Final Assessment Test (FAT) – November/December 2022

Programme	**B.Tech.**	Semester	**Fall Semester 2022-23**
Course Title	**MECHANICS OF SOLIDS**	Course Code	**BMEE202L**
Faculty Name	**Prof. Lakshmi Pathi Jakkamputi**	Slot	**E1+TE1**
		Class Nbr	**CH2022231001571**
Time	**3 Hours**	Max. Marks	**100**

PART A (5 X 12 Marks)
Answer any 5 questions

1. An axial tensile force of 200 kN is applied to the assembly shown in Figure 1, by means of rigid end plates. Determine the normal stress in the aluminum shell and the corresponding deformation of the assembly. [12]

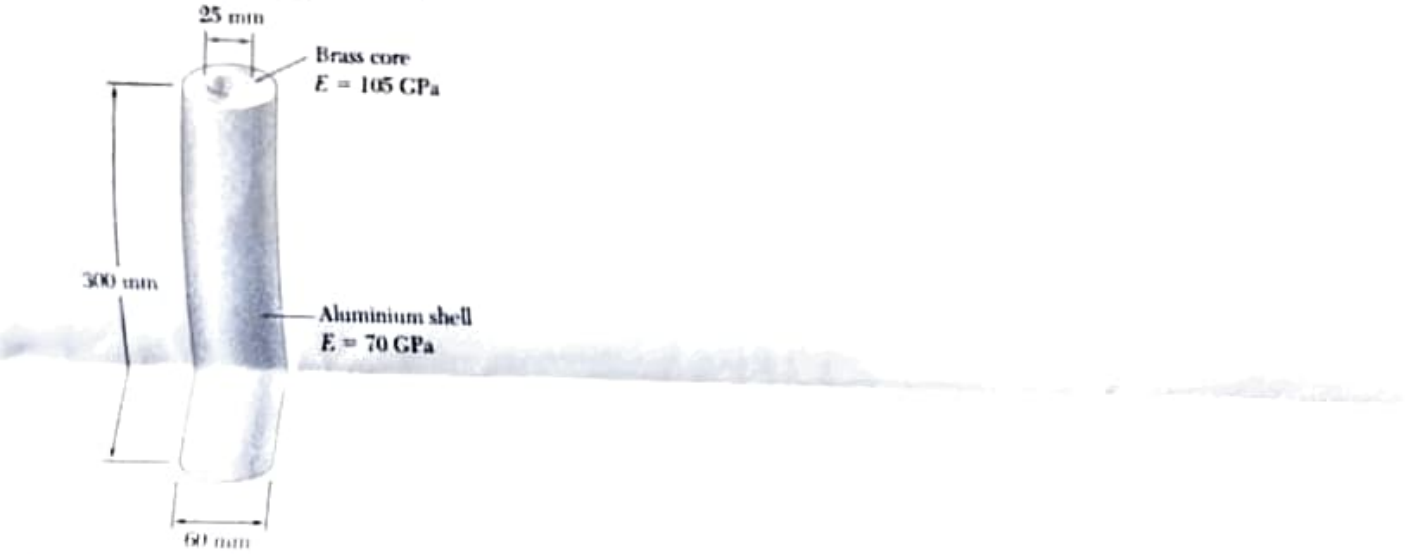

Figure 1

2. Knowing that for the cantilever beam shown in Figure 2, the allowable stress is 120 MPa in tension and 150 MPa in compression, determine the largest moment M that can be applied. [12]

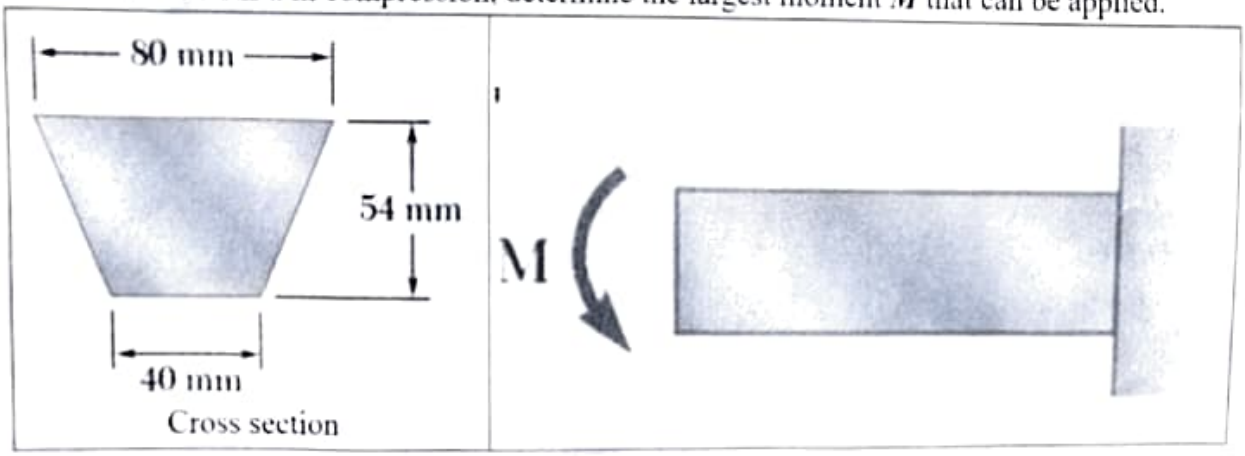

Figure 2

3. A torque of magnitude **T = 4 kN-m** is applied at end A of the composite shaft shown in **Figure 3**. Knowing that the modulus of rigidity is **77 GPa** for the steel and **27 GPa** for the aluminum, determine (a) the maximum shearing stress in the steel core, (b) the maximum shearing stress in the aluminum jacket, and (c) the angle of twist at A. [12]

