BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP2023)

CLASS:	**BTECH**		**SEMESTER : V**
BRANCH:	**MECHANICAL**		**SESSION : SP2023**

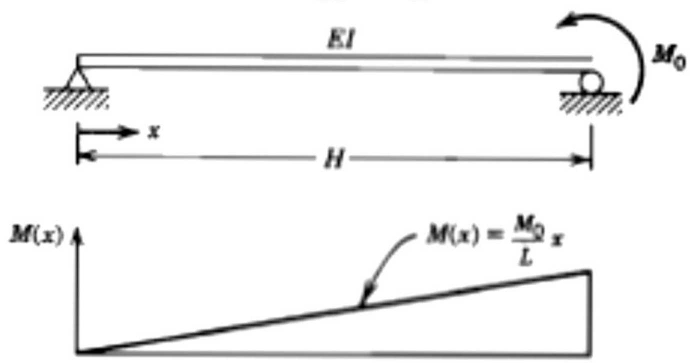
SUBJECT: ME351 FINITE ELEMENT METHODS

TIME:	**02 Hours**		**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 FEM And FVM.	[2]	1	2
Q.1(b)	Obtain an approximate displacement equation by Galerkin's method for the simply supported beam shown in Figure using the trial solution y(x)=Asin(πx/H).The governing differential equation is	[3]	1	4

$$EI\frac{d^2y}{dx^2} - \frac{M_o x}{H} = 0$$



Q.2(a)	What are the rules for the placement of nodes?	[2]	1	1
Q.2(b)	Explain the various steps of FEM	[3]	1	2
Q.3(a)	What are the properties of the shape function?	[2]	2	1
Q.3(b)	Check whether the below shape function satisfy all the properties of shape function	[3]	2	3

$$N_i = \frac{2}{L^2}(x - X_j)(x - X_k)$$
$$N_j = -\frac{4}{L^2}(x - X_i)(x - X_k)$$
$$N_k = \frac{2}{L^2}(x - X_j)(x - X_i)$$

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

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

Boundary conditions φ(0)= φ_0 and φ(H)= φ_H

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

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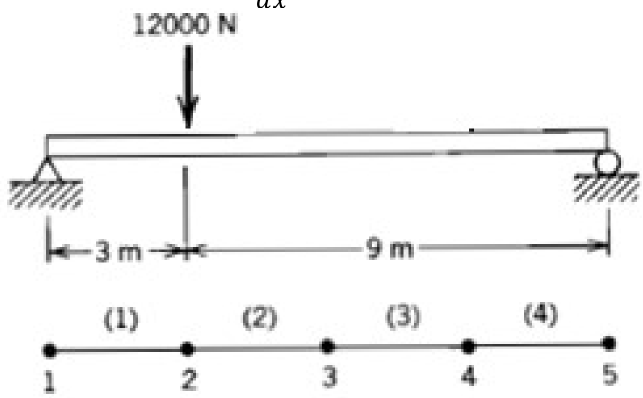
Q.5(a) Obtain the nodal displacement for the beam shown below. The governing eq. is [2] 3 4

$$EI\frac{d^2y}{dx^2} - M(x) = 0$$



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

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

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