SE/Sem-III/NEP/Dec-25/Mechanical
Q.P. Code:-98452

Time: 2 Hours

Marks: 60

19/12/25

NB: 1. The question paper consists of 6 questions each of 15 marks.
2. Question number 1 is **compulsory**.
3. Attempt **any THREE** questions from Q2 to Q6.
4. Figures to the right indicate full marks.
5. Assume suitable data wherever necessary and state it clearly.

Q1 Attempt any ***FIVE*** of the following

a) Write a short note on a stress-strain diagram for mild steel. 3M

b) Prove that the ratio of strain energy stored in a bar subjected to a gradually applied load to the strain energy stored in the same bar subjected to a suddenly applied load is 0.5. 3M

c) List the assumptions made in Theory of Bending. 3M

d) What stresses are developed in a thin cylindrical shell subjected to internal pressure? Which of these stresses is higher? Justify your answer. 3M

e) Two cantilever beams of equal length, L, and the same material, carry the same concentrated load W at the free end. Beam A has a square cross-section of side D, whereas beam B has circular cross section with diameter, D. Find the ratio of the maximum deflection of circular beam to the square beam. 3M

f) The Euler critical load for a column hinged at both ends is 200 kN. What will be the Euler critical load for the same column if both ends are fixed? 3M

Q2 a) Find the area moment of inertia for the cross-section shown in figure 1. 05M

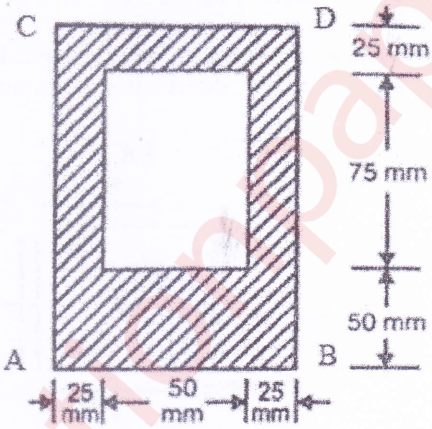

Figure 1

b) An overhanging beam, CADBE, with supports at point A and B is loaded as shown in figure 2. Compute slope at A and deflection at the midpoint D. Take EI=Constant. 10M

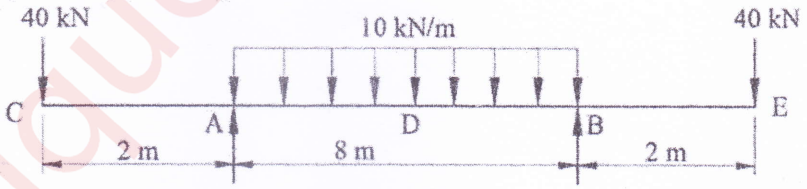

Figure 2

Q3 a) A steel rod 2.5 m long and 30 mm in diameter is rigidly fixed between two unyielding supports. The temperature of the rod rises by 60°C. Considering, E = 200 GPa and coefficient of thermal expansion α =12 × 10^-6 per degree centigrade, determine the thermal stress developed in the rod and the magnitude of the reactive force exerted on each support. 05M

b) Draw shear force and bending moment diagrams for the beam shown in figure 3. 10M

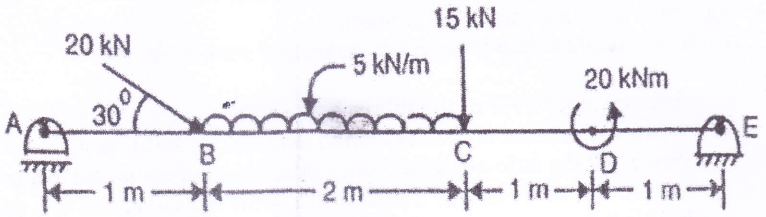

Figure 3

Q4 a) A steel bar of length 1000 mm, 25 mm breadth and 10 mm depth carries an axial tensile load of 10 kN. Find the change in its length, breadth and depth due to this load. Also find the change in the volume of the bar. Take Young's modulus as 200 GPa and Poisson's ratio as 0.3. 05M

b) Determine the diameter of the shaft to transmit 1 MW power at 220 rpm and the working conditions to be satisfied are: 10M
(i) The shaft must not twist more than 1 degree on length of 12 times the diameter and
(ii) Shear stress must not exceed 60 N/mm^2.
Take the modulus of rigidity for the material as 84 GPa.

Q5 a) A plane element is subjected to stress as shown in figure 4. Determine the principal stresses with their directions and the maximum shear stress with the planes on which it acts. 05M

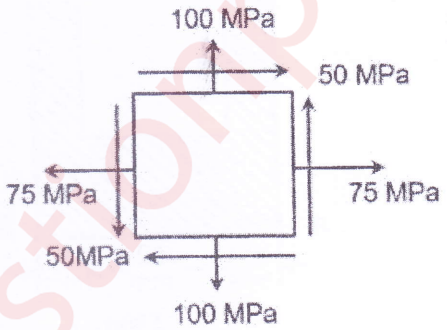

Figure 4

B/sem-III/ NEP/DEC-25 /Mechanical Q.P. Code :98452 19/12/25 (3/3)

b) The cross section of a simply supported beam is 'I', 100 mm wide x 240 mm deep with 20 mm thickness throughout. It carries a point load of 120 kN as shown in figure 5. Calculate the shear stresses at prominent points of the section and draw the shear stress distribution diagram. 10M

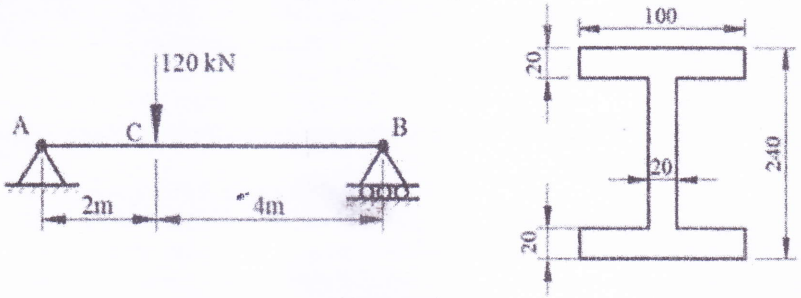

Figure 5

Q6 a) Two shafts of the same material and length are required to transmit the same power at the same speed. One is solid, and the other is hollow with an internal diameter equal to 0.6 times the external diameter. Find the ratio of weight of hollow and solid shaft. 05M

b) A hollow cast iron column, 4.5 m long, has an outside diameter of 200 mm and is fixed at both ends. Determine the safe load the column can carry using Rankine's formula. Take metal thickness of 20 mm, $\sigma c = 550$ MPa, $1/\alpha = 1600$, $E = 90$ GPa and factor of safety of 4. 10M

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