JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

M.Tech-1st Semester (CE)

COURSE CODE (CREDITS): 25M1WCE114 (3) MAX. MARKS: 35

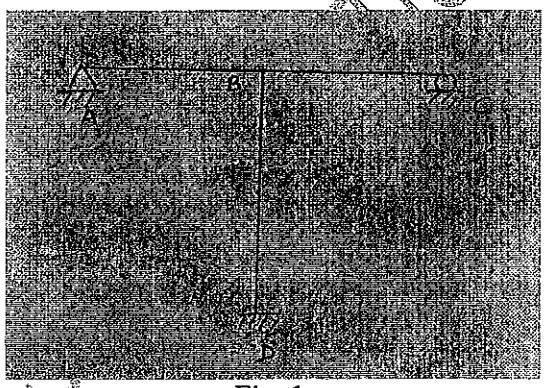
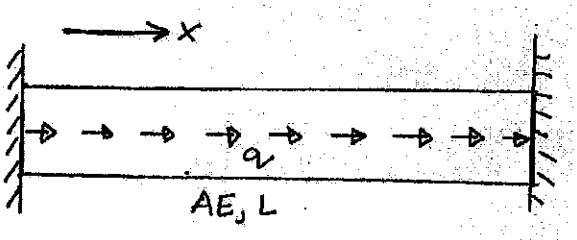
COURSE NAME: FINITE ELEMENT METHODS

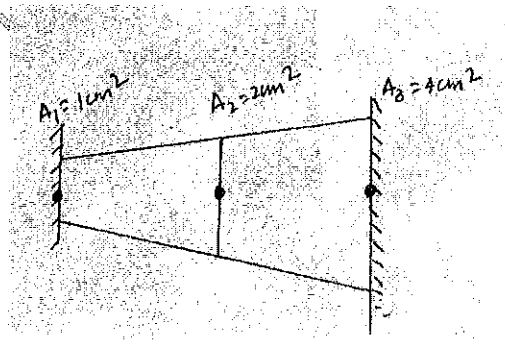
COURSE INSTRUCTORS; DR SAURAV MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

(c)Use of Non Programmable Scientific Calculator is allowed

Q.No	Question	CO	Marks
Q1	Set up a structural equilibrium equation in Matrix form for the frame as shown in Fig. 1 by Potential energy method. For AB, EI= 1 For BC, EI= 2 and For BD, EI= 3  Fig. 1	1	6
Q2	Find the stress at the support and in the middle for the system shown in Fig. 2. Use the following displacement field. **h** is the unknown displacement in the field $U=\frac{4hx(l-x)}{l^2}$  Fig. 2	1	7

Q3.	A truss member ij is oriented at an angle α measured counterclockwise from the global (structure) axis system X_S–Y_S to the local (member) axis system X_M–Y_M. A translation vector at end i has components A_{XS} and A_{YS} in the structure axis system. a) Derive the expressions for the corresponding components A_{XM} and A_{YM} in the member axis system. b) A force vector acting on a plane truss member is defined in the member coordinate system as $\{A_M\}=\begin{bmatrix} 2 \\ -1 \end{bmatrix}$ If the member axis is rotated by 45° counterclockwise from the structure axis, express this vector in the structure coordinate system.	2	6
Q3.	Compute the following integrals i) $\oint 2\, L_1^2 L_2^2 L_3^3$ dA ii) $\oint L_1{}^2\ L_2 L_4$ dV Where L_1, L_2 L_3 and L_4 are natural coordinates	3	3
Q4.	i) Explain how the strain–displacement relationship is formulated for a CST element. Derive the strain–displacement matrix [B] for a CST. ii) A constant strain triangle (CST) element has the following nodal coordinates: Node 1: 1,2 Node 2: 6,2 Node 3=3,7. Using these coordinates, compute the geometric coefficients b_1,b_2,b_3 andc_1,c_2,c_3 and form the strain–displacement matrix [B] for this CST element.	3	6
Q5	Find stresses at various points of the system as shown in the Fig. 3. EI= 1  Fig. 3	4	7