Sub Code: R2021031 **R20** **Set No. 1**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY- GURAJADA VIZIANAGARAM
II B. Tech I Semester Supplementary Examinations, November – 2024
MECHANICS OF SOLIDS
(ME, AME)

Time: 3 hours **Max. Marks: 70**

Answer any FIVE Questions
ONE Question from Each unit
All Questions Carry Equal Marks
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1 a) State Hooke's law. Explain stress-strain curve for the ductile materials with neat sketch. [7]

b) A steel bar of cross-section 500 mm^2 is acted upon by forces shown in Fig.1. Determine the total elongation of the bar. Take E=200 GPa. [7]

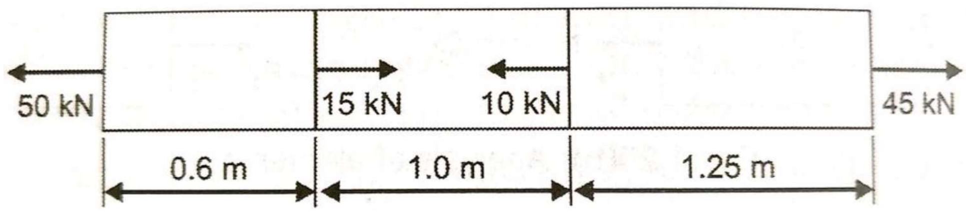

Fig.1

(OR)

2 a) The tensile stresses at a point across two mutually perpendicular planes are 100 MPa (σ_x) and 60 MPa (σ_y). Construct the Mohr's circle and determine the normal, tangential (shear) stresses on a plane inclined at 30° to major principal stress plane. [7]

b) A steel rod of 30 mm diameter and 5 m long is connected to two grips and the rod is maintained at a temperature of 95°C. Determine the stress and pull exerted when the temperature falls to 30°C, if [7]
(i) the ends do not yield, and
(ii) the ends yield by 0.12 cm.
Take $E = 2 \times 10^5$ MN/m^2 and $\alpha = 12 \times 10^{-6}/°C$.

3 a) A simply supported beam of length 10 m, carries the uniformly distributed load and two-point loads as shown in Fig. 2 Draw the S.F. and B.M. diagram for the beam. Also calculate the maximum bending moment. [7]

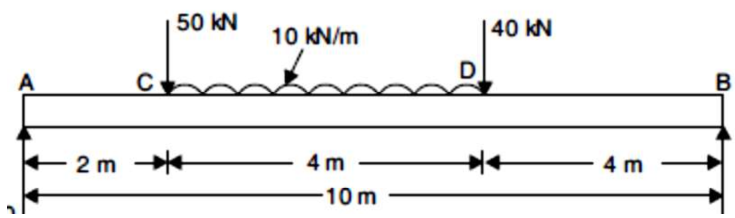

Fig. 2

b) Draw the SFD (shear force diagram) and BMD (bending moment diagram) for the cantilever with uniformly distributed load (UDL) of intensity "w" per meter length acting over total length of the beam L. [7]

(OR)

4 a) Draw the SFD (shear force diagram) and BMD (bending moment diagram) for overhanging beam shown in Fig. 3. [7]

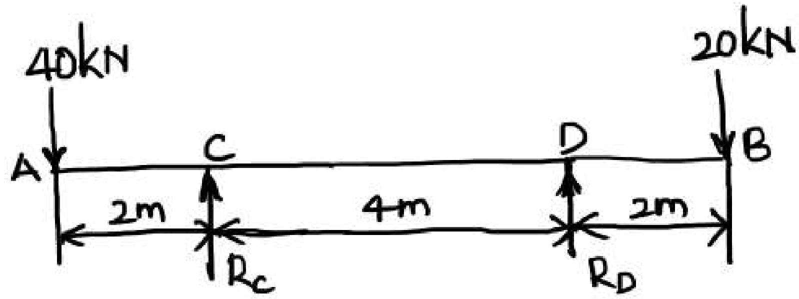

Fig. 3

b) Draw the SFD (shear force diagram) and BMD (bending moment diagram) for the cantilever beam shown in Fig. 4. [7]

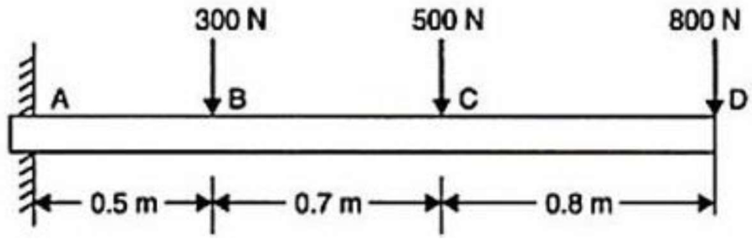

Fig. 4

5 a) Prove the relations $\frac{M}{I}=\frac{E}{R}=\frac{\sigma}{y}$ with usual notations. [7]

b) A rectangular beam 150 mm wide and 250 mm deep subjected to a maximum shear force of 30 kN. Determine a) Average shear stress and b) Maximum shear stress. [7]

