KUMARAGURU
college of technology
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B.E/B.TECH DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Fifth Semester

AUTOMOBILE ENGINEERING

U18AUI5204**:** Finite Element Analysis

COURSE OUTCOMES

CO1: Recognize the concepts of finite element method.

CO2: Formulate the finite element techniques for design problems.

CO3: Devise equations in finite element analysis for 1D, 2D and 3D problems.

CO4: Analyze and Solve problems in heat transfer and structural mechanics.

CO5: Apply finite element techniques for Non-Linear Analysis.

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

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

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1. Enlist the disadvantages of adopting FEA method in solving problems.	CO1	[K$_2$]
2. Enumerate the different applications of FEA.	CO1	[K$_2$]
3. Name the different element shapes used in the discretization of FEA.	CO2	[K$_1$]
4. List different coordinate systems used in FEA.	CO2	[K$_1$]
5. Define CST Element.	CO3	[K$_1$]
6. Explain plane stress Analysis.	CO3	[K$_2$]
7. Write the governing equation for conduction and convection in 1-D problems.	CO4	[K$_1$]
8. Define Isoparametric elements.	CO4	[K$_1$]
9. Explain theory of minimum potential energy.	CO1	[K$_2$]
10. Give two examples for nonlinear problems in FEA.	CO5	[K$_1$]

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

11.	a)	With the help of flow chart explain the steps involved in FEM	8	CO1 [K$_2$]
	b)	Solve the following differential equation using Galerkin's method.	8	CO1 [K$_3$]

$$d^2y/dx^2 + x + y = 0,\ 0 \le x \le 1$$

subjected to boundary conditions $y(0) = y(1) = 0$

12.	a)	Derive the element stiffness matrix for a 1-D bar element.	8	CO3	[K$_3$]
	b)	For the two-bar truss as shown in the figure, determine the nodal displacements in each member. Take E = 210 x 10^9 N/m^2, Area of element = 0.01m^2	8	CO2	[K$_3$]
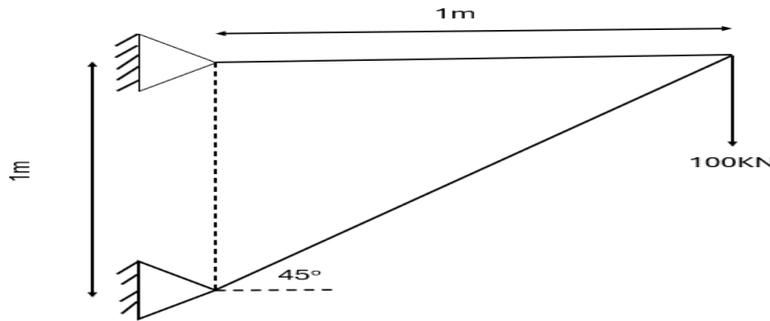
13.	a)	Derive the strain displacement matrix [B] for CST.	8	CO3	[K$_3$]
	b)	Find the element stiffness matrix for the below CST element, Poisson's ratio, γ = 0.15, E = 210 x 10^5 N/mm^2	8	CO3	[K$_3$]
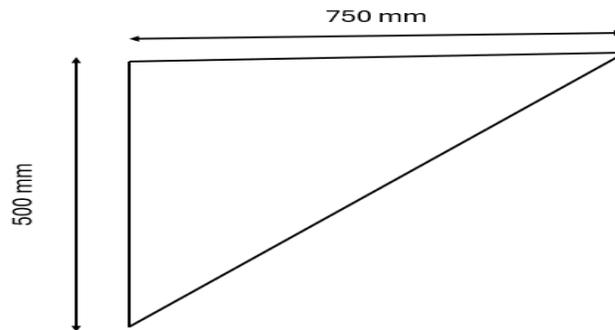
14.	a)	Derive the element stiffness matrix for Conduction heat transfer.	6	CO4	[K$_3$]
	b)	A wall of 0.5m thickness has a thermal conductivity of 6 W/mK. The wall is to be insulated with a material of thickness 0.1m having an average thermal conductivity of 0.3 W/mK. The inner surface temperature is 1200°C and the outside of the insulation is exposed to atmospheric air at 30°C with a heat transfer coefficient of 40 W/m^{2}K. Determine the nodal temperatures.	10	CO4	[K$_3$]
15.	a)	Derive iso-parametric shape functions for 1D linear and 2D quadrilateral elements.	10	CO5	[K$_3$]
	b)	Discuss the solution techniques to dynamic problems in FEA.	6	CO5	[K$_2$]
16.	a)	Explain different types of non linearity and write the governing non-linear differential equation.	8	CO5	[K$_2$]
	b)	Discuss the solution techniques of non-linear problems in FEA.	8	CO5	[K$_2$]

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