CBCS SCHEME

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21CV33

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Strength of Materials

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Sketch a typical stress-strain curve for the ductile material and explain briefly the salient features of the curve. **(05 Marks)**

b. Derive an expression for the deformation of tapered circular bar subjected to axial force. **(05 Marks)**

c. A steel tube of 30mm external diameter and 20mm internal diameter encloses a copper rod of 15mm diameter to which it is rigidly jointed at each end. If at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C. Take E for steel and copper as 2.1×10^5 N/mm^2 and 1×10^5 N/mm^2 respectively. The value of coefficient of linear expansion for steel and copper is given as 11×10^{-6} per °C and 18×10^{-6} per °C respectively. **(10 Marks)**

OR

2 a. Define the three elastic constants and derive the relationship between them. **(10 Marks)**

b. For the state of stress shown in Fig.Q2(b), determine the principal stresses and locate principal planes. Also obtain maximum tangential stress and locate corresponding planes.

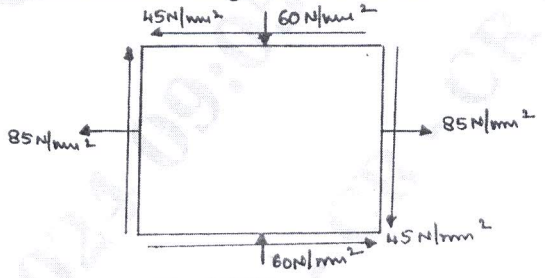

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Define shear force, bending moment and point of contraflexure. **(06 Marks)**

b. Draw SFD and BMD for a simply supported beam shown in Fig.Q3(b). Also find the maximum bending moment and its location.

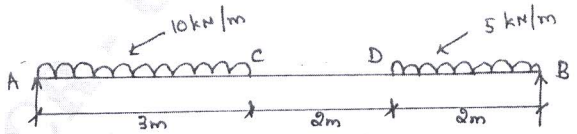

Fig.Q3(b) **(14 Marks)**

OR

4 a. Establish the relationship between shear force, bending moment and load intensity. **(06 Marks)**

b. For a cantilever beam subjected to a UDL of intensity w/unit length throughout, plot the SFD and BMD. **(06 Marks)**

c. Draw SFD and BMD for the beam shown in Fig.Q4(c) showing the salient points.

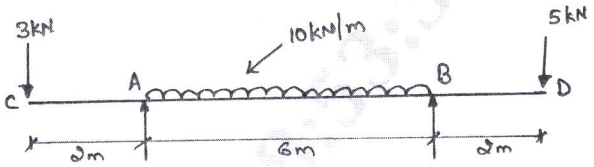

Fig.Q4(c) **(08 Marks)**

Module-3

5 a. Derive the bending equation with usual notations. **(10 Marks)**

b. A cast iron beam is of T-section as shown in Fig.Q5(b). The beam is simply supported on a span of 8m. The beam carries a UDL of 1.5 kN/m on the entire span. Determine the maximum tensile and compressive stress.

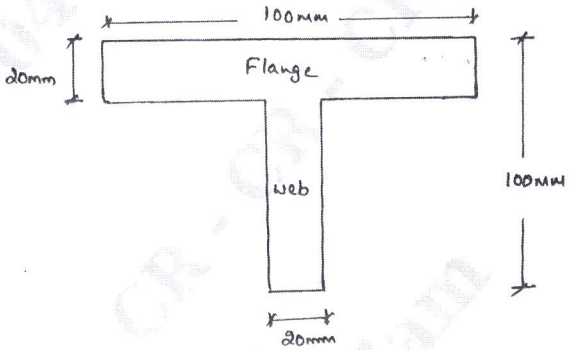

Fig.Q5(b) **(10 Marks)**

OR

6 a. Define Neutral axis, Section modulus, shear stress and bending stress. **(04 Marks)**

b. Write the assumptions made in simple bending theory. **(04 Marks)**

c. A hollow box section 120mm wide and 200mm deep is having a uniform wall thickness of 10mm. Obtain the shear stress variation across the cross section. Shear force at the section is 120 kN. Refer Fig.Q6(c).

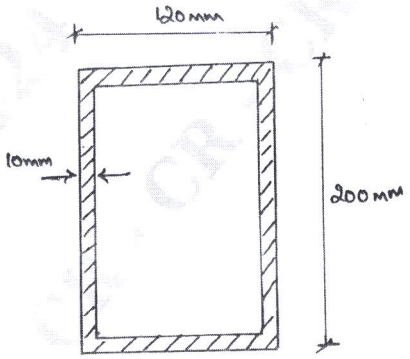

Fig.Q6(c) **(12 Marks)**

Module-4

7 a. Derive the torsion equation for a circular shaft $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$ with usual notations. **(10 Marks)**

b. Find the diameter of the shaft required to transmit 60 kW at 150 rpm. If the maximum torque exceeds 25% of the mean torque for a maximum permissible shear stress of 60 MN/mm^2. Also find the angle of twist for a length of 4m. Take G = 80 GPa. **(10 Marks)**

OR

8 a. Derive Lame's equation for radial and hoop stresses for thick cylinder subjected to internal and external fluid pressures. **(10 Marks)**

b. A thin cylindrical shell 1m in diameter and 3m long has a metal wall of thickness 10mm. It is subjected to an internal fluid pressure of 3 MPa. Find the circumferential and longitudinal stresses in the wall. Determine the changes in length, diameter and volume of the cylinder. Also find the maximum shear stress in the cylinder. Take E = 210 GPa and $\mu = 0.3$. **(10 Marks)**

Module-5

9 a. Derive the Euler's equation for buckling load on a column with both ends hinged using usual notations. **(10 Marks)**

b. Derive an expression for slope and deflection in a simply supported beam subjected to UDL throughout. Calculate maximum slope and deflection. **(10 Marks)**

OR

10 a. Define :
i) Buckling load ii) Effective length iii) Slenderness ratio. **(06 Marks)**

b. Differentiate between short and long column. **(04 Marks)**

c. Determine the deflection at point B and rotation at A in the beam shown in Fig.Q10(c). Take E = 200 kN/mm^2 and I = 200×10^6 mm^4.

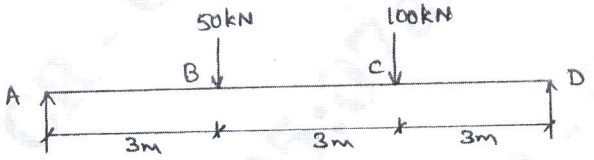

Fig.Q10(c) **(10 Marks)**

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