Register No : ___________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

M.E DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025

Second Semester

Product Design and Development

PPDT2421 - Finite Element Methods in Mechanical Design

Regulations - 2021

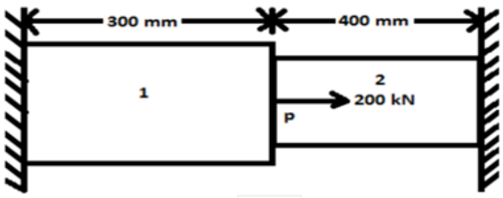
Duration : 3 Hrs *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q. No	*Questions*	*BLT*	*CO*	*Marks*
1.	What are the types of problems treated as one dimensional problem?	L1	1	2
2.	State the differences between Quadric and linear bar element.	L3	1	2
3.	State the applications for scalar variable problems.	L3	2	2
4.	How do you define two dimensional elements?	L1	2	2
5.	Define iso-parametric elements.	L2	3	2
6.	What is the difference between natural coordinates and local coordinates?	L1	3	2
7.	List the types of dynamics analysis problems?	L2	4	2
8.	What is meant by longitudinal vibration?	L1	4	2
9.	Discuss the stress stiffening.	L3	5	2
10.	Justify way do you achieve mesh quality.	L3	5	2

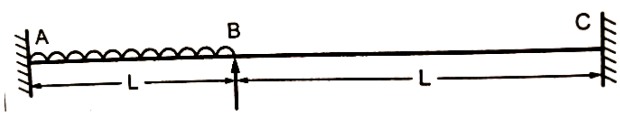
*PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	Consider a bar as shown in Fig. An axial load of 200 kN is applied at point p. Take A_1 = 2400 mm², E_1 = 70 × 10^9 N/m², A_2 = 600 mm², E, = 200 x 10^9 N/m². Calculate the following: (a) The nodal displacement au point p. (b) Stress in each material. (c) Reaction force	L3	1	16

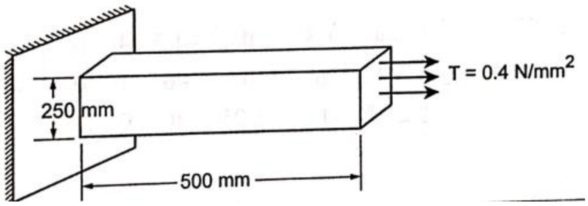


Or

	b	A fixed beam of length 2 L m carries a uniformly distributed load of w (N/m) which run over a length of L m from the fixed end, as shown in Fig. Calculate the rotation at point B.	L3	1	16

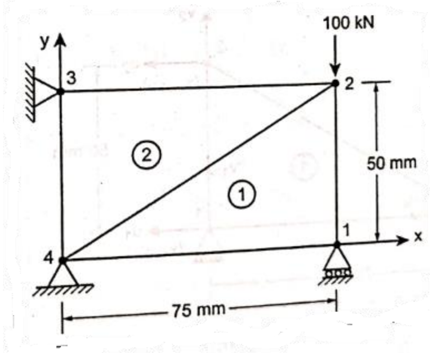


12. a A thin plate is subjected to surface traction as shown in Fig. Calculate the global stiffness matrix. L2 2 16

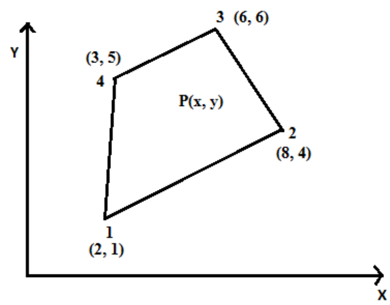


Or

b Determine the nodal displacements of nodes 1 and 2 and the element stresses for the two-dimensional loaded plate as shown in Fig. Assume plane stress condition. Take, v= 0.25, E = 2 × 105 N/mm², Thickness = 15 mm. L2 2 16

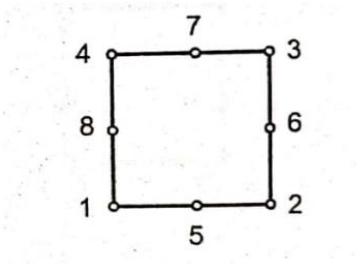


13. a For the isoparametric quadrilateral element shown in Fig, the Cartesian coordinates of point ‘P’, are (6,4). The loads 10 kN and 12 kN are acting in x and y direction on that point P. Evaluate the nodal forces. L5 3 16

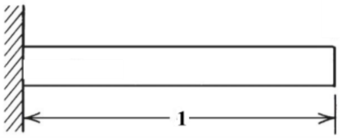


Or

b Consider the eight-node quadrilateral element defined by the following nodal coordinates: $x_1 = 5$, $y_1 = 7$, $x_2 = 1$, $y_2 = 4$, $x_3 = 2$, $y_3 = 1$, $x_4 = 8$, $y_4 = 4$, $x_5 = 3$, $y_5 = 3$, $x_6 = 6$, $y_6 = 5$, $x_7 = 2.5$, $y_7 = 3$, $x_8 = 1.5$ and $y_8 = 2$ Determine global coordinates that corresponds $\eta = 1$ and E = 0.75. L5 3 16

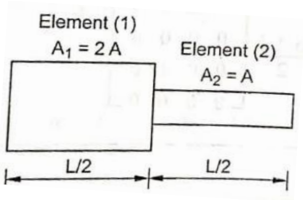


14. a Consider a bar shown in Fig. Let the length L = 1m, E = $2X10^{11}$ N /m^2 are of cross section A = $300cm^2$ and density 7800 Kg/m^3. By taking two element, estimate the natural frequencies of axial vibration of the bar using lumped and consistent mass matrix. L5 4 16

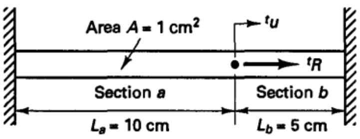


Or

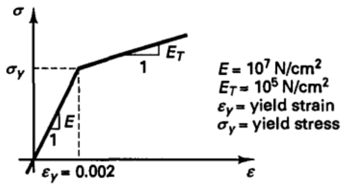
b Find the natural frequency of longitudinal vibration of the unconstrained stepped bar as shown in Fig. L5 4 16



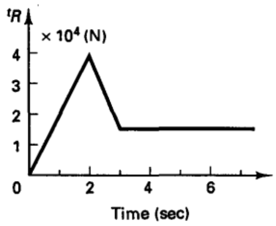
15. a A bar rigidly supported at both ends is subjected to an axial load as shown in Fig. (a) The stress-strain relation and the load-versus-time curve relation are given in Fig. (b) and (c), respectively. Assuming that the displacements and strains are small and that the load is applied slowly, calculate the displacement at the point of load application. L5 5 15



(a) Simple bar structure



(b) Stress-strain relation (in tension and compression)



(c) Load variation

Or

b A four-node element is stretched until time t and then undergoes without distortion a large rigid body rotation from time to time t + ∇t as depicted in Fig. Show explicitly that for the element the components of the Green-Lagrange strain tensor at time t and time t + ∇t are exactly equal. L5 5 16