CBCS SCHEME

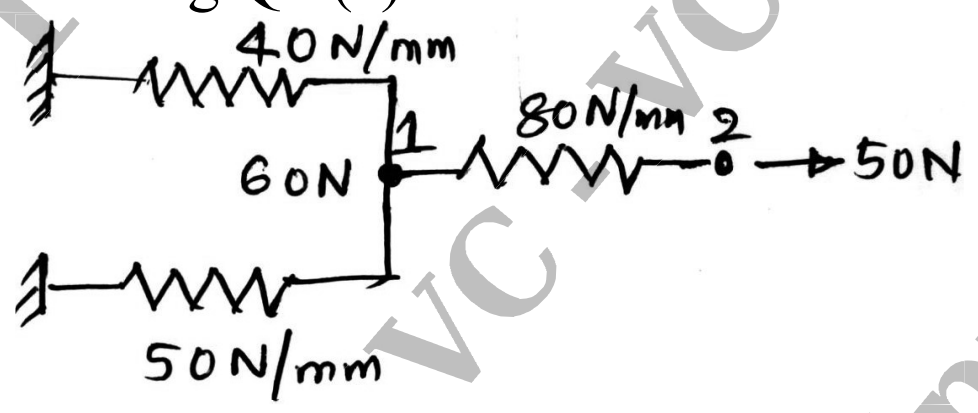
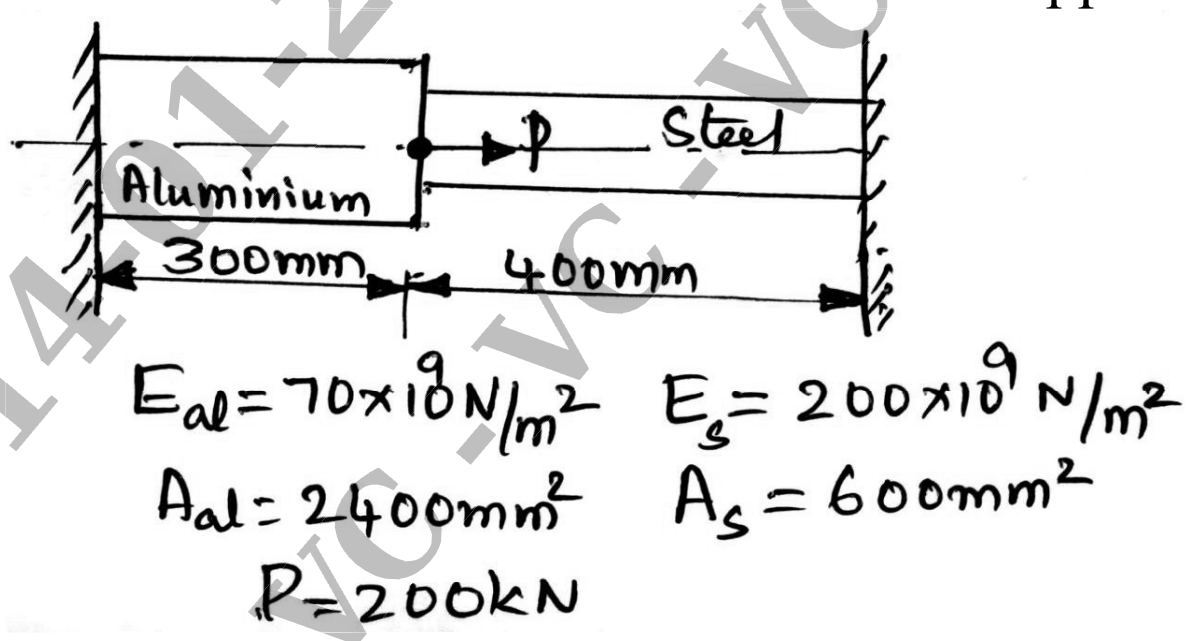
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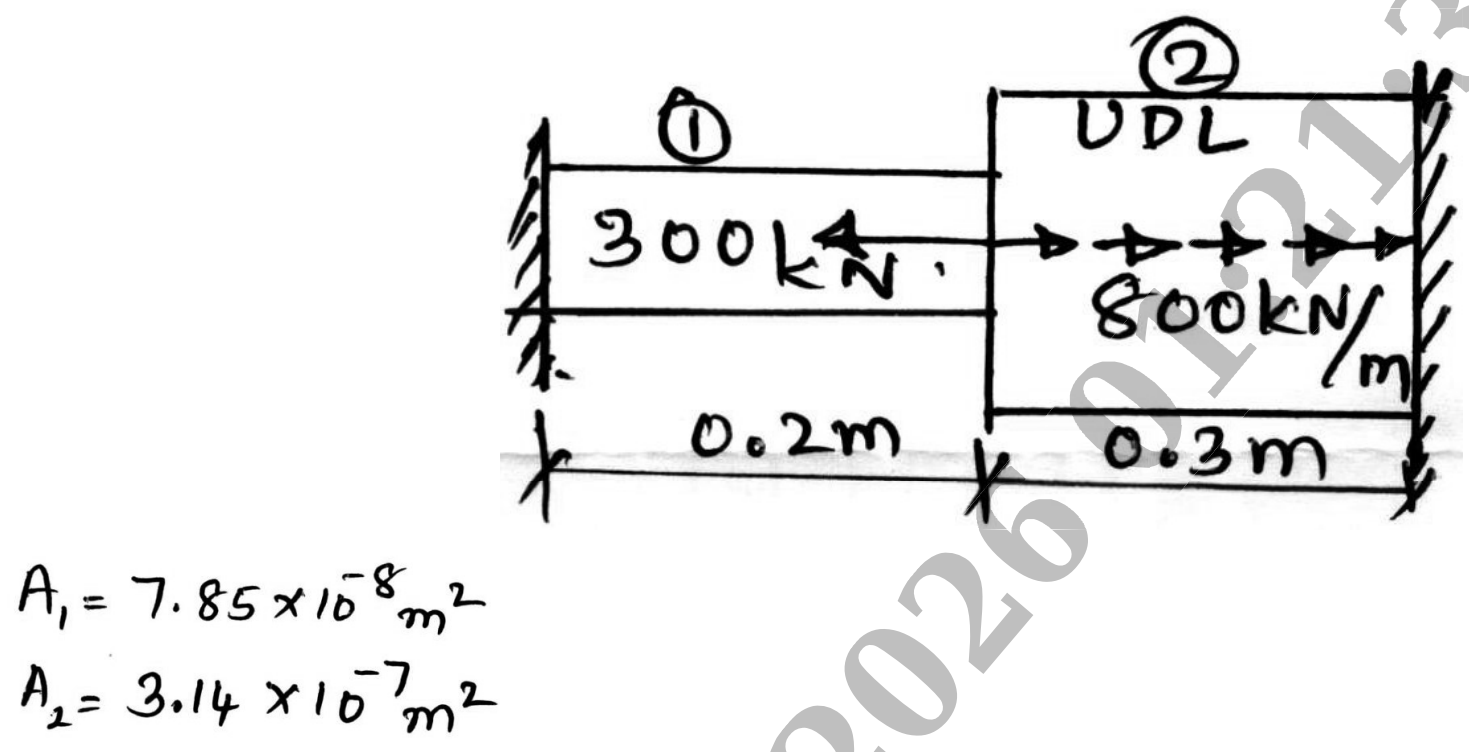
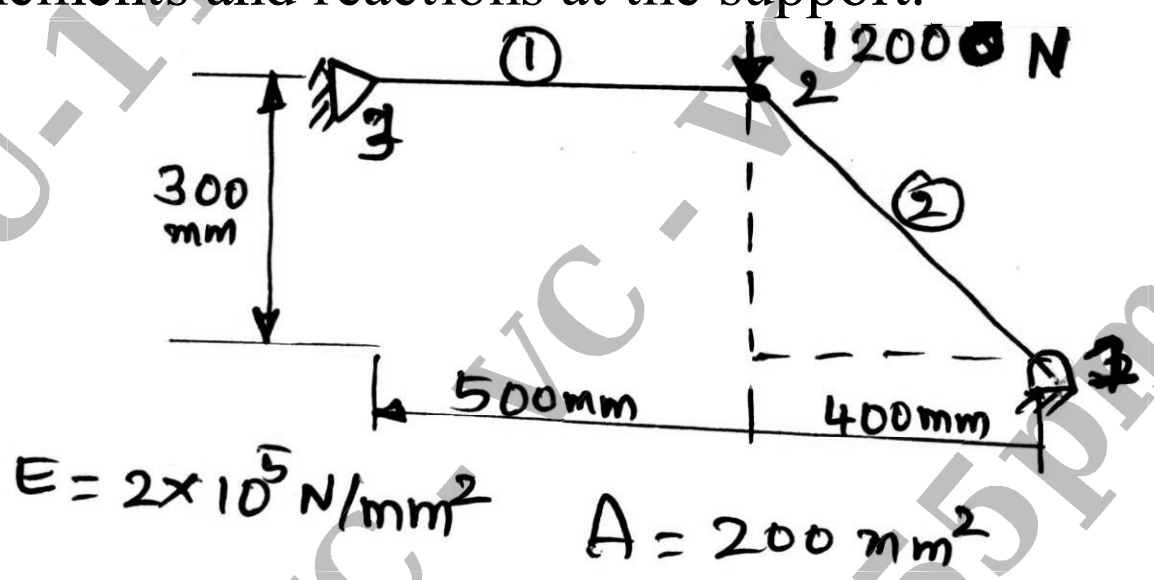
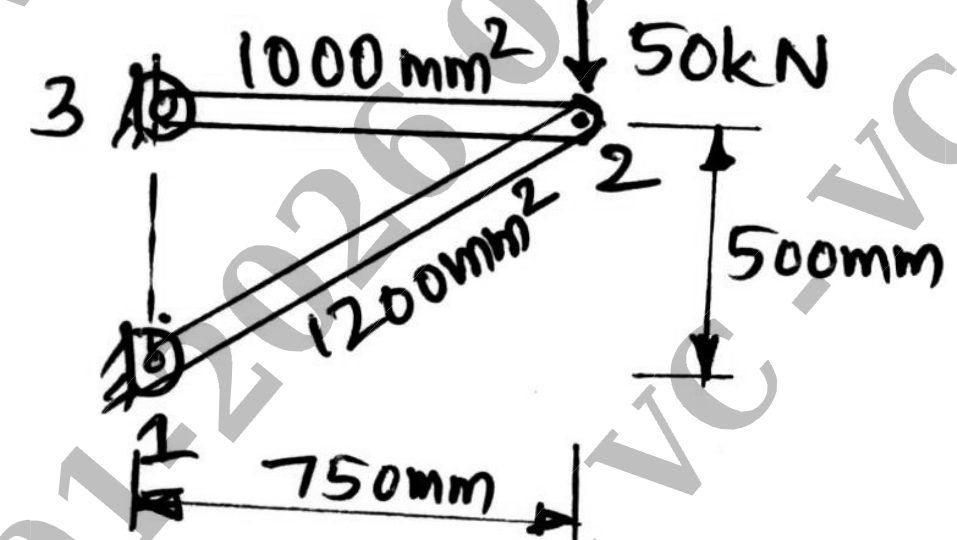
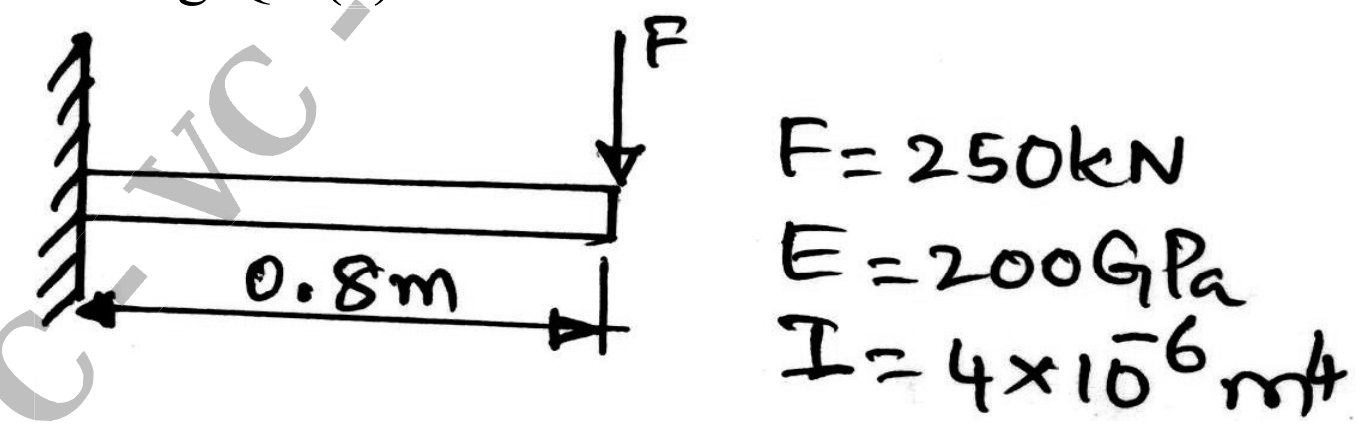
Seventh Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Finite Element Methods

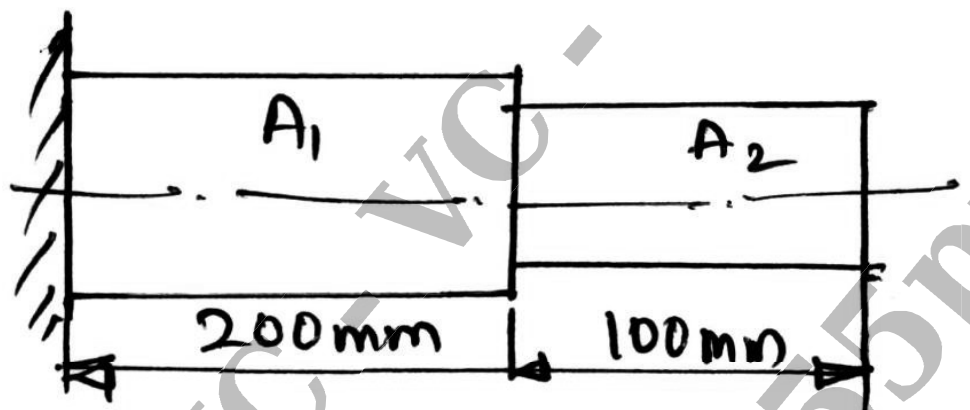
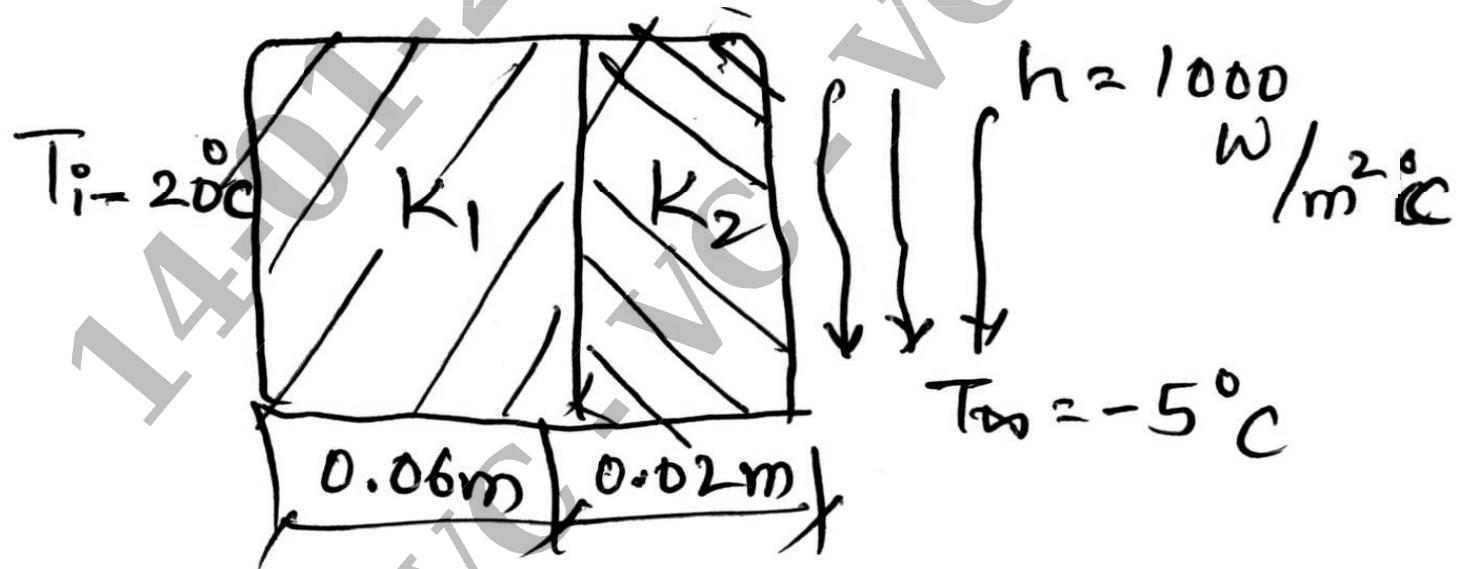
Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	**M**	**L**	**C**
Q.1	**a.**	Define FEM. Explain the basic steps in the finite element methods.	**10**	**L2**	**CO1**
	b.	Explain the plane stress and plane strain problems with examples, write the relation between stress and strain.	**10**	**L2**	**CO1**
