Register No: ____________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

M.E DEGREE END SEMESTER THEORY EXAMINATIONS, APRIL-MAY 2025

Second Semester

Product Design and Development

ED4251/PPDT2421 – Finite Element Methods in Mechanical Design

Regulations – 2021/2024

Duration : 3 Hrs ***Maximum: 100 Marks***

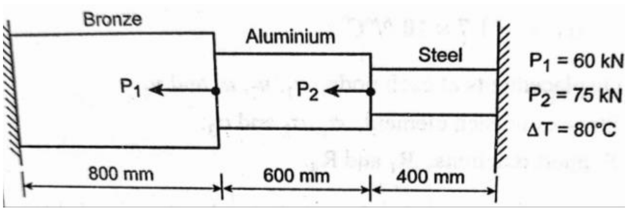
*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	Questions	BLT	CO	Marks
1.	What are the applications of Ritz method?	L1	1	2
2.	Define the three phases of finite element method.	L1	1	2
3.	How do you define two dimensional elements?	L1	2	2
4.	Compare the CST and LST elements.	L2	2	2
5.	List the types of non-linearity.	L1	3	2
6.	Illustrate the purpose of isoperimetric element.	L2	3	2
7.	State the principle of superposition.	L1	4	2
8.	Classify the types of Eigen value problems.	L2	4	2
9.	Interpret the element used for Nonlinear analysis and specify its nodal degrees of freedom.	L2	5	2
10.	Compare the elasto plastic and viscoplastic behaviour of materials.	L2	5	2

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

Q.No		Questions	BLT	CO	Marks
11.	a	The structure shown in Fig. is subjected to an increase in temperature of 80°C. Determine the displacements, stresses and support reactions. Assume the following data:	L3	1	16

Bronze	Aluminum	Steel
A = 2400mm^2	A = 1200mm^2	A = 600mm^2
E = 83 GPa	E = 70 GPa	E = 200 GPa
α = 18.9 × 10^{-6}/°C	α = 23 × 10^{-6}/°C	α = 11.7 × 10^{-6}/°C

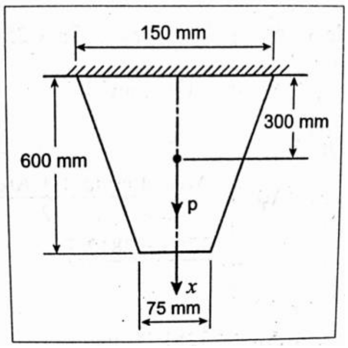


Or

	b	Consider a taper steel plate of uniform thickness, t = 25mm as	L3	1	16

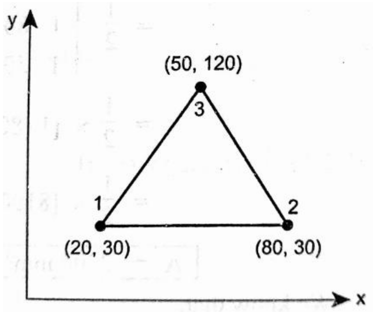
shown in Fig. The young's modulus of the plate, $E = 2 \times 10^5$ N/mm^2 and weight density, $\rho = 0.82 \times 10^{-4}$ n/mm^3. In addition to its self-weight, the plate is subjected to a point load p = 100N at its mid-point. Calculate the following by modeling the plate with two finite elements:

(i) Global force vector {F}.
(ii) Global stiffness matrix [K]
(iii) Displacements in each element.
(iv) Stresses in each element.
(v) Reaction force at the support.



12. a Estimate the stiffness matrix for the constant strain triangular element shown in Fig. The co-ordinates are given in units of millimeters. Assume plane stress conditions. L5 2 16

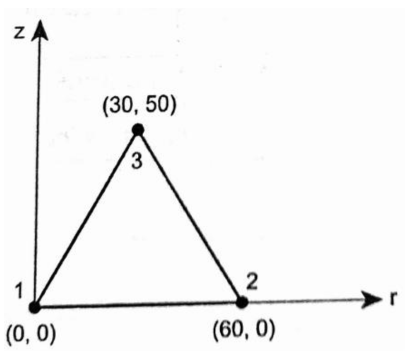
Take E = 210GPa, v = 0.25 and t = 10mm.



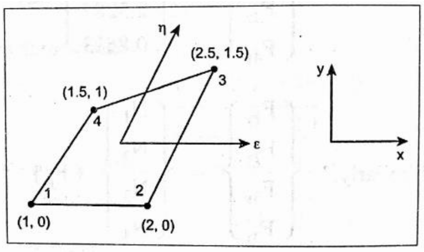
Or

b Determine the element stresses for the axis symmetric element shown in fig. Take $E = 2.1 \times 10^5$ N/mm^2 and v = 0.25.The coordinates shown in Fig are in mm. The Nodal displacements are: L5 2 16

$u_1 = 0.05mm$ $w_1 = 0.03$ mm
$u_2 = 0.02mm$ $w_2= 0.02$ mm
$u_3 = 0$ mm $w_3 = 0$ mm

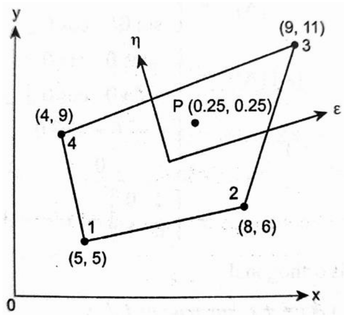


13. a Evaluate the Jacobian matrix for the isoperimetric quadrilateral element shown in figure. L5 3 16

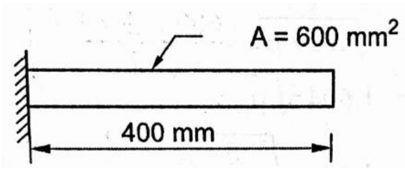


Or

b Evaluate [J] at ε = η = 0.25 for the linear quadrilateral element shown in figure. L5 3 16



14. a Determine the natural frequency of longitudinal vibration using two elements of equal length as shown in fig. Take E = 2×10^5 N/mm^2, ρ = 0.8×10^{-4} N/mm^3, and L = 400mm. L3 4 16



Or

b Solve the eigen values and eigen function of $y'' - 4xy' + 4\lambda^2 y = 0$; with boundary conditions are, $y(0) = 0$, $y(1) + y'(1) = 0$. L3 4 16

15. a Discuss the following: L2 5 16

(i) Free and mapped meshing

(ii) Error Estimate

Or

b Explain the solution techniques for non-linear problems with examples. L2 5 16