

CLASS: B.Tech.  
BRANCH: Mechanical

SEMESTER : V  
SESSION : MO/23

SUBJECT: ME351 FINITE ELEMENT METHODS

TIME: 02 hrs

FULL MARKS: 25

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates

- |   |     |     |
|---|-----|-----|
|   | CO  | BL  |
| Q.1(a) Explain the difference between Finite Element Method and Finite difference Method.   | [2] | 1 2 |
| Q.1(b) Obtain an approximate displacement equation by using least squares method for the simply supported beam shown in Figure 1 using the trial solution $y(x) = A \sin(\pi x/H)$ . The governing differential equation is | [3] | 1 4 |

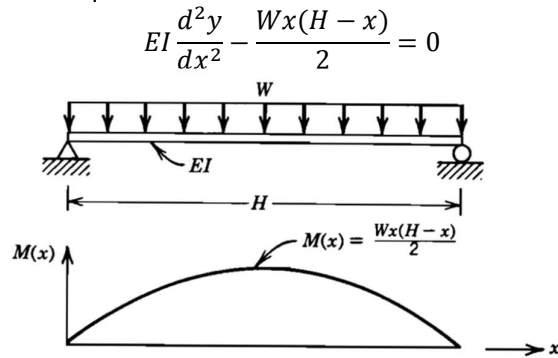


Figure 1

- |   |     |     |
|---|-----|-----|
| Q.2(a) What are the rules for the meshing i.e. element size and nodes?  | [2] | 1 1 |
| Q.2(b) Explain any six methods for solving boundary value problem.  | [3] | 1 2 |
| Q.3(a) What are the properties of the shape function?   | [2] | 2 1 |
| Q.3(b) The coordinate $\xi$ shown in Figure 2 is a natural coordinate whose origin is at the center of the element. The value of $\xi$ at nodes i and j is 1 and -1, respectively. Develop the shape functions $N_i(\xi)$ and $N_j(\xi)$ starting with $\phi(\xi) = a_1 + a_2\xi$ and solving for $a_1$ and $a_2$ . | [3] | 2 3 |

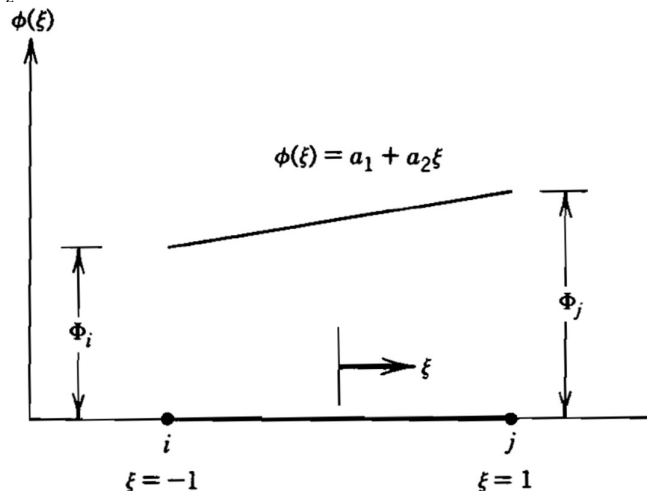


Figure 2

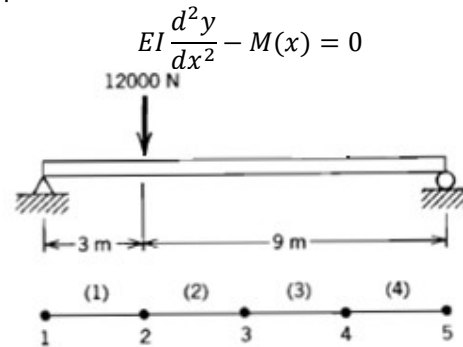
- Q.4(a) Derive the Galerkin's formulation of nodal residue integrals for the given one [2] 2 3  
dimensional differential equation

$$D \frac{d^2 \varphi}{dx^2} + Q = 0$$

Boundary conditions  $\varphi(0) = \varphi_0$  and  $\varphi(H) = \varphi_H$

- Q.4(b) Evaluate the Galerkin's integrals using linear elements [3] 2 4

- Q.5(a) Obtain the nodal displacement for the beam shown below. The governing eq. is [2] 3 4



where all elements lengths are equal and  $EI = 2(10^{10}) \text{ N.cm}^2$

- Q.5(b) Derive the global stiffness matrix of the above problem by direct formulation method [3] 3 1

:::::22/09/2023 M:::::