

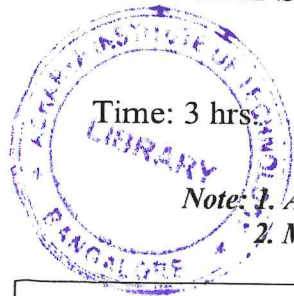
Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026

Finite Element Method

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

Q.1	a.	Explain the steps involved in FEM.	M	L	C
			8	L1	CO1
	b.	Explain plane stress and plane strain condition.	8	L1	CO1
	c.	Write the strain displacement equations for a 3D electric body.	4	L2	CO1

OR

Q.2	a.	Explain principle of minimum potential energy.	5	L2	CO1
	b.	Use Rayleigh-Ritz Method to find stress and displacement at the mid point of a bar shown in Fig.Q.2(b). Take $E = 70 \text{ GPa}$, $A = 100 \text{ mm}^2$. Assume the displacement model to be a 2 nd order polynomial.	15	L3	CO1

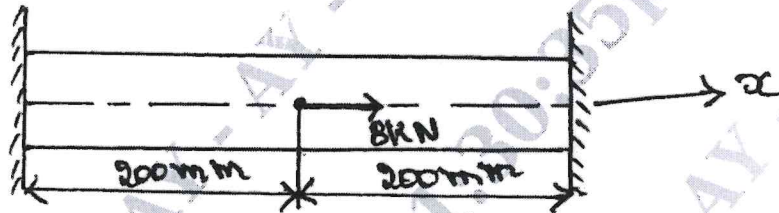


Fig.Q.2(b)

Module – 2

Q.3	a.	Derive shape function for triangular (CST) element in natural coordinate system.	8	L2	CO2
	b.	For the axially loaded bar shown in Fig.Q.3(b). Determine : i) Nodal Displacements ii) Element stress. Take $E_{\text{steel}} = 200 \text{ GPa}$, $E_{\text{cu}} = 100 \text{ GPa}$.	12	L3	CO2

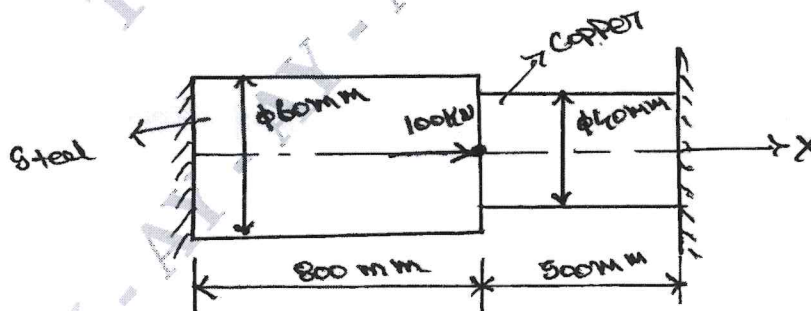
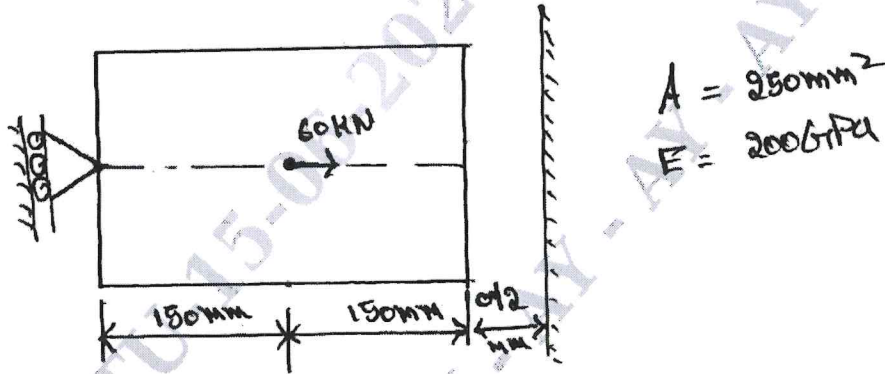


Fig.Q.3(b)

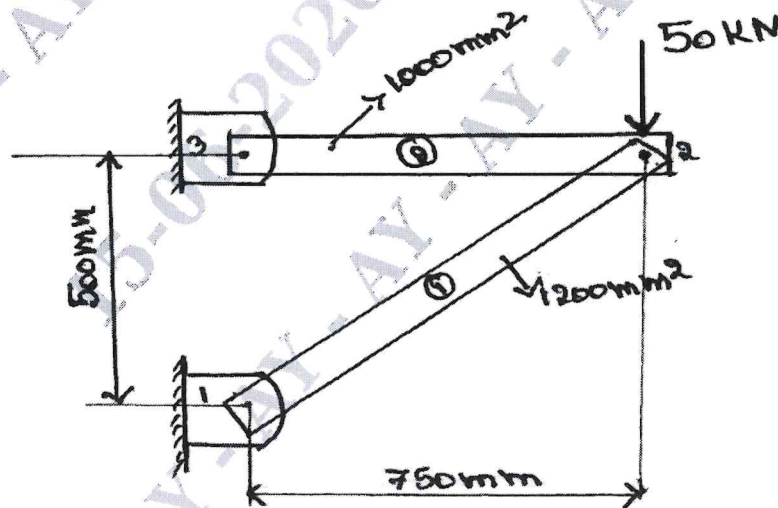
OR

Q.4	a.	Derive stiffness matrix for a 1D bar element using the principle of minimum potential energy.	8	L3	CO2
	b.	For the bar shown in Fig.Q.4(b), an axial load $P = 60 \times 10^3$ N is applied at its midpoint using penalty method of handling boundary conditions determine the nodal displacements and support reactions.	12	L2	CO2



