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10CV/EV/CT33

Third Semester B.E. Degree Examination, June/July 2018
Strength of Materials

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define: i) Hooke's law and ii) Modulus of rigidity. **(04 Marks)**

b. Derive an relation between modulus of rigidity, modulus of elasticity and Poisson's ratio. **(06 Marks)**

c. A stepped bar is subjected to an external loading as shown in Fig.Q.1(c). Calculate the change in length of the bar. Take E for steel = 200GPa, E for aluminium = 70GPa and E for copper = 100GPa. **(05 Marks)**

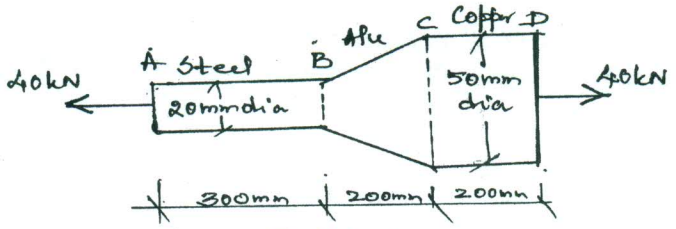

Fig.Q.1(c)

d. A solid alloy bar of 40mm diameter is used as tie. If the permissible tensile stress in material is 32MN/m^2, determine the capacity of the bar. If a hollow steel bar with internal diameter 20mm is used instead of solid bar, determine its external diameter if the permissible stress is 150 MN/m^2. **(05 Marks)**

2 a. Define composite section. **(02 Marks)**

b. A reinforced concrete column of size 0.3m × 0.3m contains 4no. 40mm diameter rods and subjected to a load of 500kN. Determine the stresses in concrete and steel if the modular ratio of steel to concrete is 15. **(08 Marks)**

c. A brass bar of 25mm diameter is enclosed within a steel tube of internal diameter 25mm and external diameter 50mm, the length of the composite bar is 1m and further the ends are rigidity held by means of rigid collars. Find the stresses induced in the materials when the temperature rises by 100°C. Find the final stresses if the composite bar is subjected to a tensile load of 600kN. E for steel = 200GPa; α for steel = 11.6×10^{-6}/°C, E for brass = 100GPa; α for brass = 18.7×10^{-6}/°C. **(10 Marks)**

3 a. Define principal stress and principal planes. **(03 Marks)**

b. Derive the expressions for normal and tangential stress components on any arbitrary plane which is inclined at an 'θ' with horizontal in a two dimensional stress system. **(07 Marks)**

c. At a point in an elastic material the stresses on two perpendicular directions are 80N/mm^2 compressive along X-direction, 60N/mm^2 tensile along Y-direction with a shear stress of 40N/mm^2. Find the normal and tangential stresses on a plane which is making an angle of 40° with the plane on which the tensile stress acts. Also find the magnitude and direction of principal stress. **(10 Marks)**

4 a. Define: i) Bending moment ii) Shear force. **(02 Marks)**

b. Derive the relationship between bending moment, shear force and loading. **(04 Marks)**

c. Draw the shear force and bending moment diagram with salient values for the overhanging beam loaded as shown in Fig.Q.4(c). Also locate the point of contra flexures, of any **(14 Marks)**

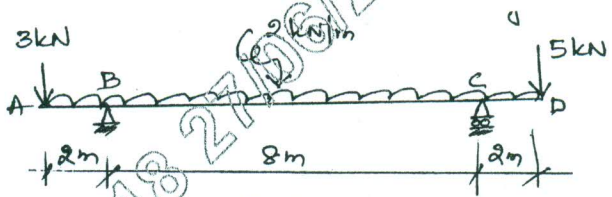

Fig.Q.4(c)

PART – B

5 a. Show that for a rectangular cross section shear stress distribution varies parabolically across the depth. Further show that maximum shear stress is 1.5 times average shear stress. **(06 Marks)**

b. A cantilever beam 3m long is subjected to a udl of 30kN/m over the entire span. The allowable working stress in compression and tension is 150MPa. If the cross section is to be of rectangular, determine the dimensions. Take the depth of the c/s as twice the width. **(14 Marks)**

6 a. Derive $EI\frac{d^2y}{dx^2} = +M$ with usual notations. **(08 Marks)**

b. A simply supported beam 'AB' of span $\frac{'2L'}{3}$ has an overhang BC of length $\frac{'L'}{3}$. The beam supports a uniform load of intensity 'q' per meter run over (Refer Fig.Q.6(b)).

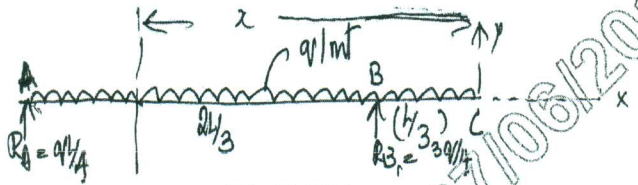

Fig.Q.6(b)

Its entire length. Determine deflection and slope at free end 'C'. **(12 Marks)**

7 a. State the assumptions made in theory of pure torsion. **(03 Marks)**

b. Prove that a hollow shaft is stronger and stiffer than the solid shaft of the same material, length and weight. **(07 Marks)**

c. A hollow steel shaft transmits 200kW of power at 150rpm. The total angle of twist in a length of 5m of the shaft is 3°. Find the inner and outer diameters of the shaft if the permissible shear stress is 60MPa. Take G = 80 GPa. **(10 Marks)**

8 a. Derive the Euler's expression for crippling load for column with one end fixed and other end hinged. **(08 Marks)**

b. Determine the Euler's crippling load for the column of steel of diameter 50mm and length 4m with both ends hinged. Further compare the same with Rankine's formula. Take E = 200GPa, factor of safety = 3; Rankine's constants σ_c = 320 MPa ; a = 1/7500. **(12 Marks)**

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