VIT

Vellore Institute of Technology

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST (CAT) -II
WINTER SEMESTER 2025-2026

Programme Name & Branch	: B.Tech. Mechanical Engineering
Course Code	: BMEE306L
Course Name	: CAD & FEA
Faculty Name(s)	: Dr Deepa A, Dr Niranjana Behera, Dr Sharan Chandran M, Dr K. V. Mohankumar
Class Number(s)	: VL2025260502951, VL2025260502955, VL2025260502961, VL2025260501050
Date of Examination	: 17-03-2026
Exam Duration	: 90 minutes

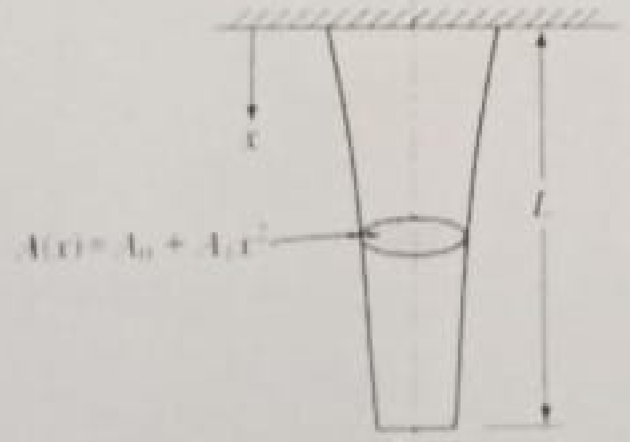
Maximum Marks: 50

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes Statements:

  CO. 4: Formulate 1D and 2D finite element equations at element and assembly level for static structural, thermal and dynamic applications

  CO.6: Solve complex engineering problems using the first principles and commercial CAD/FEM tools.

Q. No	Question	M	CO	BL
1.	Consider the nonlinear boundary value problem $-2u\dfrac{d^2u}{dx^2}+\left(\dfrac{du}{dx}\right)^2=4, \qquad 0<x<1$ subject to the boundary conditions: $u(0)=1$ and $u(1)=0$. Using the Galerkin weighted residual method, obtain a one-parameter approximate solution for $u(x)$.	10	6	3
2.	Determine the axial deformation of the bar with varying cross-section subjected to its self-weight (shown in Fig. 1) using Ritz method.  Figure 1. Structure under self-weight	10	6	3

VIT
Vellore Institute of Technology

SLOT: C2 + TC2

REG.NO.:

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST (CAT) -II
WINTER SEMESTER 2025-2026

3. The aluminium and steel pipes shown in Fig. 2 are fastened to rigid supports at ends A and B and to a rigid plate C at their junction.

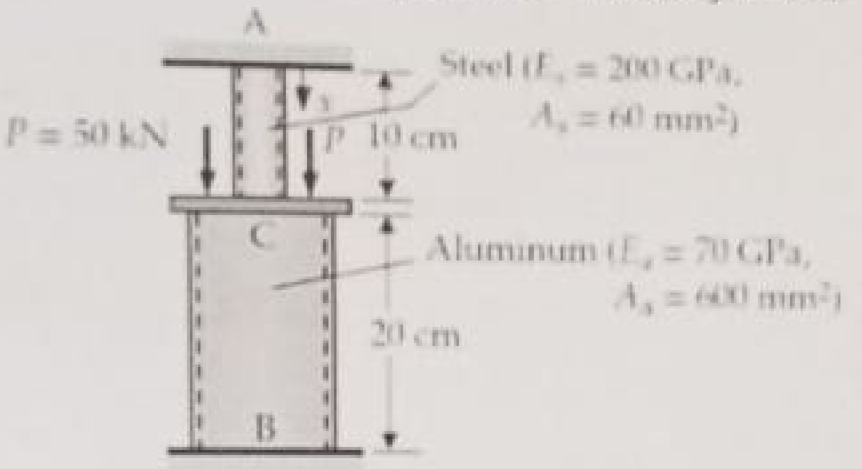


Figure 2: Pipe assembly

Using linear bar elements, determine the displacement of point C and stresses in the pipes due to the net axial load of 100 kN.

10 | 4 | 3

4. The I-beam shown in Fig. 3 has a cross-sectional area of 6500 mm^2 and a depth of 450 mm. The second moment of area of the section is 210×10^6 mm^4. The beam is subjected to a linearly varying distributed load, starting at 30 kN/m at the left end and reducing to zero at the right end. Using two linear beam elements, determine:

1. The vertical displacement at node 3
2. The rotations at nodes 2 and 3
3. The reaction forces and moment at the supports.

Assume modulus of elasticity, E=200 GPa.

