load of 40 kN/m run on entire span of beam of length 10m. If I section is having dimensions as shown in Fig.Q.6(b), determine the maximum stress produced due to bending. **(08 Marks)**

Fig.Q.6(b).

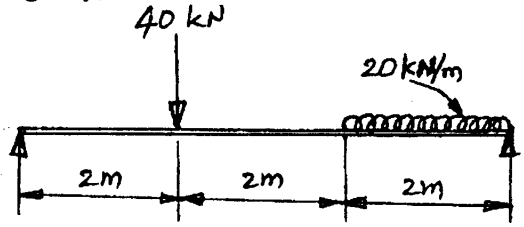


All dimensions are in MM.

7 a. Derive an expression with usual notations for the maximum deflection in a simply supported beam subjected to point load at the mid span. **(08 Marks)**

b. Find the maximum deflection and the maximum slope for the beam loaded as shown in Fig.Q.7(b). Take fluxural rigidity, EI = 15×10^9 kN.mm^2. **(12 Marks)**

Fig.Q.7(b).



8 a. A solid shaft is to transmit 192 kW at 450 rpm. Taking allowable stress for the shaft material as 70 MPa, find the diameter of the solid shaft. What percentage of saving in weight would by obtained, if this shaft were to be replaced by hollow shaft, whose internal diameter is 0.8 times its external diameter? The length of the shaft, power to be transmitted and speed are equal in both cases. **(10 Marks)**

b. Derive an expression for the critical load in a column subjected to compressive load, when both the ends are hinged. Also mention the assumptions made in the derivation. **(10 Marks)**

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