		OR			
Q.2	**a.**	Using minimum potential energy determine the nodal displacement of a spring system shown in Fig.Q.2(a).  Fig.Q.2(a)	**8**	**L3**	**CO1 CO2**
	b.	A simply supported beam subjected to point load at the centre. Derive an equation for maximum deflection using trigonometric function by Rayleigh Ritz method.	**12**	**L3**	**CO1 CO2**
		Module – 2			
Q.3	**a.**	Derive shape functions (interpolation polynomial) for a 1-D bar element in natural coordinates.	**8**	**L2**	**CO3**
	b.	For the stepped bar shown in Fig.Q.3(b). Determine the nodal displacements, stress in each element and reaction at supports.  Fig.Q.3(b)	**12**	**L3**	**CO4 CO5**
		OR			
Q.4	**a.**	Derive element stiffness matrix of a 1-D bar element. List the properties of stiffness matrix.	**10**	**L2**	**CO3**

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	b.	Find the nodal displacements, stress and reaction for the bar subjected to load as shown in Fig.Q.4(b). Take E_1 = 70 GPa, E_2 = 200 GPa.  Fig.Q.4(b)	**10**	**L3**	**CO4** **CO5**
		Module – 3			
Q.5	**a.**	For the two-bar truss shown in Fig.Q.5(a) determine the displacements stress in each elements and reactions at the support.  Fig.Q.5(a)	**10**	**L3**	**CO4** **CO5**
	b.	For the two bar truss shown in Fig.Q.5(b). Determine the nodal displacements and stress in each member. Also find support reaction. Take E = 200GPa  Fig.Q.5(b)	**10**	**L3**	**CO4** **CO5**
