U.S.N.										

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

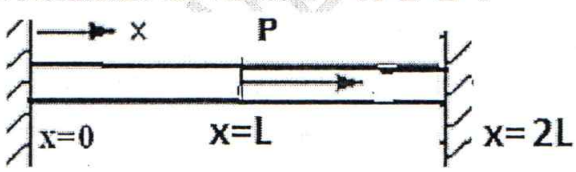
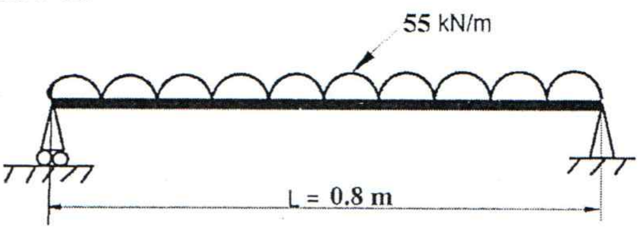
Autonomous Institute Affiliated to VTU

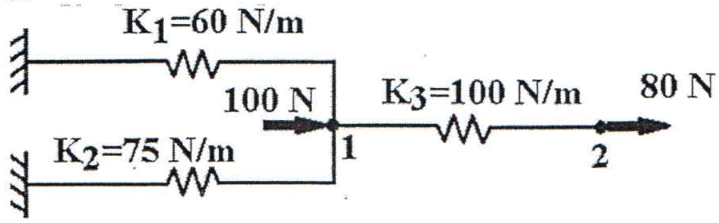
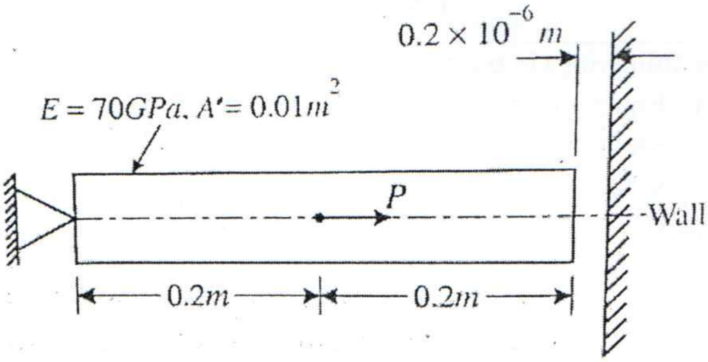
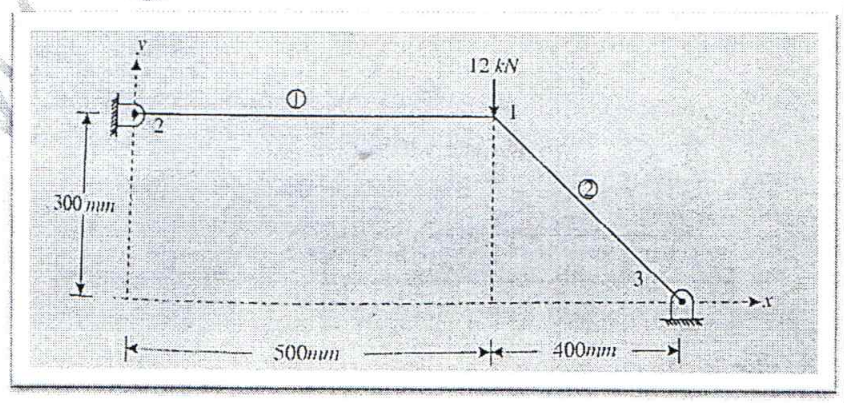
July 2023 Semester End Main Examinations

Programme: B.E. | **Semester: VI**
Branch: Mechanical Engineering | **Duration: 3 hrs.**
Course Code: 20ME6DCMFE / 16ME6DCMFE | **Max Marks: 100**
Course: Modelling and Finite Element Analysis | **Date: 05.07.2023**

