

SE - Sem III (C - scheme) / Nov 2025 / 14-11-25
Branch: Mech

QP Code: ~~954~~
95465

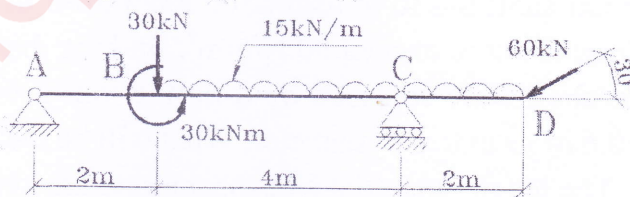
Duration: 3 Hour

Max. Marks: 80

- Question-1 is compulsory. Answer any three from remaining questions.
- Assume any suitable data wherever required, but justify the same. Assumptions made should be clearly stated. Illustrate answers with sketches wherever required.
- Figures to the right indicate marks
- Students should sit for at least 30 minutes

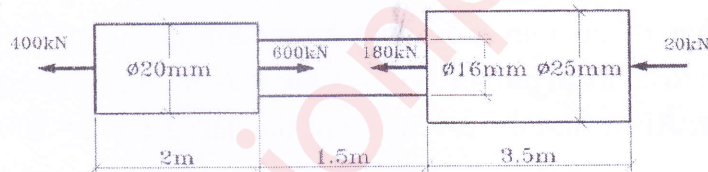
I Answer any four of the following:

- A round bar of 50 mm diameter and 2.5 m long of a certain material has Young's modulus of $1.1 \times 10^5 \text{ N/mm}^2$ and modulus of rigidity of $4.5 \times 10^4 \text{ N/mm}^2$. Find the bulk modulus of the bar **05**
 - Derive the relationship between the rate of loading, shear force and bending moment in a beam. **05**
 - Prove the relationship between maximum and average shear stress for a circular section with neat sketches **05**
 - A steel bar of 50 mm x 50 mm in section and 3 m in length is subjected to an axial pull of 140 N. Calculate the strain energy stored in the bar. Also, find the extension of the bar. Take $E = 200 \text{ GPa}$ **05**
 - A simply supported beam of 6 m span carries a UDL of 8 kN/m for the entire span. If EI is constant, find the deflection at the center. **05**
 - Find the maximum power that can be transmitted through a 50 mm diameter shaft at 150 rpm, if the maximum permissible shear stress in the shaft is 80 N/mm^2 . **05**
- IIa. For the beam shown below, draw A.F, S.F. and B.M. diagrams and mark all important points. **10**



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- IIb. An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 20 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes and directions of principal stresses and also the greatest shear stress. Verify the values analytically. **10**
- IIIa. A simply supported beam, with a span of 1.3 m and a rectangular cross section of 150 mm wide and 250 mm deep, carries a concentrated load of W at the centre. If the allowable stresses are 7 N/mm^2 for bending and 1 N/mm^2 for shear, what is the value of the safe load W ? Also draw bending stress and shear stress distribution diagrams **12**
- IIIb. A simply supported beam of span 4 m with EI constant throughout the span is subjected to a load of 24 kN at 3 m from left end support. Find total strain energy of the beam in bending. **08**
- IVa. Find the total change in length of the following member for the given loading. **10**
 Take $E = 2 \times 10^5 \text{ N/mm}^2$



- IVb. A cylindrical vessel of 1.5 m internal diameter and 4 m long is closed at the ends by rigid plates. It is subjected to an internal pressure of 3 N/mm^2 . If maximum circumferential stress is not to exceed 150 N/mm^2 , find the thickness of the shell. Find change in diameter, length and volume of the shell. Assume $E = 2 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio = 0.25 . **10**
- Va. A solid circular shaft has to transmit 300 kW power at 100 rpm . If the shear stress is not to exceed 80 N/mm^2 , find the diameter of the shaft. If this shaft were replaced by a hollow one whose internal diameter is 0.6 of its external diameter, What will be the % of saving of material. The length, material and shear stress are kept same. **10**

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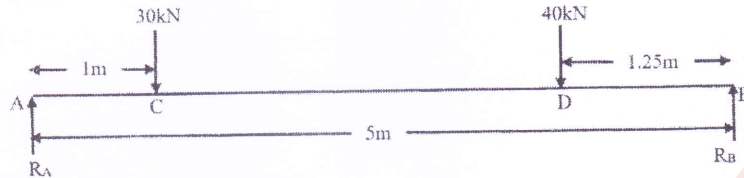
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Vb. Figure shows a simply supported beam of span 5 m carrying two point loads. Find 10

- (1) the deflection at the section of the point loads.
- (ii) Slope at A,
- (iii) maximum deflection of the beam.

Take $E=200 \text{ GPa}$, $I=7332.9 \text{ cm}^4$.



Vla. A hollow cast iron column of 200 mm external diameter, 150 mm internal diameter and 8 m long has both ends fixed. It is subjected to axial compressive load. Taking factor of safety as 6, $\sigma_c = 560 \text{ N/mm}^2$, $\alpha = \frac{1}{1600}$, determine the safe Rankine load. 10

Vib. A 30 m long steel rail is at a temperature of 24°C . 10

- a) Estimate the elongation when temperature increases to 44°C .
- b) Calculate the thermal stress in the rail under the following two conditions:
 - i. No expansion gap provided.
 - ii. 4.5 mm gap is provided for expansion.
- c) If the stress developed is 60 MPa, what is the gap left between the rails?

Take $E = 200 \text{ GPa}$, $\alpha = 12 \times 10^{-6}/^\circ\text{C}$