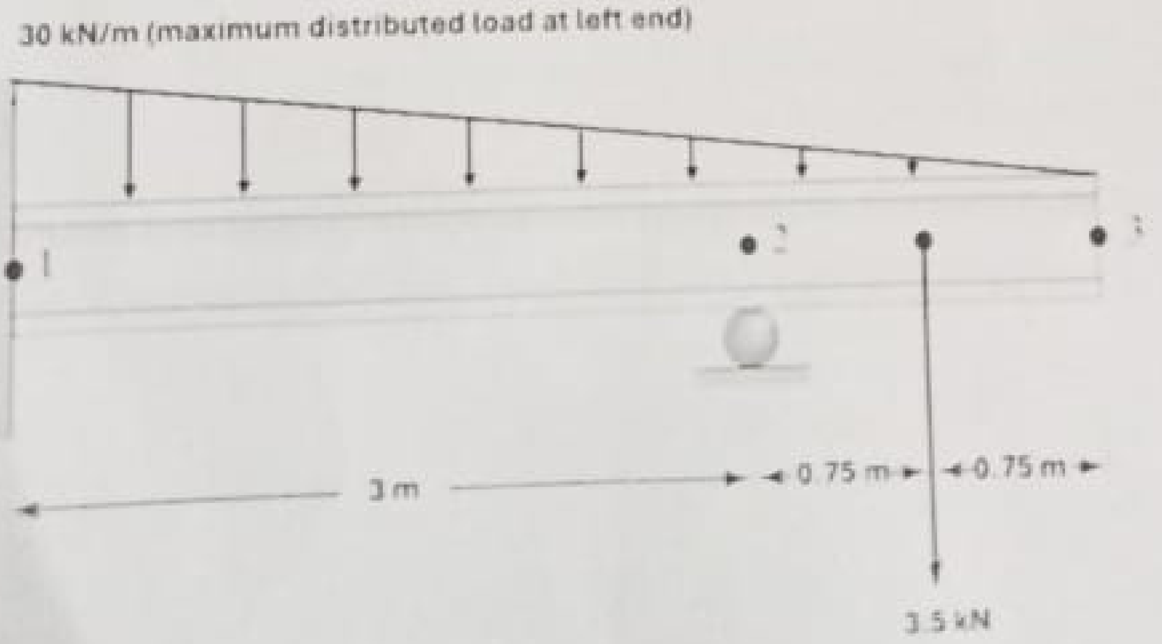


Figure 3: I-beam structure

10 | 4 | 4

SLOT: C2 + TC2

REG.NO.:

SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST (CAT) -II
WINTER SEMESTER 2025-2026

5. A single aluminium cooling fin is attached to a base plate to dissipate heat generated by a computer chip, as shown in Fig. 4. The chip generates 8 W of heat, which enters the base plate uniformly over the chip area of 25 mm × 25 mm. Assume that the heat entering the base of the fin is equal to this heat input and may be treated as a uniform heat flux at the fin base.

The fin loses heat to the surrounding air by convection from its lateral surfaces, while the tip of the fin is assumed to be insulated. The fin has a square cross-section with width $w = 2$ mm. The total volume of the fin (w^2L) is fixed at 125 mm³.

Determine the nodal temperature distribution along the fin using two 1-D linear finite elements.

Material and Thermal Data:

- Thermal conductivity of aluminium: $k = 210$ W/m °C
- Convection heat transfer coefficient on the fin surface: $h_{fin} = 200$ W/m^2 °C
- Ambient temperature: $T_\infty = 25°C$

10	4	4

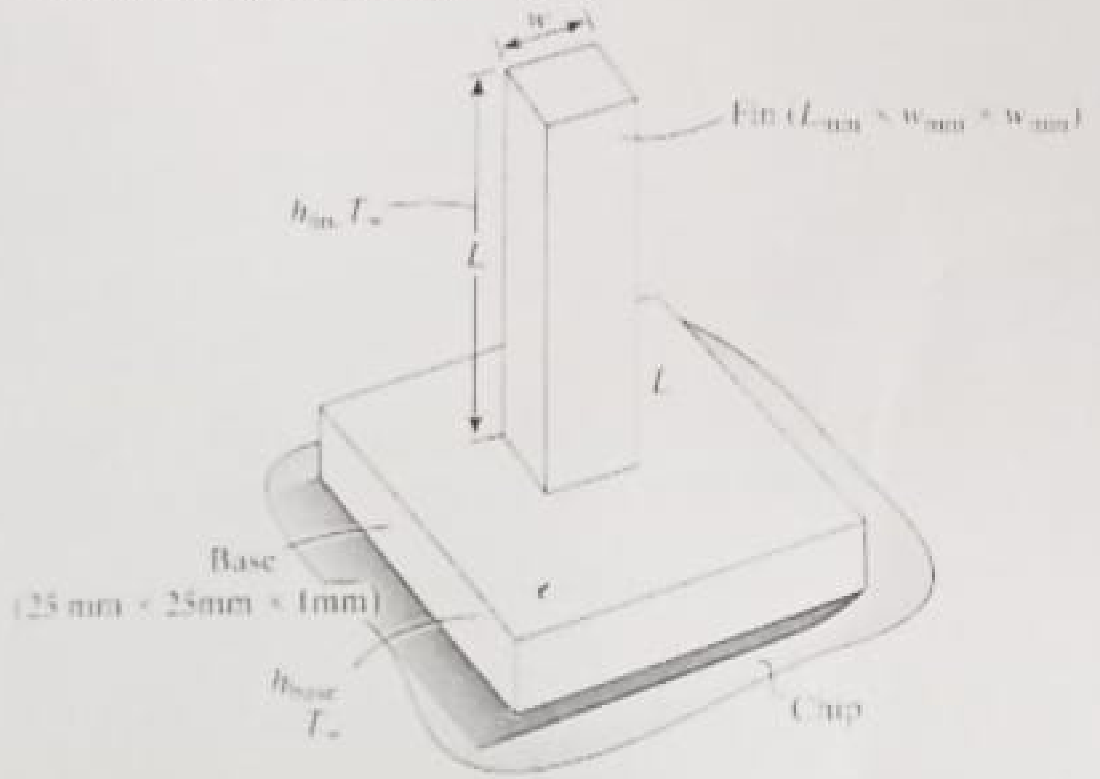


Figure 4: Cooling Fin on a Chip base plate

****