Code No.: ME603PC | R20 | H.T.No. | | | 8 | R | | | | | |

CMR ENGINEERING COLLEGE: : HYDERABAD
UGC AUTONOMOUS
III–B.TECH–II–Semester End Examinations (Supply) - January- 2024
FINITE ELEMENT METHODS
(MECH)

[Time: 3 Hours] **[Max. Marks: 70]**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 20 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART-A **(20 Marks)**

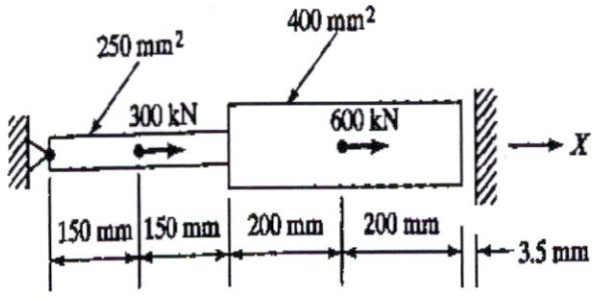
1. a) Explain the relationship between displacement and strain. [2M]
   b) Define degrees of freedom in FEM. [2M]
   c) What is Constant Strain Triangle in structural analysis? [2M]
   d) Outline the Hermite shape functions of the beam element. [2M]
   e) With suitable sketch briefly explain axi-symmetric loading. [2M]
   f) Write a short note on numerical integration. [2M]
   g) Explain the convection mode of heat transfer. [2M]
   h) Outline the importance of fin in heat transfer. [2M]
   i) List the desirable features of FEA packages. [2M]
   j) What are the advantages of ANSYS commercial software? [2M]

PART-B **(50 Marks)**

2.a) Define the role of boundary conditions in Finite Element Analysis. [7M]
   b) By using Galerkin method, find the approximate solution of $\frac{d^2y}{dx^2} + 500x^2 = 0$ with boundary conditions $y(0) = 0$; $y(1) = 0$; with assumed trail function $y = a_1(x-x^4)$. [3M]

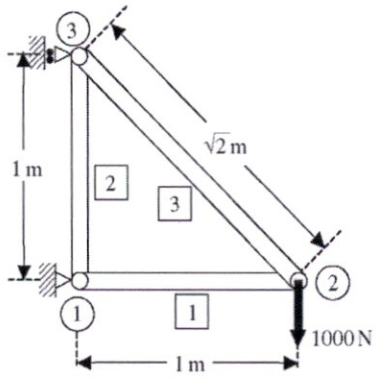
OR

3. Find the Deflections in the structure shown below. [10M]



$E = 200 \times 10^9\ N/m^2$

4. Determine the Displacements for the truss as shown in Fig. Consider E = 70 Gpa , A = 0.1 m^2 [10M]



OR

5. A concentrated load P = 50 kN is applied at the center of a fixed beam of length 3m, depth 200 mm and width 120 mm. Calculate the deflection at the midpoint. Assume E = 2 x 10^5 N/mm^2. [10M]

6. What is a CST Element? Starting from fundamentals, derive the stiffness matrices of CST Element. [10M]

OR

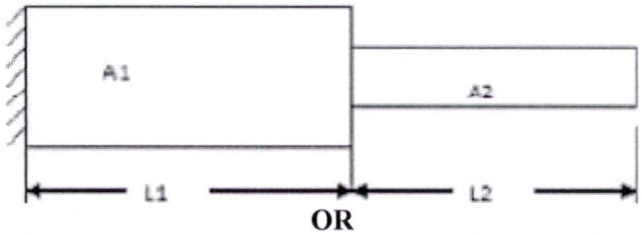
7. Derive the Stiffness matrix in the case of Axi Symmetric Modeling. [10M]

8. A metallic fin, with thermal conductivity 70 W/m °K, 1 cm radius and 5 cm long extends from a plane wall whose temperature is 140°C. Determine the temperature distribution along the fin if heat is transferred to ambient air at 20°C with heat transfer coefficient of $5W/m^2$ K. Take two elements along the fin. [10M]

OR

9. Derive the stiffness matrix for heat flow in a rectangular fin, where k, h and P denotes thermal conductivity, convective heat coefficient and perimeter of fin and A is area of cross section of fin. [10M]

10. For the stepped bar shown in the figure below, develop the global stiffness and mass matrices and determine the natural frequencies. [10M]
Assume: E = 200 GPa and mass density = 7850 kg/m3, $L_1 = L_2 = 0.3$ m,
$A_1 = 350\ mm^2$, $A_2 = 600\ mm^2$.



OR

11. Discuss the concept of element mass matrices in dynamic finite element analysis. How these matrices are derived and incorporated into the overall system matrices? Provide an example. [10M]

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