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10CV/EV/CT33

Third Semester B.E. Degree Examination, June/July 2017

Strength 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. Draw the stress-strain diagram for ductile specimen under axial tensile force. Mark the salient points on the diagram and name them. **(06 Marks)**

b. Find the maximum and minimum stresses produced in the stepped bar shown in Fig.Q1(b) due to an axially applied compressive load of 12 kN.

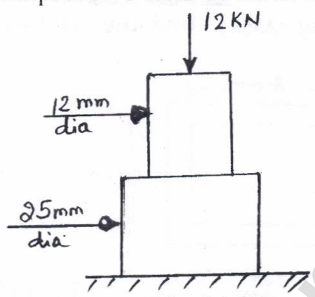

Fig.Q1(b) **(04 Marks)**

c. A 2 mt long steel bar has a uniform diameter of 40 mm for a length of 1 mt from one end. For the next 0.5 mt length the diameter decreases uniformly to "d". For the remaining 0.5 mt length it has a uniform diameter of "d" mm. When a load of 150 kN is applied, the observed extension is 2.40 mm. Determine the diameter "d". Take modulus of elasticity for steel as 200 GPa. [Refer Fig.Q1(c)]

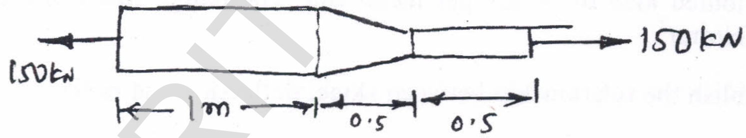

Fig.Q1(c) **(10 Marks)**

2 a. A steel bar is placed between two copper bars each having the same area and length as the steel bar at 15°C. At this stage they are rigidly connected together at both the ends. When the temperature is raised to 315°C, the length of the bars increases by 1.50 mm. Determine the original length and the final stresses in the bars. Take $E_{st} = 2.1 \times 10^5$ N/mm^2, $E_{cu} = 1 \times 10^5$ N/mm^2, $\alpha_{st} = 12 \times 10^{-6}$/°C and $\alpha_{cu} = 17 \times 10^{-6}$/°C. **(10 Marks)**

b. A concrete column 300 mm × 300 mm in cross section has 8 bars of 20 mm diameter. The column is subjected to an axial compressive load of 500 kN. Determine the stresses in each material. Also calculate the load shared by the two materials. Take the modular ratio between steel and concrete as 20. **(10 Marks)**

3 a. At a certain point in a strained material the intensities of normal stresses on two planes at right angles to each other are 20 N/mm^2 and 10 N/mm^2 both tensile. They are accompanied by shear stress of 10 N/mm^2. Find the principal planes and principal stresses. Also find the maximum shear stress. **(10 Marks)**

b. The principal stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major principal stress. Also determine the maximum intensity of shear stress in the material at the point. **(10 Marks)**

4 a. Establish a relationship between bending moment, shear force and loading for a laterally loaded member. **(06 Marks)**

b. Draw shear force and bending moment diagram for the beam loaded as shown in Fig.Q4(b). Also locate the points of contra flexures.

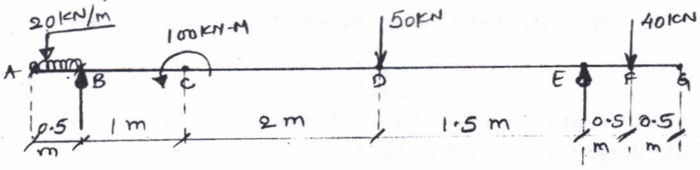

Fig.Q4(b) **(14 Marks)**

PART – B

5 a. For the section shown in Fig.Q5(a), find the (i) Position of the neutral axis, (ii) Section modulus.

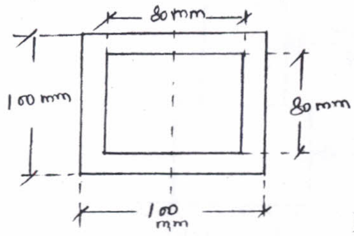

Fig.Q5(a) **(06 Marks)**

b. A steel beam of hollow section of outer side 100 mm and inner side 80 mm is used on a span of 4 mt. Find the uniformly distributed load the beam can carry if the bending stress is not to exceed 120 N/mm^2. The beam is taken as simply supported. [Refer Fig.Q5(a)] **(06 Marks)**

c. The moment of inertia of a beam section 500 mm deep is 69.49×10^7 mm^4. Find the longest span over which a beam of this section, when simply supported, could carry a uniformly distributed load of 50 kN per meter run. The flange stress in the material is not to exceed 110 N/mm^2. **(08 Marks)**

6 a. Establish the relationship between slope, deflection and radius of curvature for a beam. **(06 Marks)**

b. A horizontal girder of steel having uniform section is 14 metres long and is simply supported at its ends. It carries concentrated loads of 120 kN and 80 kN at two points 3m and 4.5m from the two ends respectively. I for the section of the girder is 16×10^8 mm^4 and $E = 210 \times 10^3$ N/mm^2. Calculate the deflections of the girder at points under the two loads. Find also the maximum deflection. **(14 Marks)**

7 a. State the assumptions in the theory of pure torsion. **(05 Marks)**

b. Define: i) Polar section modulus, ii) Torsional rigidity. **(05 Marks)**

c. The external and internal diameters of a hollow shaft are 160 mm and 120 mm respectively. If the shaft is subjected to a torque of 20 kN-m, find:

i) Shear stress at the outer surface of the shaft
ii) Shear stress at the inner surface of the shaft
iii) Angle of hoist per metre length of the shaft.

Take $C = 7.5 \times 10^4$ N/mm^2. **(10 Marks)**

8 a. Derive an expression for the Euler's crippling load for slender column having both ends of the column hinged. **(06 Marks)**

b. Find Euler's critical load for a hollow cylindrical cast iron column 200 mm external diameter and 25 mm thick, if it is 6 meters long and hinged at both ends. Take $E = 8 \times 10^4$ N/mm^2. Compare Euler's critical load with the Rankine's critical load taking $f_c = 550$ N/mm^2 and $a = 1/1600$. For what length of the column would the critical loads by Euler's and Rankine's formula will be equal? **(14 Marks)**

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