U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

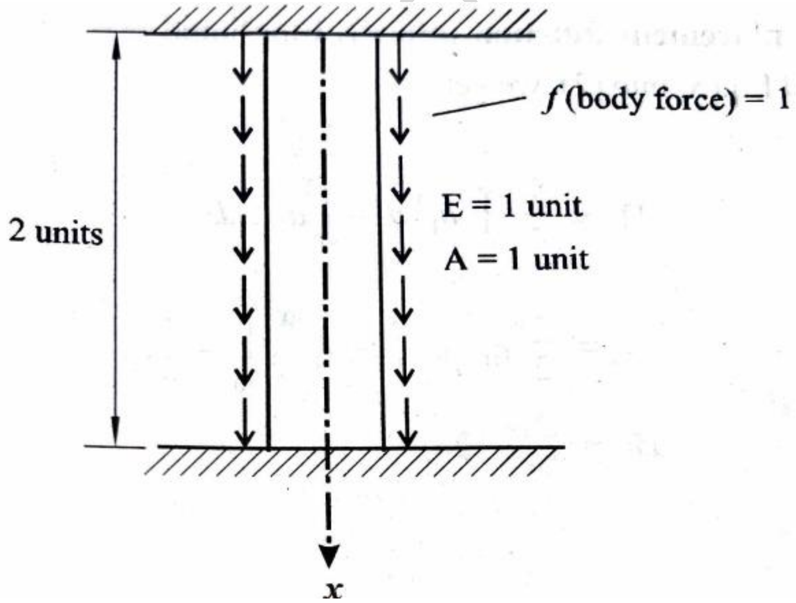
Autonomous Institute Affiliated to VTU

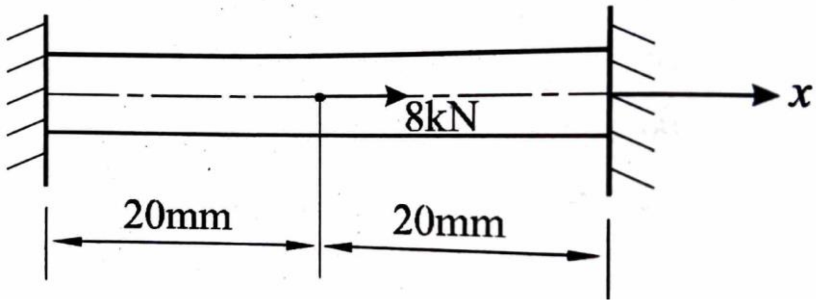
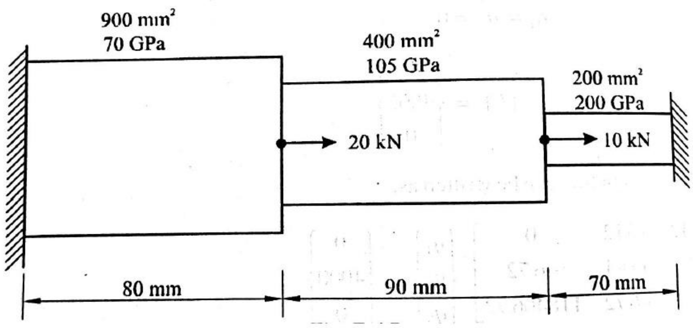
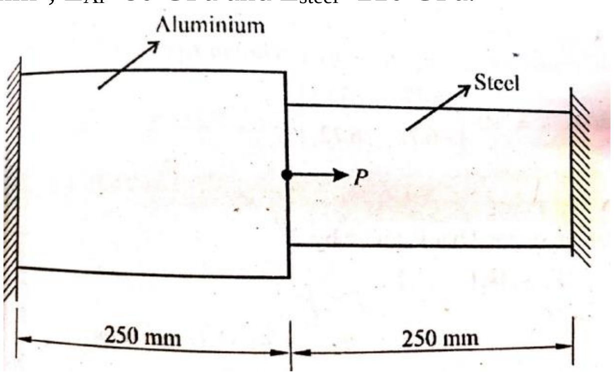
June 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 23AS5PEFEM / 22AS5PEFEM **Max Marks: 100**
Course: FINITE ELEMENT METHOD

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	**Marks**
1	a)	Explain plane stress with an example and equation	*CO1*	*PO1*	**06**
	b)	Explain maximum shear and von-Mises stresses	*CO1*	*PO1*	**04**
	c)	Investigate using RR method the displacement at the midpoint of the rod shown in the figure-1.  Figure-1	*CO1*	*PO2*	**10**
		OR			
2	a)	List and discuss the steps in FEM	*CO1*	*PO1*	**08**
	b)	Using RR method investigate for the element stress & displacement at the midpoint of the bar shown in the figure-2 taking E = 70*10^3 MPa A = 100 mm^2. Assume second order polynomial function.			