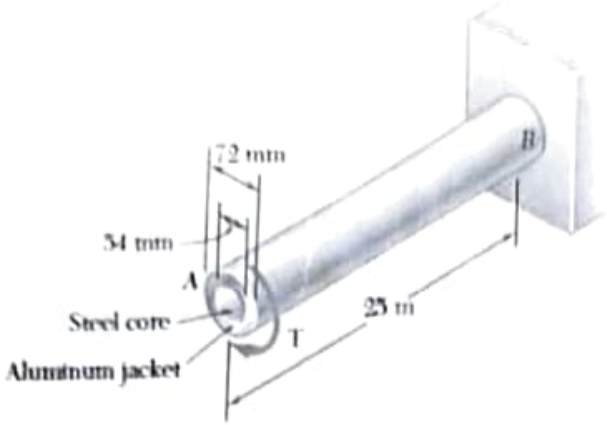

Figure 3

4. The stiffness of a close-coiled helical spring is **1.5 N/mm** of compression under a maximum load of **60 N**. The maximum shear stress produced in the wire of the spring is **125 N/mm²**. The solid length of the spring (when the coils are touching) is given as **5 cm**. Find: (i) diameter of wire. (ii) mean diameter of the coils and (iii) number of coils required. Take modulus of rigidity = 4.5 x 10^4 N/mm². [12]

5. Derive an expression for *buckling load* of the column when one end is fixed and the other end is free. [12]

6. A closed cylindrical vessel made of steel plates **5 mm** thick with plane ends, carries fluid under a pressure of **3 N/mm²**. The diameter of the cylinder is **30 cm** and length is **80 cm**, determine the change in diameter, length and volume of the cylinder. Take $E = 2.1 \times 10^5$ **N/mm²** and **Poisson's ratio = 0.26**. [12]

PART B (2 X 20 Marks)

Answer All questions

7. The state of stress at a point is shown in the Figure 4. Using analytical method, determine (a) the principal stresses, (b) the maximum in-plane shear stress and average normal stress at the point and (c) the orientation of principal planes and the maximum shear stress plane. Verify the above answers by drawing a Mohr's circle. Also determine the normal and shear stresses at an angle of 60° clockwise and show the state of stress on the orientated element. [20]

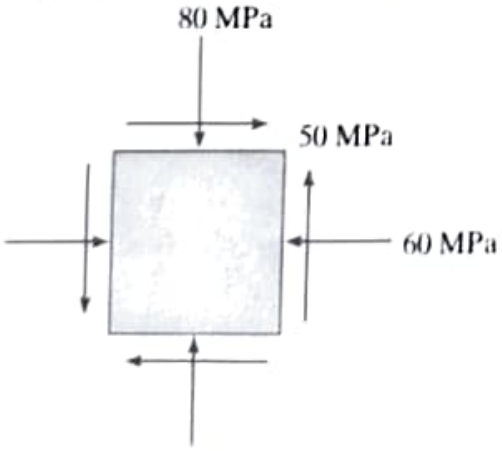

Figure 4

8. For the beam and loading shown in Figure 5, determine (a) the slope at end A, (b) the deflection at point C and (c) the maximum deflection. Use E = 200 GPa. The moment of inertia about the neutral axis of the I-section shown is 6.83 x 10^6 mm⁴. [20]

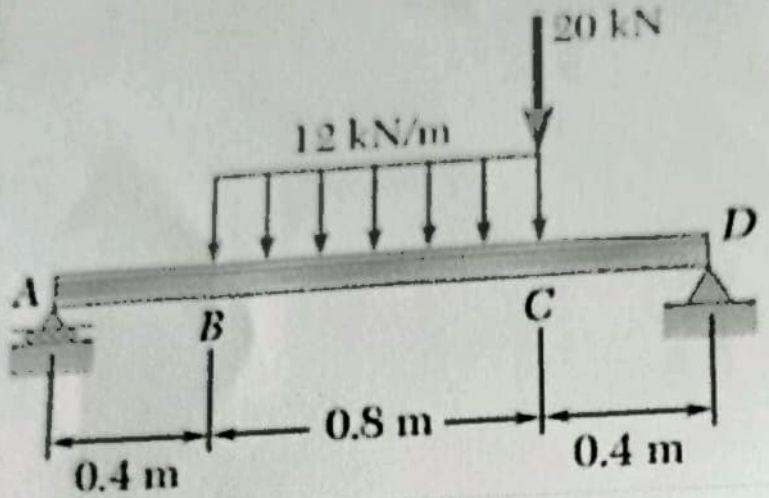

Figure 5