BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH. **SEMESTER: V**
BRANCH: MECHANICAL **SESSION: MO/2025**

SUBJECT: ME351 FINITE ELEMENT METHODS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data handbook/Graph paper, etc., to be supplied to the candidates in the examination hall.

			CO	BL
Q.1	For the spring assemblage shown in Figure 1, determine the nodal displacements, the forces in each element, and the reactions. Use the direct stiffness method.	[10]	2	1,2

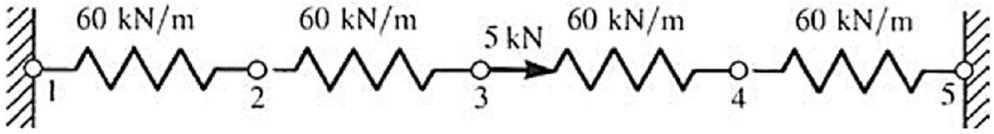

Fig. 1

Q.2	A simply supported beam subjected to concentrated moments at each end is shown in Fig. 2. Find the approximate solution for the beam deflection using the Variational method and Galerkin's method.	[10]	2	1,2

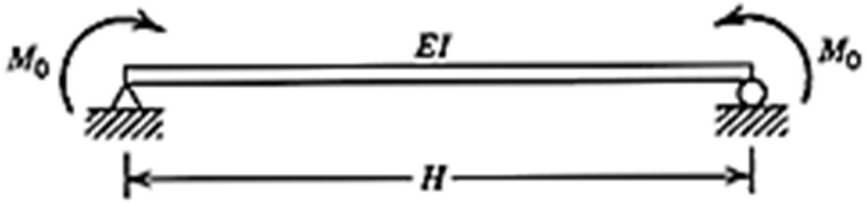

Fig. 2

Q.3	Calculate the displacement at node 2 of a tapered bar with area of cross section A_1 at node 1, and A_2 at node 2, subjected to an axial tensile load P. Take A_1 = 40 mm^2, A_2 = 20 mm^2, and l = 200 mm. Assume $A_1 > A_2$, and the rod is fixed at node 1.	[10]	2	1,2
Q.4(a)	What are shape functions, and why are they important in FEM?	[5]	1	1
Q.4(b)	Derive an expression for the shape function using the quadratic interpolation scheme on a three-node linear element.	[5]	1	1
Q.5(a)	Define various coordinate systems used in FEM in detail.	[5]	1	1

PTO

Q.5(b) Evaluate the element shape functions and calculate the pressure value at point A in Fig. 2. [5] 3 1-3
Point A is located at (2, 1.5). The nodal values are given as Φ_i, Φ_j and Φ_k are the nodal values.

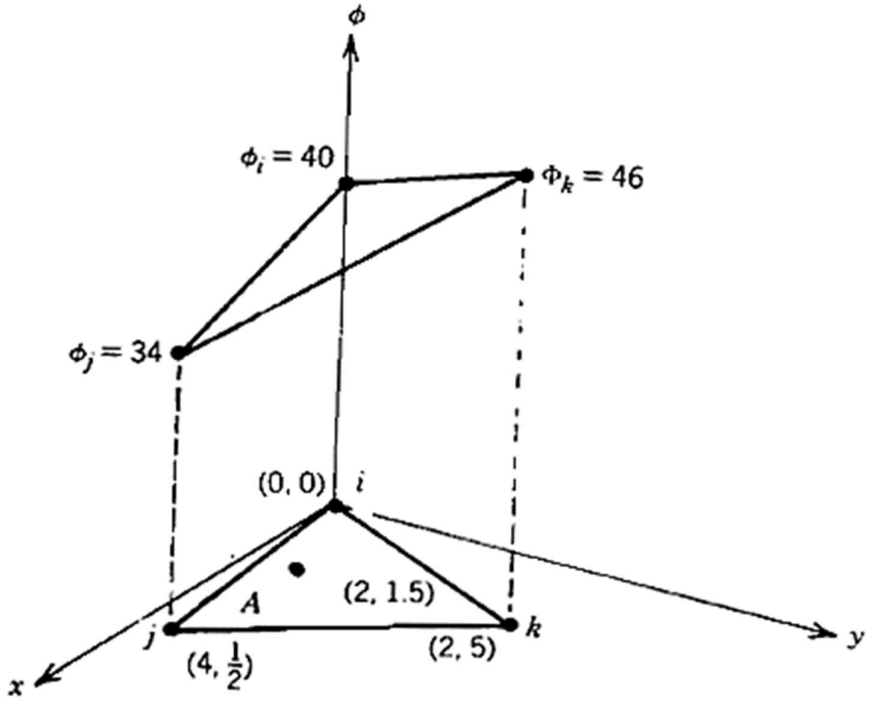

Fig. 3

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