			 Figure-2	*CO1*	*PO1*	**12**
			UNIT - II			
	3	a)	Sketch and explain the linear shape functions used for bar element formulation	*CO2*	*PO1*	**04**
		b)	Illustrate node numbering scheme for linear bar element to have banded matrix	*CO2*	*PO1*	**04**
		c)	Estimate the nodal displacement, element stress in the thickest section and left support reaction for the structure shown in figure-3.  Figure-3	*CO2*	*PO2*	**12**
			OR			
	4	a)	Estimate the displacement of a stepped bar shown in figure-4 which is made up of two different materials having total length of 500 mm. Load acting at the center is 4000 N. Take A_1=1600mm^2, A_2=800mm^2, E_{Al}=80 GPa and E_{steel}=210 GPa.  Figure-4	*CO2*	*PO2*	**10**
		b)	Determine the nodal displacements and stresses for the bar shown in figure-5. Take E=200 GPa, A=300 mm^2.	*CO2*	*PO2*	**10**

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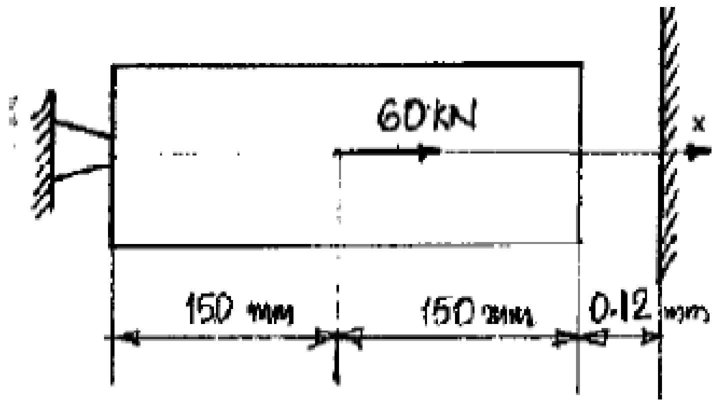
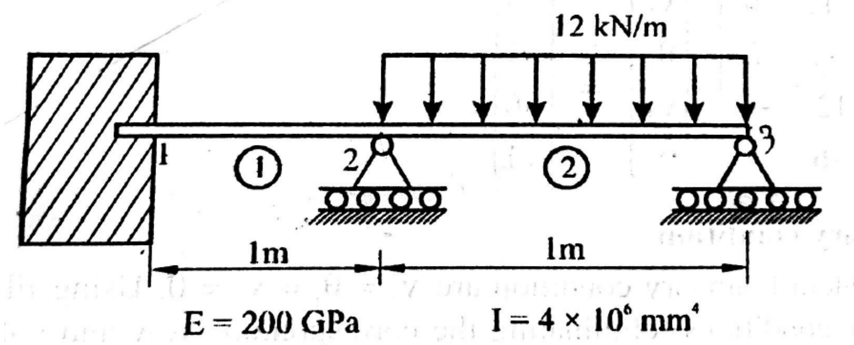
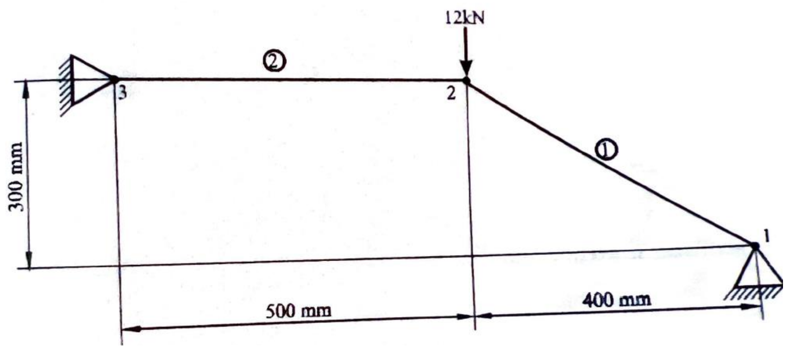
			 Figure-5			
			UNIT - III			
	5	a)	Derive Hermit shape functions for the Beam element	*CO3*	*PO2*	**07**
		b)	For the beam as shown in figure-6, determine the slopes at nodes 2 and 3. Take E=200 GPa, I=4X10^6 mm^4.  Figure-6	*CO3*	*PO2*	**13**
			OR			
	6	a)	For a two-bar truss structure shown in the figure-7, determine the displacement at node 2.  Figure-7	*CO3*	*PO2*	**10**
		b)	For the beam shown in figure-8. Determine the deflection at mid span between the roller supports. Take E=200 GPa, I=4X10^6 mm^4.	*CO3*	*PO2*	**10**