		OR			
Q.6	**a.**	Derive Hermite shape function for a beam element.	**10**	**L2**	**CO3**
	b.	Find the deflection at the free end and the support reaction of a cantilever beam shown in Fig.Q.6(b).  Fig.Q.6(b)	**10**	**L3**	**CO4** **CO5**

		Module – 4			
Q.7	**a.**	Derive shape functions of Constant Strain Triangular (CST) element in natural coordinates.	**10**	**L2**	**CO3**
	b.	Obtain the shape functions of 4 noded rectangular (quadrilateral) element in Lagrangian-in natural coordinates.	**10**	**L2**	**CO3**
		OR			
Q.8	**a.**	Explain the concept of isoparametric, sub parametric, super parametric elements, with sketches.	**10**	**L2**	**CO2**
	b.	Obtain the shape functions of nine (9) noded rectangular element in Lagrangian.	**10**	**L2**	**CO3**
		Module – 5			
Q.9	**a.**	Derive an expression of element mass matrix for a bar element.	**6**	**L2**	**CO3**
	b.	For the stepped bar shown in Fig.Q.9(b) determine the eigen values and eigen vector. Take A_1 = 400 mm^2, A_2 = 200 mm^2, ρ = 7850 kg/m^3, E = 200 GPa.  Fig.Q.9(b)	**14**	**L3**	**CO4** **CO5**
		OR			
Q.10	**a.**	Briefly describe rate equations and boundary conditions in heat transfer analysis.	**6**	**L2**	**CO2**
	b.	Determine the temperature distribution through composite wall shown in Fig.Q.10(b), when the convective heat loss occurs on the right surface. Take K_1 = 6 W/m°C, and K_2 = 20 W/m°C.  Fig.Q.10(b)	**14**	**L3**	**CO4** **CO5**

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