PVP 23

Code: 23ME3603

III B.Tech - II Semester - Regular Examinations – APRIL 2026

FINITE ELEMENT METHODS
(MECHANICAL ENGINEERING)

Duration: 3 hours   Max. Marks: 70

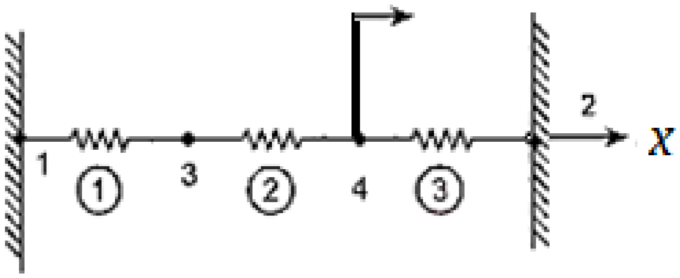
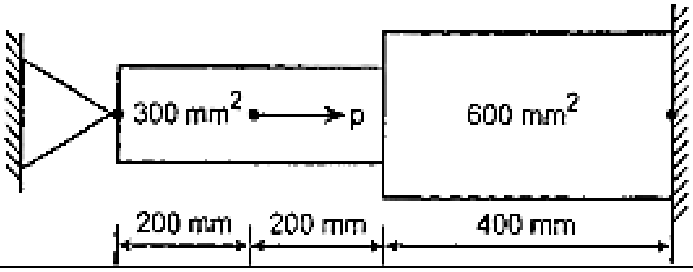
Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

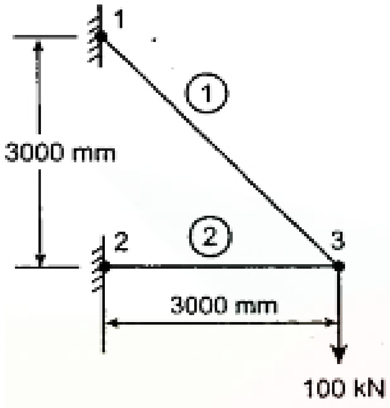
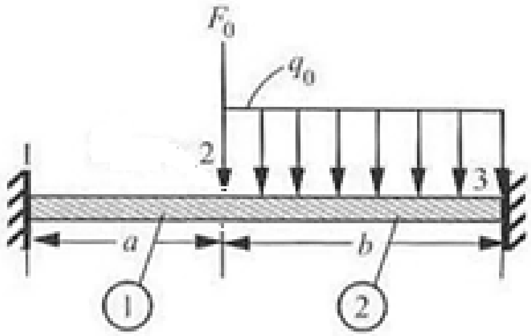
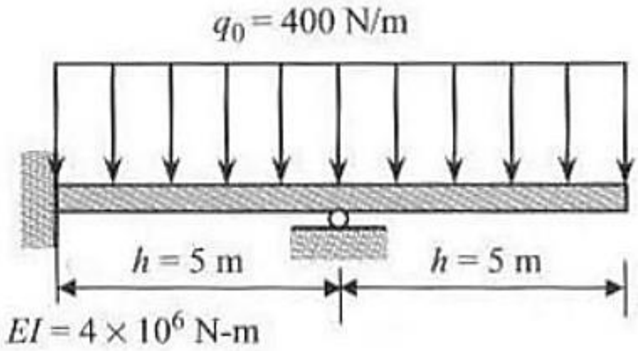
BL – Blooms Level   CO – Course Outcome

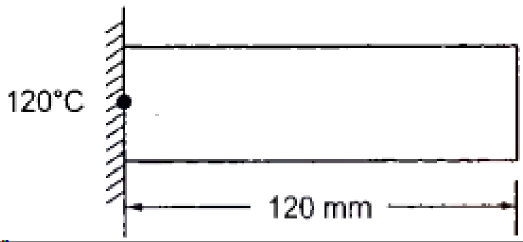
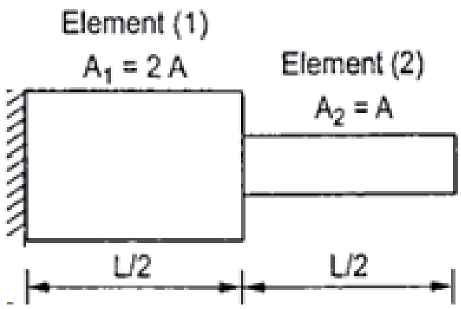
PART – A

		BL	CO
1.a)	Give examples of plane strain conditions.	L1	CO1
1.b)	Write statement for the principle of minimum potential energy.	L1	CO1
1.c)	What are the different 2-D elements available in FEM?	L2	CO2
1.d)	Write stiffness matrix for a 2-D truss element.	L2	CO2
1.e)	What is lumped load vector for 1-D beam element?	L2	CO3
1.f)	How is beam element different from 1-D bar element?	L2	CO3
1.g)	What is Constant Strain Triangular element (CST)?	L2	CO4
1.h)	What is the meaning of super-parametric formulation?	L1	CO4
1.i)	Write the general 1-D heat transfer equation.	L2	CO5
1.j)	What are possible boundary conditions for a fin problem?	L2	CO5

PART – B

			BL	CO	Max. Marks
UNIT-I					
2	Derive the D matrix for 3-D stress strain relations from fundamentals.		L2	CO1	10 M
OR					
3	A spring assemblage with arbitrarily numbered nodes is shown in fig. The Nodes 1 and 2 are fixed and a force of 500kN is applied at node 4 in the x-direction. Calculate Nodal displacements. Take spring constants K_1 =100kN/m, K_2 = 200kN/m and K_3 = 300kN/m.  		L3	CO1	10 M
UNIT-II					
4	Consider the stepped bar shown in fig. Obtain Nodal displacements and Support reactions. Take E = $2x10^5 N/mm^2$. Load P = 400kN.  		L3	CO2	10 M
OR					
5	Find the unknown nodal displacements of the truss shown in fig. Take A_1 = $500mm^2$, A_2 =$1200mm^2$ and E = $2x10^5$ N/mm^2.		L3	CO2	10 M

				
UNIT-III				
6	Model the beam problem with two elements shown in fig. Find displacements at node 2. 	L4	CO3	10 M
OR				
7	Model the problem shown in fig. using two 1-D beam elements. Determine displacements at the nodes. 	L4	CO3	10 M
UNIT-IV				
8	Explain the axi-symmetric formulation in Finite Element Analysis. Also derive the strain–displacement relations for axi-symmetric elements and explain force vector in detail.	L2	CO4	10 M

OR					
9	a)	Compute the integral $\int_{-1}^{+1}\left(x^3+5x^2-6\right)dx$ using the Gaussian 2 point formula.	L3	CO4	7 M
	b)	Obtain Jacobian for 4-node quadrilateral element.	L3	CO4	3 M
UNIT-V					
10	Calculate the temperature distribution in a 1-D fin shown in the fig. The fin is rectangular in shape and is 120mm long, 40mm wide and 10mm thick. Assume that tip is insulated. Use two elements. Take k = 0.3 W/mm˚C, h = 1× 10^{-3} W/$m^{2˚}$ C, T_∞ = 20˚C. 		L3	CO5	10 M
OR					
11	Find the natural frequency of longitudinal vibration for the stepped bar as shown in fig. Take L = 400mm, A= 600 mm^2, E = 2×10^5 N/mm^2, ρ = 0.8 × 10^{-4} kg/mm^3. 		L3	CO5	10 M