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. A material has Young's modulus of 2×10^5 N/mm^2 Poisson's ratio of 0.32, determine rigidity and Bulk modulus of the material. *(05)*

b. A rectangular beam 300mm deep is simply supported over a span 4m. What uniformly distributed load the beam can carry if the bending stress is not to exceed 120MPa. Take I $=8\times10^6$ mm^4. *(05)*

c. A water main 800mm diameter contains water at a pressure head of 100m. If the weight of water 10kN/m^3, find the thickness of metal required for the water main if permissible stress in metal is 20N/mm^2. *(05)*

d. State the assumptions made in the analysis of struts and columns by Euler's buckling theory. *(05)*

e. Draw shear stress distribution for I section, T section and rectangular section. *(05)*

f. Establish the relationship between shear force, bending moment and rate of loading. *(05)*

2 a) 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)*

2 b) A composite bar is made of Steel and Aluminium is held between two supports as shown in fig 1. The bars are stress free at temp 38°C. What will be the stress in the two bars when temperature decreased to 21°C, the supports come near to each other by 0.1mm. Take Es =210 GN/m^2, E_{Al} =100 GN/m^2, $\alpha_s = 11.7\times10^{-6}$/°C and $\alpha_{Al} = 23.4\times10^{-6}$/°C *(10)*

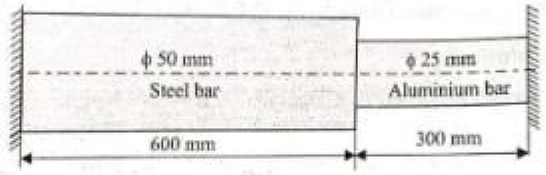

Fig.1

3 a) A T section (Flange =200mm×10mm, web=10mm×240mm) is used as struts which is 6m long, one end is hinged and other end is fixed. Determine the buckling load using Euler's formula. E=200×10^3 N/mm^2 *(10)*

3 b) Figure 2, 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)*

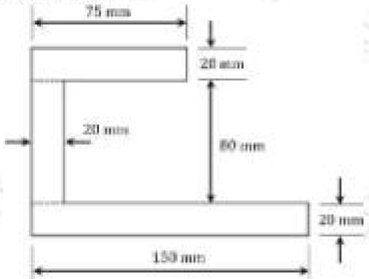

Fig.2

4 a) A cylindrical vessel of 1.5m diameter and 4m long is closed at ends by rigid plate. It is subjected to an internal pressure of $3N/mm^2$. If the maximum circumferential stress is not to exceed $150N/mm^2$, find the thickness of shell. Also change in diameter length and volume of the shell. Take $E=2\times10^5$ N/mm^2, $1/m=0.25$ *(10)*

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

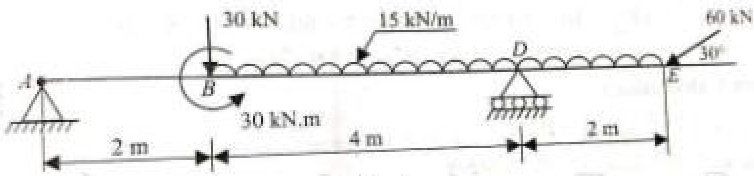

Fig.3

5 a) The beam has a T-shaped cross-section with a top flange measuring 90 mm × 20 mm and a web measuring 20 mm × 90 mm. The beam is a simply supported on a span of 8m and subjected to 1200N/m over entire span. Determine bending stresses in compression and tension, also sketch the bending stress distribution. *(10)*

5 b) Find the slope at A and deflection at a point C for the beam loaded shown in fig.4. Assume moment of inertia and modulus of elasticity as $I=20\times10^6$ mm^4 and $E=200$ kN/mm^2. *(10)*

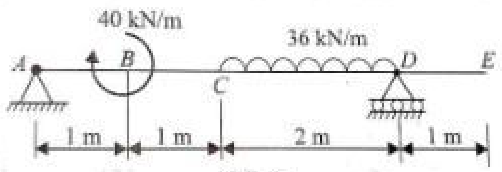

Fig. 4

6 a) Two mutually perpendicular plane of an element subjected to $\sigma_x=100MPa$ (tensile) and $\sigma_y=40MPa$ (compressive) and shear stress =30MPa. Locate the principal planes and determine the principal stresses, maximum shear stresses using Mohr's circle verify answers with analytical method. *(10)*

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