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10ME/AU34

Third Semester B.E. Degree Examination, June/July 2019
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define the following : (i) Plasticity (ii) Ductility (iii) Brittleness (iv) Malleability (v) Toughness (vi) Hardness. **(06 Marks)**

b. If a tension test bar is found to taper from (D + a) diameter to (D – a) diameter, over a length 'L' . Derive an expression for extension of bar. **(06 Marks)**

c. A stepped bar with three different portions has a fixed support at one of its ends. The stepped bar is subjected to forces as shown in Fig.Q1(c). Determine the stresses and deformations induced in each portion. Also find the net deformation induced in the stepped bar. Take E = 200 GPa. **(08 Marks)**

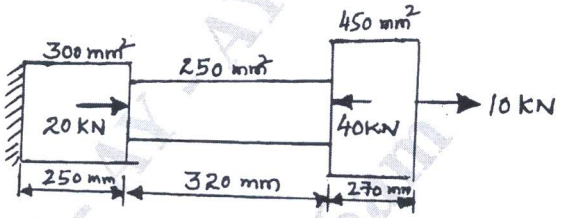

Fig.Q1(c)

2 a. Determine the changes in length, width and thickness of a steel bar which is 4 m long, 30 mm wide and 20 mm thick and is subjected to an axial pull of 30 kN in the direction of length. $E = 2\times10^5$ N/mm^2 and Poisson's ratio = 0.3. Also determine the volumetric strain, change in volume and final volume of the given bar. **(10 Marks)**

b. A composite bar made up of aluminium and steel is held between two supports as shown in Fig.Q2(b). The bars are stress free at a temperature if 42°C. What will be the stresses in the two bars with the temperature drops to 24°C if (a) the supports are unyielding (b) the supports come nearer to each other by 0.1 mm. The cross sectional area of steel bar is 160 mm^2 and that of aluminium bar is 240 mm^2. $E_A = 0.7\times10^5$ N/mm^2, $E_s = 2\times10^5$ N/mm^2, $\alpha_A = 24\times10^{-6}$ per °C and $\alpha_S = 12\times10^{-6}$ per °C **(10 Marks)**

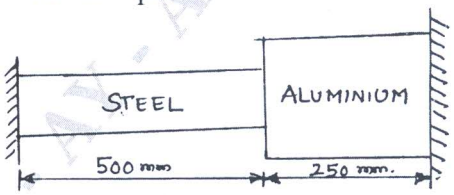

Fig.Q2(b)

3 a. At a point in a strained material, the principal tensile stresses across two perpendicular planes are 80 N/mm^2 and 40 N/mm^2. Determine the normal stress, shear stress and the resultant stress on a plane inclined at 20° with major principal plane. Determine also the angle of obliquity. What will be the intensity of stress which acting alone will produce the same maximum strain if Poisson's ratio = 1/4. **(10 Marks)**

b. The state of stress in a strained material is as shown in Fig.Q3(b). Determine the normal, tangential and resultant stresses on plane DE by Mohr's circle method. Also determine the direction of resultant stress. **(10 Marks)**

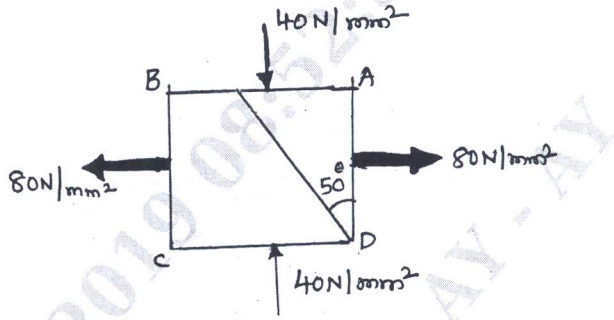

Fig.Q3(b)

4 a. Define the following : (i) Strain energy (ii) Proof Resilience (iii) Modulus of resilience. **(03 Marks)**

b. Show that in a bar, subjected to an axial load, the instantaneous stress due to sudden application of a load is twice the stress caused by the gradual application of load. **(07 Marks)**

c. A thick cylinder of internal diameter 160 mm is subjected to an internal pressure 40 N/mm^2. If the allowable stress in the material is 120 N/mm^2. Find the thickness required. **(10 Marks)**

PART – B

5 a. Define the following : (i) Bending moment (ii) Shear force (iii) Point of contraflexure. **(06 Marks)**

b. A beam 5 m long and simply supported at each end, has a uniformly distributed load of 1000 N/m extending from the left end to a point 2 m away. There is also a clockwise couple of 1500 N-m applied at the centre of the beam. Draw the shear force and bending moment diagrams for the beam and find the maximum ending moment. Neglect the weight of the beam. **(14 Marks)**

6 a. A cast iron beam has an I-section with top flange 80mm×40mm, web 120mm×20mm and bottom flange 160mm×40mm. If tensile stress is not to exceed 30 N/mm^2 and compressive stress 90 N/mm^2, what is the maximum uniformly distributed load the beam can carry over a simply supported span of 6m if the larger flange is in tension? **(12 Marks)**

b. Show that for a rectangular section, the distribution of shearing stress is parabolic. **(08 Marks)**

7 a. Derive a relation for the slope and deflection of a simply supported beam subjected to a uniformly distributed load of W/m length. **(10 Marks)**

b. A simply supported beam of span 10m is carrying a point load of 10 kN at a distance of 6m from the left end. If E = 200 GN/m^2 and I = 1000×10^6 mm^4, determine :
(i) Slope at the left end (ii) Deflection under the load and
(iii) Maximum deflection of the beam **(10 Marks)**

8 a. A hallow circular shaft of 6m length and inner and outer diameter of 75 mm and 100mm is subjected to a torque of 10 kN-m. If G = 80 GPa, determine the maximum shear stress produced and the total angle of twist. **(10 Marks)**

b. Derive a relation for the Euler's crippling load for a column when it has both ends hinged. **(10 Marks)**

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