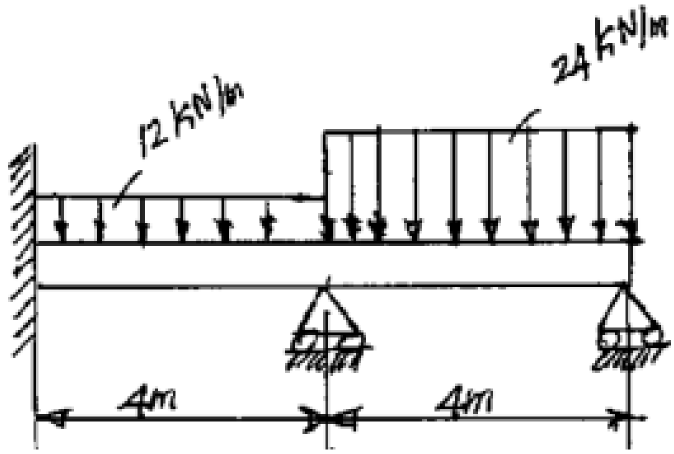


Figure-8

			UNIT - IV			
	7	a)	Plot the shape functions for the CST element	*CO4*	*PO1*	**06**
		b)	Develop the strain-displacement matrix for a 2-D CST element	*CO4*	*PO2*	**14**
			OR			
	8	a)	Develop the shape function for 6 noded triangular element	*CO4*	*PO2*	**08**
		b)	Discuss the following. a. Shape functions for Quadrilateral element b. Convergence of FEM solution	*CO4*	*PO1*	**12**
			UNIT - V			
	9	a)	For the brick wall shown in figure-9. the inner surface temperature is 28^oC and outer surface is exposed to cold air at -15^oC. Investigate the temperature distribution in steady state within the wall by considering two elements	*CO4*	*PO2*	**10**

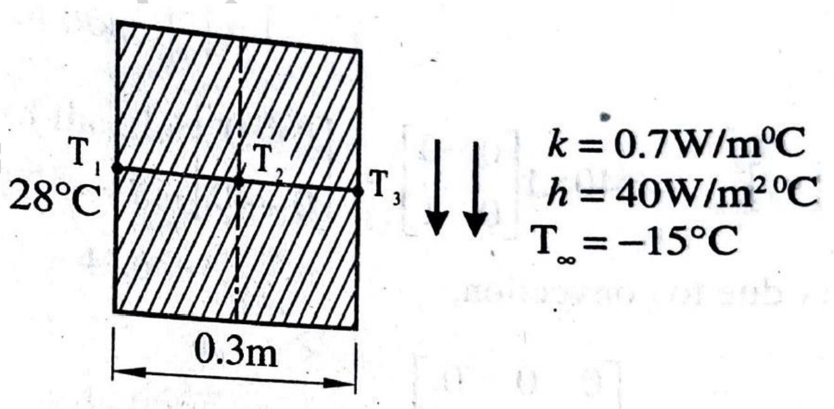


Figure-9

		b)	Solve for the temperature distribution in the one dimensional fin shown in the figure-10	*CO4*	*PO2*	**10**

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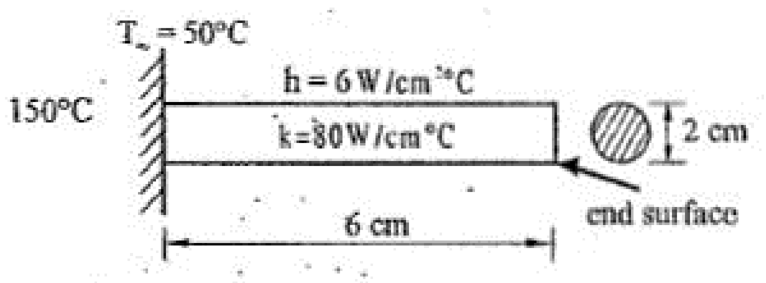
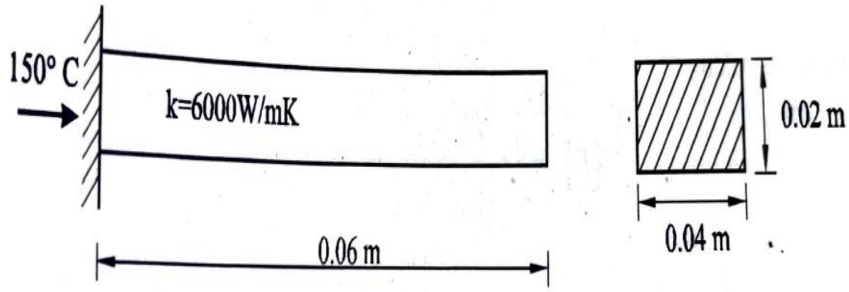
			 Figure-10			
			OR			
	10	a)	Estimate the temperature distribution in the rectangular fin shown in figure-11. Neglect convention heat transfer and assume heat generated inside the fin as 500 W/m^3  Figure-11	*CO4*	*PO2*	**12**
		b)	Derive the equation for lumped mass matrix	*CO4*	*PO2*	**08**

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