Reg. No. [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Question Paper Code	13870

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025
Seventh Semester
Mechanical Engineering
20MEPC701 - FINITE ELEMENT ANALYSIS
Regulations - 2020

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)
Answer ALL Questions

		Marks	K-Level	CO
1.	Identify the 1dimensional element among the following	1	K1	CO1
	(a) Bar (b) Beam (c) Truss (d) All of the above			
2.	The number of shape functions will be equal to the number of	1	K1	CO1
	(a) Nodes of element (b) Elements of the structure			
	(c) Size of the structure (d) Co ordinates			
3.	The loading on a element includes	1	K1	CO2
	(a) Body Force (b) Traction force (c) Point Load (d) All of the Above			
4.	_____ is defined as a long, slender structural member whose cross - sectional dimensions are relatively smaller than its length.	1	K1	CO2
	(a) Trusses (b) Bars (c) Beams (d) None of the above			
5.	Axis-Symmetric element is_____Element	1	K1	CO3
	(a) 1D (b) 2D (c) 3D (d) 4D			
6.	Six nodded triangular elements are known as	1	K1	CO3
	(a) Constant Strain Triangular Elements (b) Linear Strain Triangular Elements			
	(c) Constant Stress Triangular Elements (d) Quadratic strain triangle.			
7.	In Thermal analysis, the unknown at each node is	1	K1	CO4
	(a) Temperature (b) Power (c) Heat Sources (d) All of the above			
8.	When there is reduction in amplitude over every cycle of vibration, motion is said to be_____	1	K1	CO4
	(a) undamped vibration (b) decreasing vibration			
	(c) Damped vibration (d) unforced vibration			
9.	In the FEM element library, what is the other name of a higher- order element?	1	K1	CO5
	(a) Complex element (b) Simplex element (c) Linear element (d) Nonlinear element			
10.	In a bilinear iso-parametric quadrilateral element, how many nodes does it have?	1	K1	CO6
	(a) 4 (b) 8 (c) 9 (d) 16			

PART - B (12 × 2 = 24 Marks)
Answer ALL Questions

		Marks	K-Level	CO
11.	Illustrate the methods generally associated with finite element analysis.	2	K2	CO1
12.	Point out any four advantages of the finite element method.	2	K1	CO1
13.	Summarize the stiffness matrix properties.	2	K2	CO2
14.	Define a natural coordinate system.	2	K1	CO2
15.	What is meant by plane stress analysis?	2	K1	CO3
16.	Write the displacement function equation for CST element.	2	K1	CO3
17.	Differentiate Conduction, Convection and Radiation.	2	K2	CO4
18.	Write down the Stiffness Matrix for 1D Heat conduction element.	2	K1	CO4
19.	Illustrate the purpose of Isoparametric element.	2	K2	CO5
20.	Differentiate between Isoparametric, super parametric and sub - parametric elements.	2	K2	CO5
21.	Elaborate about Numerical integration.	2	K2	CO6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

13870

22. List out the significance of Jacobian transformation.   *2*   *K1*   *CO6*

PART - C (6 × 11 = 66 Marks)
Answer ALL Questions

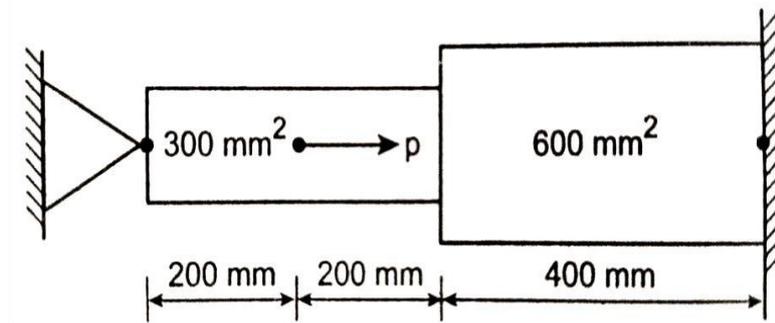23. a) Describe the step by step procedure of solving FEA.   *11*   *K3*   *CO1*

OR

b) Using Rayleigh-Ritz method obtain an approximate solution of the differential   *11*   *K3*   *CO1* equation with boundary conditions $y(0) = 0$ and $y(l) = 0$.

$$\frac{d^2 y}{dx^2} - 10x^2 = 5$$

24. a) For the bar element as shown in the figure. Calculate the nodal displacements and   *11*   *K3*   *CO2* elemental stresses. Take E= 2.1 x 10^5 N/mm^2 ; P = 400 kN.
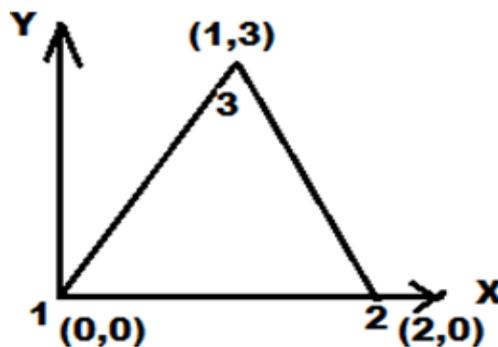

