Register Number:……………..

B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Sixth Semester

MECHANICAL ENGINEERING

U18MEI6203: Finite Element Analysis

COURSE OUTCOMES

CO1: Solve problems by applying standard finite element techniques

CO2: Analyze 1-D finite elements and to build the stiffness matrix

CO3: Examine 2-D finite element continuum for structural applications

CO4: Solve 1-D and 2-D heat transfer problems using finite element approach.

CO5: Apply axisymmetric formulation for specific applications.

CO6: Make use of finite element principles in iso-parametric applications

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions: -

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

1	State the three phases of finite element method.	CO1	[K_2]
2	List out the advantages of finite element method over other numerical analysis method.	CO1	[K_2]
3	What is the need for developing the overall stiffness matrix of the entire structure in terms of its global coordinate system? Give example	CO2	[K_3]
4	What are the h and p versions of finite element method?	CO2	[K_3]
5	Write down the nodal displacement equation for a two dimensional triangular elasticity element?	CO3	[K_3]
6	State whether plane stress or plane strain elements can be used to model the following structures with reasons. a. A wall subjected to wind load b. A wrench subjected to a force in the plane of the wrench	CO3	[K_3]
7	Write the conduction, free end convection and thermal load matrices for 1D heat transfer through a fin	CO4	[K_2]
8	Give four examples of practical applications of axisymmetric applications	CO5	[K_2]
9	When isoperimetric elements are used?	CO6	[K_2]
10	Write down the shape functions for 4 noded rectangular elements using natural coordinate system	CO6	[K_2]

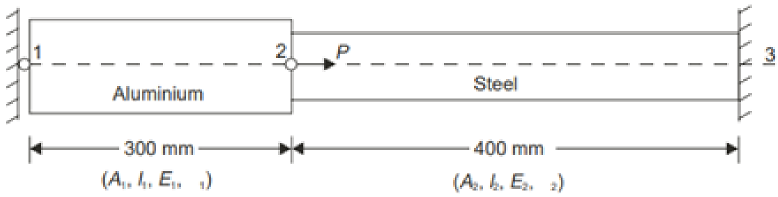
Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. a) For the differential equation: $d/dx\ [(1 + x)\ dy\ dx] = 0$ for $0<x<1$ with the boundary conditions: y (0) = 0 and y (1) = 1, obtain a two parameter Ritz approximation for the solution using Rayleigh-Ritz method — 10 — CO1 — [K_2]

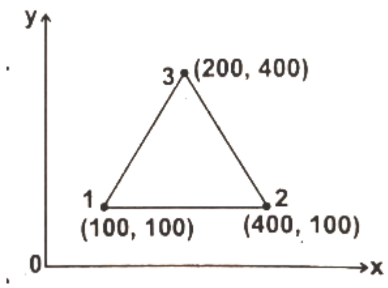
b) State the different types of analysis that can be carried out using finite element analysis. Explain anyone of them briefly. — 06 — CO1 — [K_2]

12. Consider a bar as shown in Fig. An axial load of P=200 kN is applied at point 2. Consider the following data. — 16 — CO2 — [K_3]

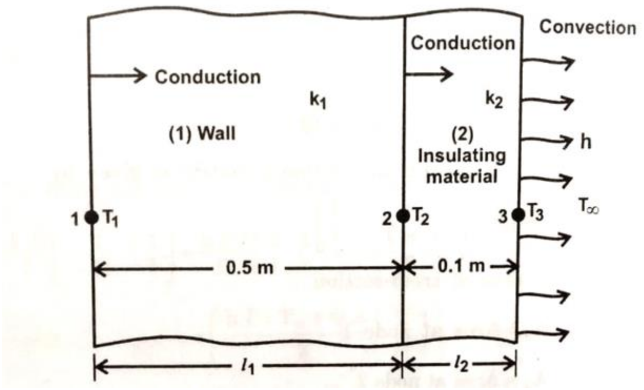
$A_1 = 2400\ mm^2$. $A_2 = 600\ mm^2$
$E_1 = 70 \times 10^9\ N/m^2$.$E_2 = 200 \times 10^9\ N/m^2$
Determine the following:
(a) Nodal displacements at node 2,
(b) Stresses in each material



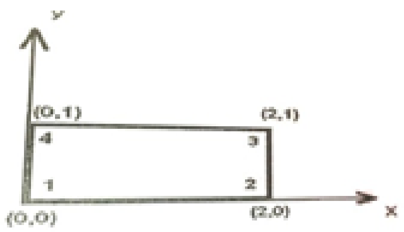
13. For the plane stress element shown in figure. The nodal displacements are — 16 — CO3 — [K_3]
u_1=2 mm, v_1=1 mm,
u_2= 1 mm, v_2=1.5 mm,
u_3= 2.5 mm ,v_3=0.5 mm.
Determine the element stresses. Assume E = 200 GN/m^2 : μ = 0.3 and t = 10 mm. All coordinates are in millimeters.



14.	a)	A wall of 0.5 m thickness having thermal conductivity of 6 W/mk. The wall is to be insulated with a material of thickness 0.1 m having an average thermal conductivity of 0.3 W/mk. The inner surface temperature is 1200°C and outside of the insulation is exposed to atmospheric air at 30°C with heat transfer co-efficient of 40 W/m^2 k. Calculate the nodal temperature.	10	CO4	[K_3]



	b)	What are the different types of elements? Explain the significance of each.	06	CO1	[K_2]
15.	a)	Evaluate the strain-displacement matrix for the axisymmetric element as shown in figure. Take E = 2.1 x 10^5 N/mm^2, ν = 0.25. The coordinates are in mm .	10	CO5	[K_3]
	b)	Distinguish plane stress and plane strain analysis with suitable examples.	06	CO3	[K_2]
16.	a)	For the four noded element shown in figure, determine the Jacobian matrix and evaluate its value at the point (0,0). .	10	CO6	[K_5]



	b)	Evaluate by applying 3 point Gaussian quadrature and compare with the exact solution.	06	CO6	[K_3]

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