3 Hours *Total Marks: 80*

- *Question-1 is compulsory.*
- *Answer any three from remaining five questions.*
- *Assume any suitable data, wherever required, but justify the same. Assumptions made should be clearly stated.*
- *Illustrate the answers with sketches, wherever required.*

1 *Answer any four of the following:*

a. Draw the shear force diagram and bending moment diagram and also calculate magnitude of shear force and bending moment at all salient points, for a simply supported beam of span 6m subjected to a uniformly distributed load (UDL) of 3 kN/m acting over its entire length. ***(05)***

b. A circular steel bar is subjected to various forces shown in fig.1 Determine the total elongation of bar AD. (E = 202 GPa) ***(05)***

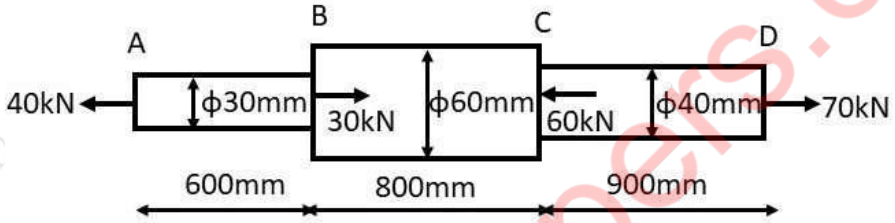


Fig.1

c. What is equivalent length of column? Give the ratio of equivalent length and actual length of column with various end condition. ***(05)***

d. What is the length of 5 mm diameter aluminium wire so that it can be twisted through one complete revolution without exceeding shear stress of 42 MN/m^2, Modulus of rigidity G = 27 GN/m^2. ***(05)***

e. A steel bar of 400m long, 200mm wide and 50mm thick subjected to gradually tensile load of 1200kN. Calculate i) Proof resilience ii) Modulus of resilience. E= 200 kN/mm^2 ***(05)***

f. A cantilever beam 4 m span carrying a uniformly distributed load of 5 kN/m and permissible bending stress in the material of beam is 15 N/mm^2. Design the section of beam if depth to width ratio is 2. ***(05)***

2 a) Determine slope and deflection at point A and B for beam shown in fig.2 Take EI constant. ***(10)***

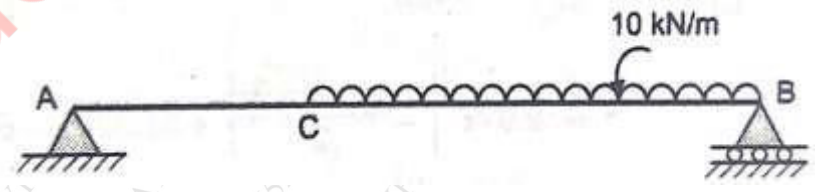


Fig.2

2 b) Find Euler's crippling load for a hollow cylindrical column of 200 mm external diameter and 25 mm thick. Both ends of the column are hinged and the length of the column is 6 m. Take E = 8 $\times 10^4$ N/mm^2. Compare Euler's crippling load with Rankine's crippling load for the same column. Take f_c = 550 MPa and α = 1/1600. For what length of the column the critical loads by Euler's and Rankine's formula will be equal to each other. ***(10)***

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3 a) Two mutually perpendicular plane of an element subjected to σ_x = 80 MPa (tensile) and σ_y = 30MPa (compressive) and shear stress = 40 MPa. Locate the principal planes and determine the principal stresses, maximum shear stresses using Mohr's circle verify answers with analytical method. ***(10)***

3 b) Draw shear force and bending moment diagram for beam shown in fig. 3 ***(10)***