(OR)

6 a) A T-shaped cross-section of a beam has a top flange of 100 mm × 20 mm and web 130 mm ×20 mm. If it is subjected to a vertical shear force of 100 kN. Find the shear stress at the neutral axis. Moment of inertia of the section about the horizontal neutral axis is 10.08×10^6 mm^4. [7]

b) A cast iron beam is of T-section as shown in Fig. 5. The beam is simply supported on a span of 8 m. The beam carries a uniformly distributed load of 1.5 kN/m length on the entire span. Determine the maximum tensile and maximum compressive stresses. [7]

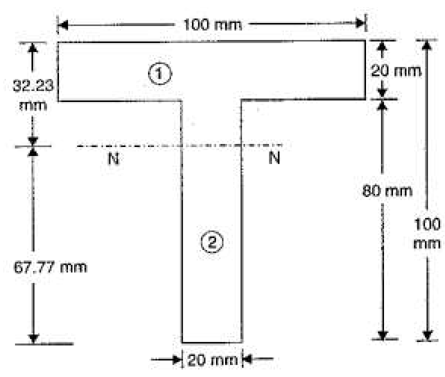

Fig. 5

7 a) A horizontal beam is freely supported at its ends 8 m apart and carries a UDL of 15 kN/m over the entire span as shown in Fig.6. Find the maximum deflection and location of the maximum deflection using double integration method. Take I=2×10^9 mm^4 and E=2×10^5 N/mm^2. [7]

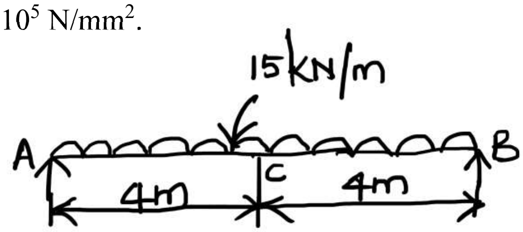

Fig.6

b) A solid steel shaft transmits 100 kW at 150 rpm. Determine suitable diameter of the shaft, if the shear stress in the shaft is not to exceed 60 MPa. Also, find the maximum angle of twist, of the shaft length is 4 m. Take modulus of rigidity as 80GPa. [7]

(OR)

8 a) A cantilever projecting 3 m from a wall carries a UDL of 12 kN/m for a length of 2 m from the fixed end and a point load of 1.5 kN at the free end as shown in Fig.7. Find the deflection at the free end using moment area method. Take $I=1\times10^{8}$ mm^4 and E=200 GPa. [7]

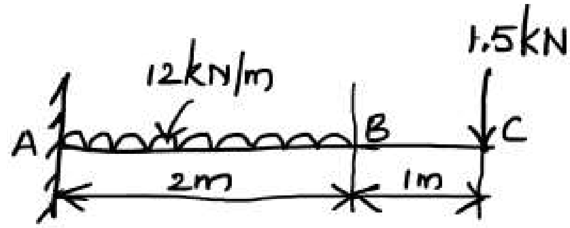

Fig. 7

b) A stepped shaft of same material with two different diameters is held against rotation as shown in Fig.8. If the allowable shear stress in the shaft is 43 MPa, what is the maximum torque that can be applied? Take G = 84 GPa. [7]

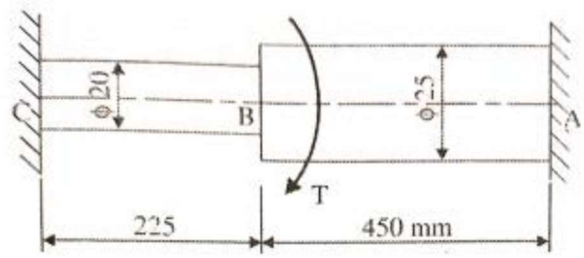

Fig. 8

9 a) Explain briefly about compound cylinder. [7]

b) A thin cylinder, 50 mm internal diameter and 1 mm wall thickness is closed at its ends and subjected to a torque of 50 kNm. The axis of which coincides with the axis of the cylinder. The internal pressure is 1 N/mm^2. Calculate the Principal stresses and maximum shear stress for a point on the outside surface of the cylinder. [7]

(OR)

10 a) Differentiate between a thin cylinder and a thick cylinder. Find an expression for the radial stress and hoop stress at a point in case of a thick cylinder. [7]

b) A pipe of 200 mm internal diameter and 100 mm thickness contains a fluid at a pressure of 6 N/mm^2. Find the maximum and minimum hoop stress across the section. [7]

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