Module – 3

Q.5	a.	Define Plane Truss and list the assumptions made in analysis of truss element.	5	L1	CO3
	b.	For the two bar truss shown in Fig.Q.5(b), find the nodal displacements, stress and support reactions. Take $E = 200$ GPa.	15	L3	CO3



OR

Q.6	a.	Derive the Hermite shape functions for a beam element.	10	L3	CO3
	b.	For the beam shown in Fig.Q.6(b) determine the slopes at 2 and 3. Also determine the vertical deflection at the mid points of the distributed load. Take $E = 200 \text{ GPa}$, $I = 4 \times 10^6 \text{ mm}^4$.	10	L2	CO3

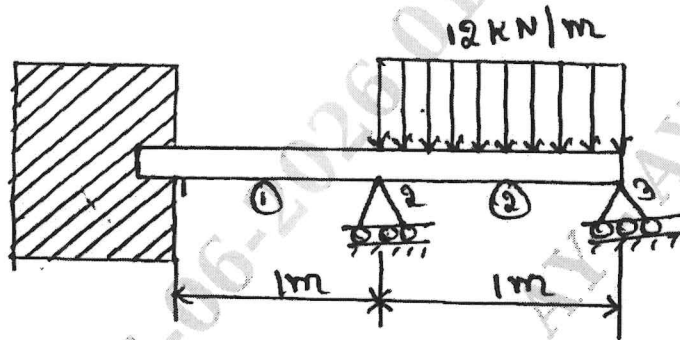


Fig.Q.6(b)

Module – 4

Q.7	a.	Write a short note on the following: i) Simplex, complex and multiplex elements ii) 2D Pascal Triangle	10	L1	CO4
	b.	Derive shape function for 2 nd order bar element in natural coordinates.	10	L2	CO4

OR

Q.8	a.	Briefly explain ISO Parametric, Sub parametric and Super parametric elements.	10	L2	CO4
	b.	Derive shapes function for a 2D quadrilateral element using natural coordinate system.	10	L3	CO4

Module – 5

Q.9		For the stepped bar shown in Fig.Q.9, determine the Eigen values and Eigen vectors. Take $A_1 = 400 \text{ mm}^2$, $A_2 = 200 \text{ mm}^2$, $\rho = 7850 \text{ kg/m}^3$, $E = 200 \text{ GPa}$.	20	L2	CO5
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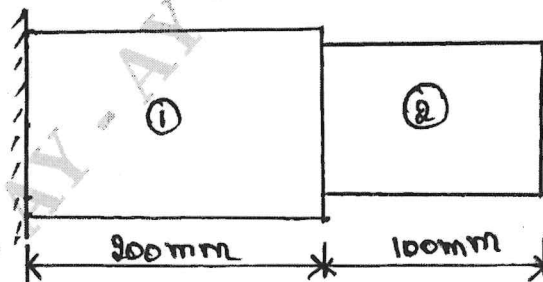


Fig.Q.9

OR

Q.10

A composite wall consist of three materials as shown in Fig.Q.10. The outer temperature is $T_0 = 20^\circ\text{C}$, convective heat transfer takes place on the inner surface of the wall with $T_\infty = 800^\circ\text{C}$ and $h = 25 \text{ W/m}^2\text{C}$. Determine the temperature distribution in the wall.

20

L3

CO3

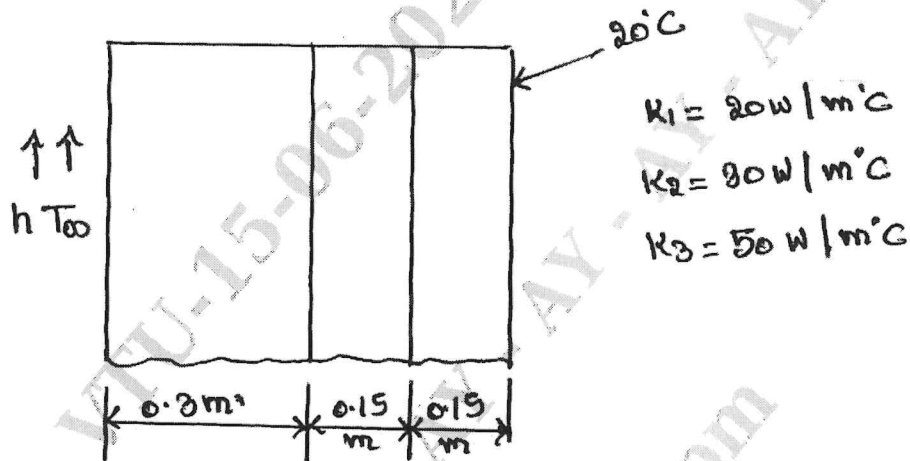


Fig.Q.10