OR

b) For the two bar truss shown in the fig, Estimate the displacements of node 1 and the   *11*   *K3*   *CO2* stress in element 1-3. Take E = 70 GPa, A = 200 mm^2.
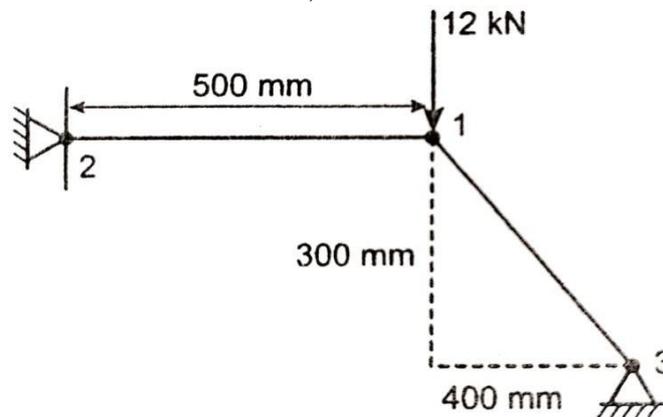
25. a) Calculate the strain displacement matrix for the CST element shown in the figure   *11*   *K3*   *CO3* given below.

OR

b) Develop shape function for axisymmetric triangular elements.   *11*   *K3*   *CO3*

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create   **13870**

26.   a)   A wall of 0.6 m thickness having thermal conductivity of 1.2 W/mK. The wall is to   *11   K3   CO4*
be insulated with a material of thickness 0.06 m having an average thermal
conductivity of 0.3 W/mK. The inner surface temperature is 1000° C and outside of
the insulation is exposed to atmospheric air at 30^oC with Heat transfer coefficient of
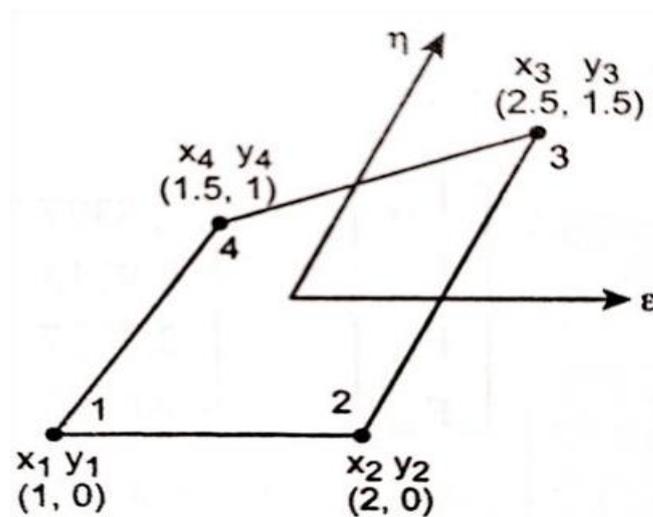35 W/m^{2}K. Calculate the nodal temperatures.
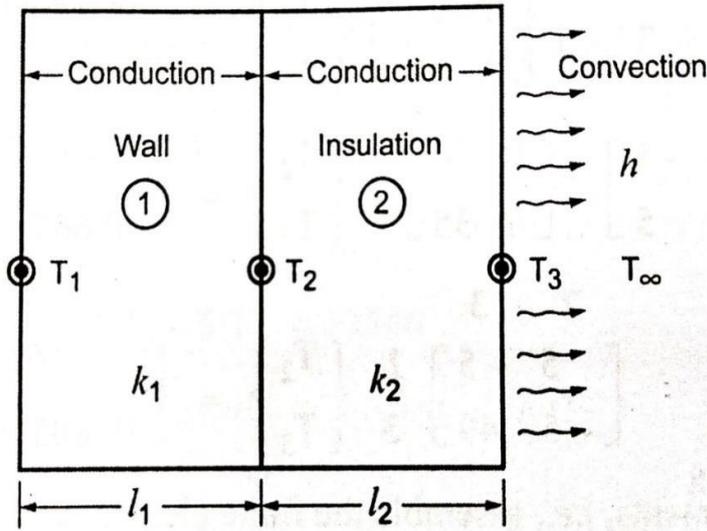
OR

b)   Determine the first two natural frequencies of longitudinal vibration of the stepped   *11   K3   CO4*
steel bar shown in fig. All the dimensions are in m E=30x10^{10} N/m^2. and ρ = 8500
kg/m^3.
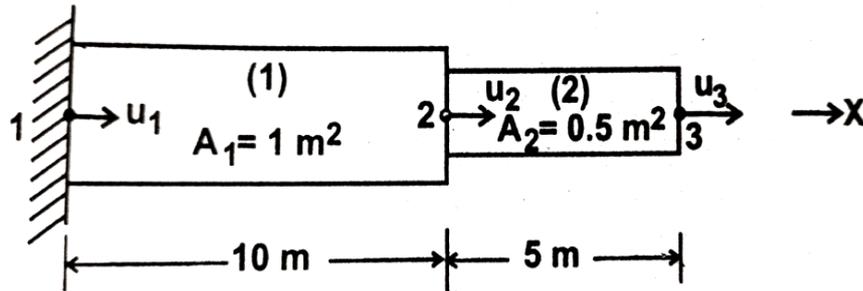
27.   a)   Develop the shape function for 4 noded isoparametric quadrilateral element.   *11   K3   CO5*

OR

b)   Evaluate the Jacobian matrix for the isoparametric quadrilateral element shown in   *11   K3   CO5*
the figure.

28. a) Evaluate by applying 3 point Gaussian quadrature.   *11* *K3* *CO6*

$$\int_{-1}^{1}(x^4 + x^2)dx$$

OR

b) Calculate the Cartesian coordinates of the point P which has local coordinates $\varepsilon =$ *11* *K3* *CO6*
0.8 and $\eta = 0.6$ as shown in figure.