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10CV/EV/CT33

Third Semester B.E. Degree Examination, Aug./Sept.2020
Strength of Materials

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Draw a neat sketch of stress-strain diagram for mild steel specimen in tension. Mark the salient points on the curve. **(05 Marks)**

b. Derive an expression for the elongation of a member due to self weight. **(05 Marks)**

c. A steel bar is subjected to tensile load of 150 kN as shown in Fig.Q1(c). Find the diameter of the middle portion if the stress in that portion is limited to 140 N/mm^2. Find also the length of the middle portion, if the total elongation of the bar is 0.16mm. Take E = 2×10^5 N/mm^2.

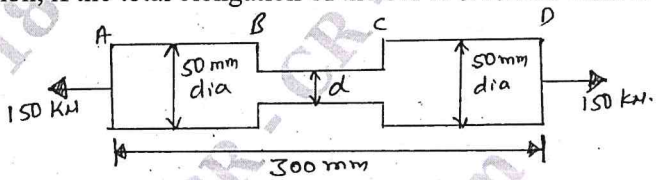

Fig.Q1(c) **(10 Marks)**

2 a. A mild steel rod of 25mm diameter and 400mm long is encased centrally inside a hollow copper tube of external diameter 35mm and inside diameter 30mm. The ends of the rod and the tube are rigidly attached and the compound bar is subjected to an axial pull of 40 kN. Find the stress developed in the rod and the tube. Find also the elongation of the rod. Take $E_s = 2\times10^5$ N/mm^2 and $E_c = 1\times10^5$ N/mm^2. **(10 Marks)**

b. A compound bar is made up of a central steel plate 60mm wide and 10mm thick, to which copper plates 40mm wide and 5mm thick are connected rigidly on each side. The length of the bar at normal temperature is 1m. If the temperature is raised by 80°C, determine the stresses in each metal and also the change in length. Take E_s = 200 GPa, E_c = 100 GPa, $\alpha_s = 12\times10^{-6}$/°C and $\alpha_c = 17\times10^{-6}$/°C. **(10 Marks)**

3 a. Define (i) Principal stresses (ii) Principal planes. **(04 Marks)**

b. Show that principal planes and maximum shearing planes are inclined at 45° with each other. **(04 Marks)**

c. A rectangular block of material is subjected to a tensile stress of 110 N/mm^2 on one plane and a tensile stress of 47 N/mm^2 on a plane at right angles, together with a shear stress of 63 N/mm^2 on the same planes as shown is Fig.Q3(c). Find
(i) The direction of principal planes
(ii) The magnitude of principal stresses
(iii) The magnitude of greatest shear stress

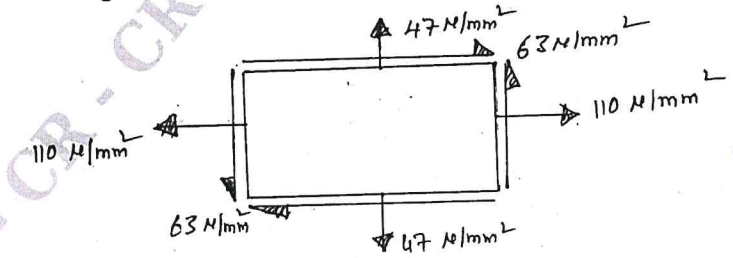

Fig.Q3(c) **(12 Marks)**

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

b. Draw bending moment diagram and shear force diagram for the beam loaded as show in Fig.Q4(b), giving the salient values. Also locate the point of contraflexure, if any.

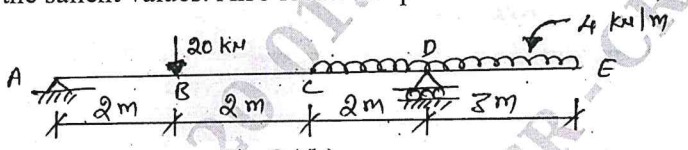

Fig.Q4(b) **(14 Marks)**

PART – B

5 a. Derive the general bending equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ with usual notations. **(08 Marks)**

b. A simply supported timber beam has a span of 6m. It carries a uniformly distributed load of 12 kN/m through out the span and a concentrated load of 9 kN at 2.5m from the left support. If the stress in timber is not to exceed 8 N/mm^2, design a suitable section taking the depth of the beam equal to twice the width of the beam. **(12 Marks)**

6 a. A simply supported beam is of span 'ℓ'. It is subjected to uniformly distributed load of intensity W/unit length over its entire length. Derive an expression for maximum deflection assuming flexural rigidity as EI. **(08 Marks)**

b. A beam uniform section is 10m long and is simply supported at the ends. It carries concentrated loads of 100 kN and 60 kN at distance of 2m and 5m respectively from the left end. Calculate the deflection under each load. Find also the maximum deflection. Take I = 18×10^8 mm^4 and E = 200 GPa. **(12 Marks)**

7 a. Derive the torsional equation for circular member

$\frac{T}{J} = \frac{G\theta}{\ell} = \frac{\tau}{R}$, with usual notations. **(10 Marks)**

b. A solid shaft has to transmit 150 kW of power at 180 rpm. If allowable shear stress is 70 MPa and allowable angle of twist is 1° in a length of 4m, find the suitable diameter of solid circular shaft. Take G = 84 GPa. **(10 Marks)**

8 a. Distinguish between short and long columns. **(04 Marks)**

b. Derive Euler's equation for crippling load of a column whose ends are hinged with standard notations. **(06 Marks)**

c. Determine the ratio of Euler's and Rankine's load for a hollow cast-iron column 150mm outer diameter and 20mm thick. It is 6m long and hinged at both ends. Take E = 140 GPa, σ_c = 550 MPa and α = 1/1600. **(10 Marks)**

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