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)	Write the followings in matrix form: i) Equilibrium equations in 3D ii) Strain - displacement relations in 3D iii) Stress - strain relations in 3D iv) Stress-strain relations for Plane stress condition	CO1	PO1	08
	b)	Using the Rayleigh-Ritz method, obtain expressions for displacement and stress for the uniform bar shown in the figuren1b. Normalize the values if P=A=L=E=1  Figure1b	CO2	PO2	10
	c)	Define Principal of Minimum Potential Energy	CO2	PO1	02
		OR			
2	a)	Evaluate the following integral with suitable Gauss quadrature. Verify the answer with an analytical solution. a) $I = \int_0^3 (1 + 2r + 3r^2 + 4r^3)dr$	CO2	PO1	06
	b)	Determine the Maximum deflection for the simply supported beam shown in the figure using R-R method. Take E=210GPa and $I=2X10^{-9}m^4$  Figure 2b	CO2	PO1	10

		c)	Determine the nodal displacements for the following spring system shown in figure 1c, using principle of minimum potential energy.  figure 1c	CO2	PO1	04
			UNIT - II			
	3	a)	Derive the element stiffness matrix for a 2 nodded bar element with 2 DOFs at each node.	CO2	PO1	08
		b)	Determine the displacement, stress and support reactions in the bar subjected to an axial load P=1000N as shown in figure 3b.  	CO4	PO2	12
			UNIT - III			
	4	a)	Derive Hermitian shape function for a beam and sketch their variation.	CO2	PO1	08
		b)	Obtain displacements at node 1, reactions at nodes 2 and 3, and stresses and strains in the truss shown in Figure 2.(b) take E=70Gpa, A =200mm2.  Figure 4b	CO4	PO2	12
			UNIT - IV			
	5	a)	Sketch 2D constant strain element indicating the degrees of freedom. Compute expressions	CO3	PO1	12

			i) Shape functions, ii) Jacobean & iii) Strain displacement matrix			
		b)	A CST element has coordinates 1(0, 0), 2(250, 0) and 3(250, 250) and thickness 5 mm. If the element displacement vector is given by$\{0,0\ ,0.001,0.002,-0.003,0.002\}^T$mm determine the element strain .	CO4	PO1	08
			OR			
	6	a)	Formulate the shape function for 1-D quadratic Bar elements and sketch their variations.	CO2	PO1	06
		b)	Discuss Iso, Sub and Super-parametric elements.	CO2	PO1	06
		c)	Sketch 9-noded quadrilateral elements and Write the shape functions for the same.	CO3	PO1	08
			UNIT - V			
	7	a)	Derive shape function for 2-noded one dimensional heat transfer element in global coordinates.	CO3	PO1	06
		b)	Determine the temperature distribution in the rectangular fin shown in Figure 7b. Use two 2 nodded 1d heat transfer elements. Also, interpolate the results and obtain temperatures at 0.005m	CO4	PO2	14

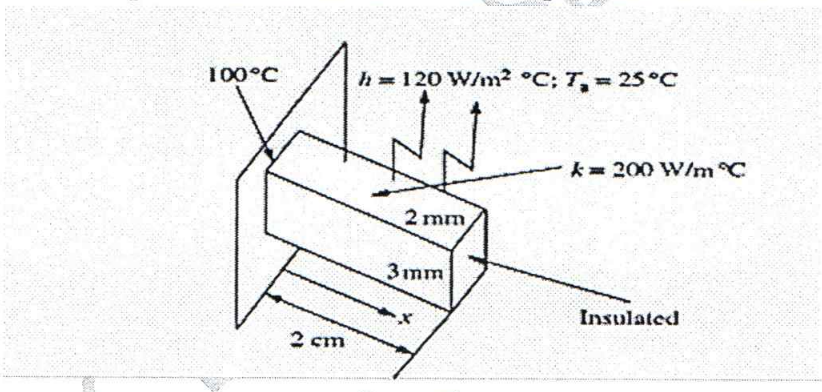


figure 7b

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