K. K. Wagh Institute of Engineering Education & Research, Nashik

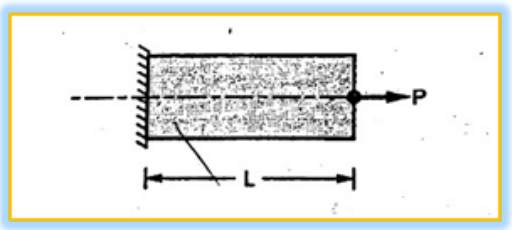
(An Autonomous Institute From A.Y. 2022-23)

WINTER-2025	
Exam Seat No.:	
Academic Year:2025-2026	Semester:VI
Class:TY	Program:B.Tech
Branch Code:MEC	Pattern:2022
Name of Course:Finite Element Analysis	Course Code:MEC223014A
Max. Marks:60	Duration:2.30 Hrs.

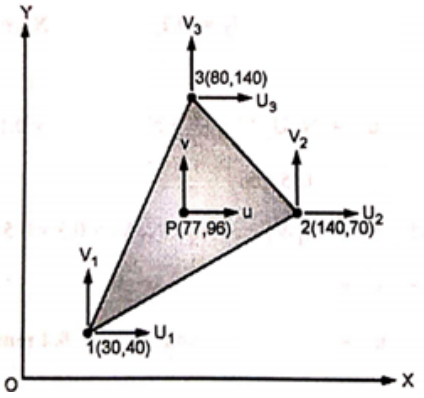
Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 03 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome of the Question/sub-question.

		Marks	CO
Question No. 1			
1a)	Illustrate Applications, Advantages, Disadvantages of Finite Element Analysis	(6)	CO1
Question No. 2			
2a)	Apply direct stiffness method to determine the nodal displacement at load point, strains, stresses and reaction for the case of 1D bar subjected to an axial concentrated load shown in Fig.	(6)	CO2



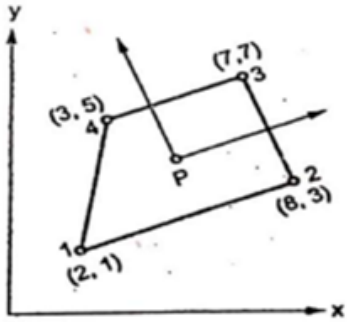
Question No. 3			
3a)	In a triangular element node 1, 2, and 3 has cartesian co-ordinates (30, 40), (140, 70) and (80, 140) respectively. Displacement at node 1, 2,and 3 are (0.1, 0.5), (0.6, 0.5) and (0.4, 0.3) respectively. Point P within element has cartesian co-ordinates (77, 96). For point P, determine (i) Natural Co-ordinates (ii) Shape Functions (iii) Displacement	(8)	CO3



OR

3b) The nodal coordinates and the nodal displacements of a triangular element, under a specific load condition are given below.X1 = 0, Y1 = 0, X2 = I mm, Y2 = 3 mm, X3= 4 mm, Y 3 = I mm, U1 = 1 mm, V1 = 0.5 mm, U2 = -0.05 mm, V2 = 1.5 mm, U3 = 2 mm, V3 = -1 mm. If E = 2 x 105 N/mm2 and υ = 0.3, analyze the stresses in the element (8) CO3

3c) Analyze the Cartesian co-ordinate of the point P ($\zeta = 0.5$, $\eta = 0.6$) of quadrilateral element (2, 1), (6, 3), (7, 7) and (3, 5) as shown in fig. (8) CO3

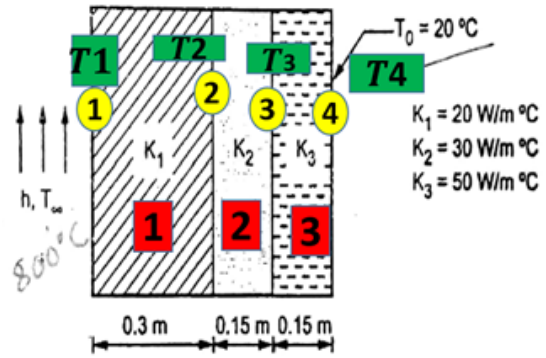


OR

3d) Illustrate with suitable diagram (i) Shape Function (ii) Properties of Shape Function (iii) Pascal's Triangle (iv) Displacement Function derived from Pascal's Triangle (8) CO3

Question No. 4

4a) A Composite wall consists of 3 materials as shown in fig. Outer temperature is $T_0 = 20°C$. Convection heat transfer takes place on the inner surface of wall with $T_\infty = 800°C$ and $h = 25 W/m^2 {}^0C$. Determine temperature distribution in the wall. (8) CO4

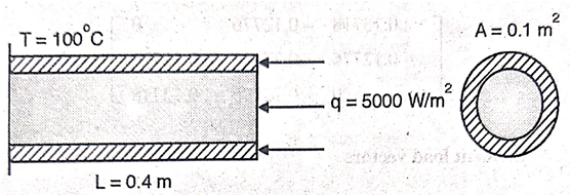


OR

4b) A metallic rod, with thermal conductivity 80 W/m ^oC, 2 cm dia and 6 cm long extends from a plane wall whose temperature is 150°C. Analyze the temperature distribution along the rod if heat is (8) CO4

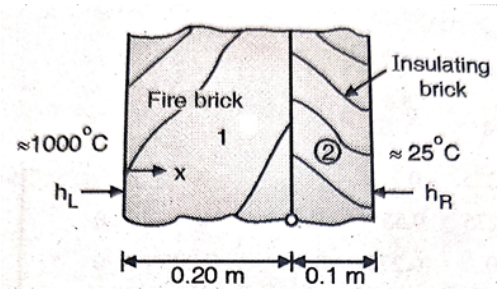
transferred to ambient air at 50°C with heat transfer coefficient of $6*10^4$ W/m^2 °C. Take two elements

4c) The fin as shown in Fig. is insulated on the perimeter. The left end has a constant temperature of 100°C. A positive heat flux of q = 5000 W/m^2 acts on the right end. Let K_{xx} = 6 W/m °C and cross sectional area A = 0.1 m^2. Determine the temperatures at L/4, L/2, 3L/4 and L where L = 0.4 m. (8) CO4



OR

4d) A composite wall shown as shown in fig., is composed of two homogeneous slabs in contact. Let thermal conductivities be K_1 = 1 W/m °C for firebrick slab 1 and K_2 = 0.3 W/m °C for insulating slab 2. The left side is exposed to an ambient temperature $T_{\infty L}$ = 1000°C inside the furnace with heat transfer coefficient of h_L = 10 W/m^2°c. The right side ambient temperature is $T_{\infty R}$ = 25°C outside of furnace with heat transfer coefficient of h_R = 3 W/m^2°c. The thickness of the slabs are L_1 = 0.2 m and L_2 = 0.1 m. Determine the temperature at the left edge, point between the two slabs and right edge of the composite wall. (8) CO4



Question No. 5

5a) Illustrate the terms with suitable diagram (i) Dynamic Analysis (ii) Free Vibrations (iii) Forced Vibrations (iv) General steps in vibration analysis (8) CO5

OR

5b) Find Eigenvalues and Eigenvectors of (8) CO5

$$\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$$

5c) What is mean by Eigen Values and Eigen Vector? How it is related to Modal analysis of structures? (8) CO5

OR

5d) Differentiate between (i) Consistent Mass Matrix and (ii) Lumped Matrix (8) CO5

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