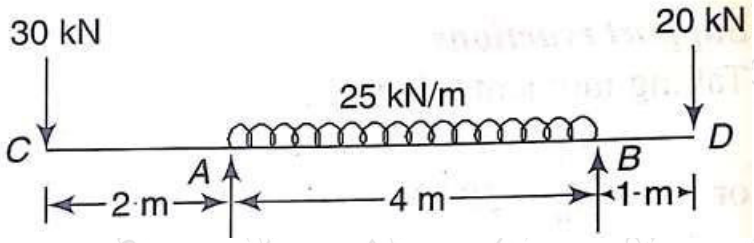


Fig.3

4 a) A composite bar made up of Aluminium and Steel which is held between two supports shown in fig. 4. The bars are stress free at a temperature of 38 °C. Determine the stresses in two bars when temperature reaches to 21°C if i) The supports are unyielding and ii) The supports come nearer to each other by 0.1 mm. Take Es = 210 GPa E_{Al} = 74 GPa, $\alpha_s = 11.7\times10^{-6}$/°C, $\alpha_{Al} = 23.4\times10^{-6}$/°C. ***(10)***

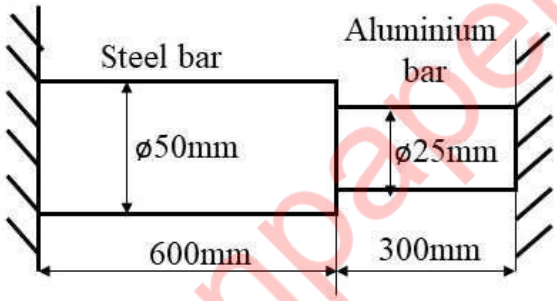


Fig.4

4 b) A cylindrical shell 800 mm in diameter and 3 m long is having 10 mm metal thickness. If the shell is subjected to an internal pressure of 2.5 N/mm², determine: change in diameter, change in length and change in volume. Assume the E= 200 kN/mm² and μ=0.25 respectively. ***(10)***

5 a) A 6 m long simply supported beam AB, loaded with a uniformly distributed load of 50 kN/m over the entire span with cross-section of beam is a T section (Flange width: 100 mm, Flange thickness: 20 mm, Web depth: 80 mm and Web thickness: 20 mm). Find the bending stresses in compression and tension also draw the bending stress distribution diagram. ***(10)***

5 b) Determine the instantaneous stress and deformation of a rod of length 1.2 m and diameter 8 mm, if a mass of 90 kg falls through a height of 15 cm and strikes the bottom of the rod. The rod is freely suspended and fixed at the top. Take E = 210 GPa. ***(10)***

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6 a) A hollow shaft of diameter ratio 3/8 (di to do) is to transmit 375 kW power at 100 rpm, the maximum torque being 20% greater than the mean, shear stress not to exceed 60 N/mm^2 and twist in length of 4 m not to exceed 2°. Calculate its safe external and internal diameters. Take G= 0.85×10^5 N/mm^2 ***(10)***

6 b) Figure 5, shows a C section subjected to a shear force of 18 kN intensity. Draw the shear stress distribution diagram across the section and obtain the shear stress values at all the salient points including the neutral axis. ***(10)***

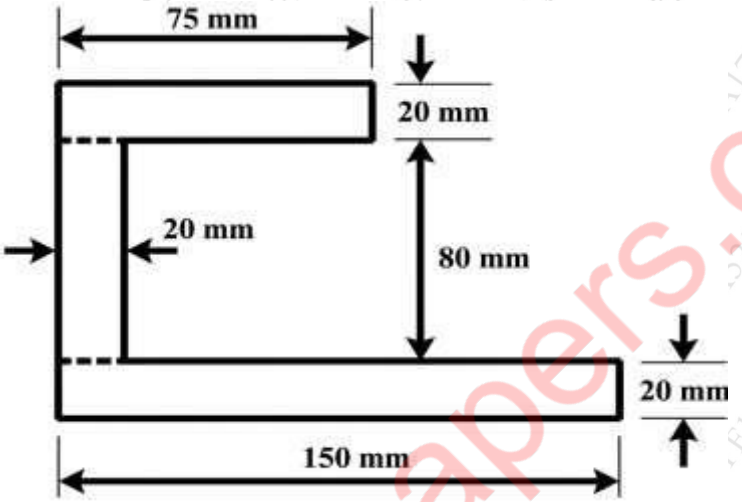


Fig.5

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