Reg. No. : | | | | | | | | | | | | |

Question Paper Code:U1102

M.E. DEGREE EXAMINATION, NOV/DEC 2024

First Semester

CAD / CAM

21PCD102-ADVANCED FINITE ELEMENT ANALYSIS

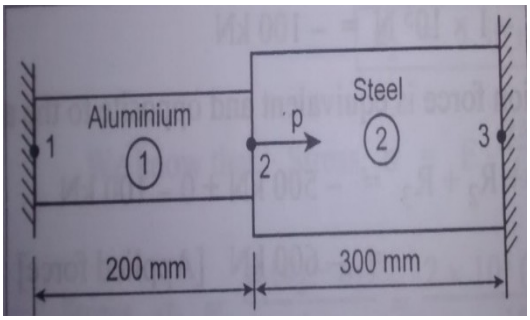
(Regulations 2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART - A (5 x 20 = 100 Marks)

1.	(a)	Evaluate the effect of using $C^0$and C^1continuity elements on the accuracy of bending stress prediction in a square plate under uniform pressure. Discuss their performance with respect to computational cost and convergence.	CO4 - Ana	(20)
		Or		
	(b)	Analyze the impact of mesh refinement on the accuracy of plate bending solutions using finite element analysis. Discuss possible issues like shear locking and how they can be mitigated.	CO4 - Ana	(20)
2.	(a)	An axial load of $4x10^5$ N is applied at 30°C to the rod as shown in the figure. The temperature is then raised to 60°C. For Aluminium: A1 = 1000 mm^2 E1 = 0.7 x 10^5 N/mm^2 Thermal coefficient = 20 x 10^{-6}/ degCelcius For Steel: A2 = 1500 mm^2 E2 = 2x 10^5 N/mm^2 Thermal coefficient = 12 x 10^{-6}/ degCelcius. Calculate and Analyze the following: (i) Assemble the K and F matrices iii) Nodal Displacements (ii) Stresses in each material iv) Reactions at each nodal point	CO4 - App	(20)



Or

(b) Consider a three bar truss as shown in figure. It is given that E= $2x10^5$ N/mm^2. CO4 - App (20)

Take Area of Element (1) = 2000 mm^2

Area of Element (2) = 2500 mm^2

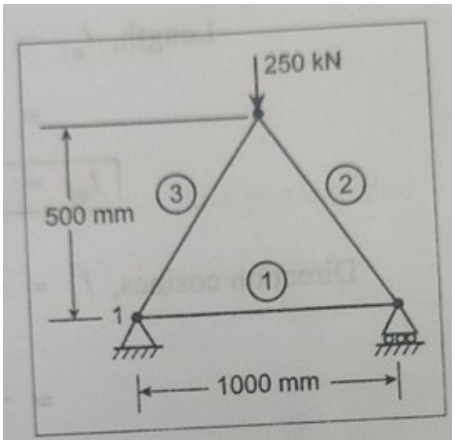
Area of Element (3) = 2500 mm^2

Calculate and Analyze the following:

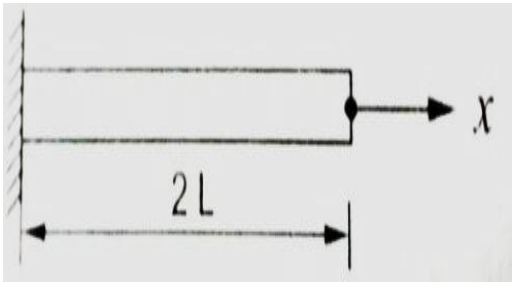
(i) Displacements in each element.

(ii) Stresses in each elements

(iii) Reaction force at the support.

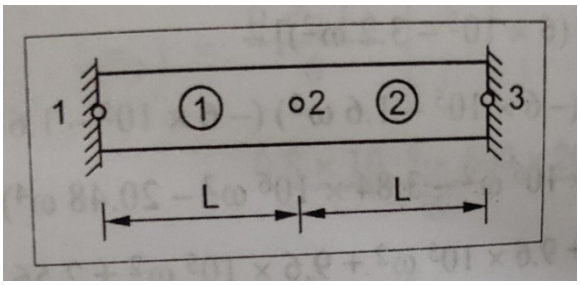


3. (a) For a bar as shown in figure with length 2L, modulus of elasticity E, mass density ρ and cross sectional area A, Compare the first two natural frequencies. CO4 - Ana (20)



Or

(b) Compare the natural frequency of vibration for a beam fixed at both ends. The beam has mass density ρ, modulus of elasticity E, cross sectional area A, moment of inertia I, and length 2L. The beam is discretized into two elements of length L. CO4 - Ana (20)



4. (a) An aluminium alloy fin of 7mm thick and 50mm long protrudes form a wall, which is maintained at 120°C. The ambient air temperature is 22°C. The heat transfer coefficient and thermal conductivity of the fin material are 140W/m^{2}K and 55W/mK respectively. Evaluate the temperature distribution of fin. CO5 - App (20)

Or

(b) A wall of 0.6m thickness having thermal conductivity of 1.2 W/mK. The wall is to be insulated with a material of thickness 0.06 m having an average thermal conductivity of 0.3 W/mK. The inner surface temperature is 1000°C and outside of the insulation is exposed to atmospheric air at 30°C with heat transfer coefficient of 35 W/m^{2}K. Evaluate the nodal temperature. CO5 - App (20)

5. (a) Implement h-refinement with adaptive refinement for a finite element analysis of a cantilever beam. Describe the steps to perform the analysis, starting from error estimation, mesh refinement, and interpretation of results. CO3 - App (20)

Or

(b) Analyze the impact of the condition number on FEA solution accuracy in a structural analysis problem. Implement strategies to improve the condition number and re-evaluate the model. CO3 - App (20)