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

CMR ENGINEERING COLLEGE: : HYDERABAD
UGC AUTONOMOUS
III–B.TECH–II–Semester End Examinations (Regular) - May- 2023
FINITE ELEMENT METHODS
(MECH)

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

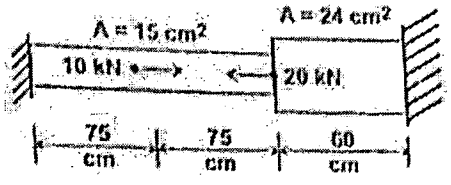
Note: This question paper contains two parts A and B.
Part A is compulsory which carries 20 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART-A **(20 Marks)**

1. a) What is the general procedure of the finite element method? [2M]
   b) What is a one-dimensional problem in the context of the finite element method? [2M]
   c) What is a truss and mention some common applications of trusses in mechanical engineering? [2M]
   d) What is the difference between a two-noded and a three-noded beam element? [2M]
   e) What is a constant strain triangle and how is it used in finite element analysis? [2M]
   f) What is the purpose of finite element modeling in axisymmetric solids subjected to Axi-symmetric loading? [2M]
   g) How is one-dimensional analysis used to model heat transfer in a fin? [2M]
   h) How do the geometric properties of a heat transfer structure affect the temperature distribution? [2M]
   i) How are the Eigenvalues and Eigenvectors calculated for a stepped bar in dynamic analysis? [2M]
   j) What is the difference between hexahedral and tetrahedral elements in 3D stress analysis? [2M]

PART-B **(50 Marks)**

2. For a stepped bar loaded as shown in figure. Determine a) Nodal displacements b) support Reactions. [10M]



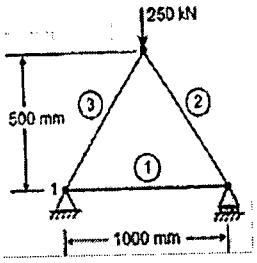
OR

3.a) Can you describe the general procedure of the Finite Element Method and how it is applied in engineering applications? [6M]
   b) How has the development of Finite Element Methods impacted the field of engineering [4M]

4. Consider a three-bar truss as shown in fig. it is given that E= $20x10^5$ N/mm^2. Calculate the following: [10M]

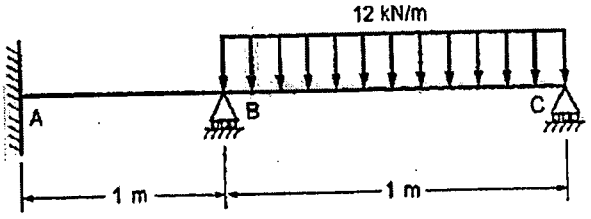
   i. Nodal displacements.
   ii. Stress in each member

Area of element (1) =2000mm^2
Area of element (2) =2500mm^2
Area of element (3) =2500mm^2

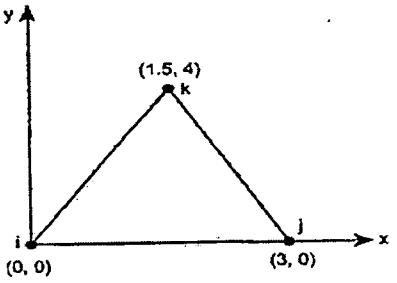


OR

5. For the beam and loading shown in fig, calculate the slopes at B and C. [10M]



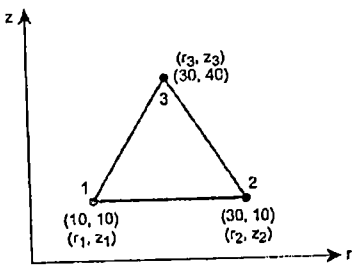
6. Evaluate the element stiffness matrix for the triangular element shown in fig, under plane stress conditions, Assume the following values; E=2X10^5 N/mm^2; v=0.3; t=10mm. [10M]



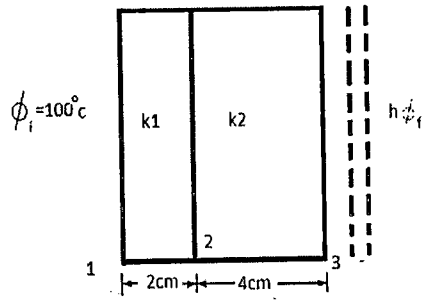
OR

7. The nodal co-ordinates for an axisymmetric triangular element are given below. [10M]

r_1=10mm; z_1=10mm
r_2=30mm; z_2=10mm
r_3=30mm; z_3=40mm
Evaluate [B] matrix for that element.

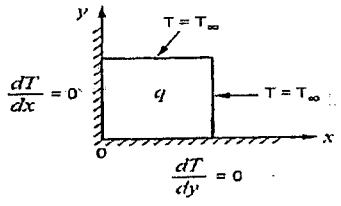


8. Determine the nodal temperatures in a composite wall shown in fig. the wall is maintained at 100^0C at the left face and convection mode of heat transfer occurs between the right face and the existing fluid. Thermal conductions are $K_1=0.06W/cm^0C$, $K_2=0.2$ W/Cm^0C, Convection co-efficient of heat transfer between walls and fluid $h=0.1W/cm^2\ ^0C$ and fluid is at $\emptyset_f=25^0C$. Consider unit area $A=1cm^2$ perpendicular to the direction of heat flow. [10M]



OR

9. Find the temperature distribution in a square region with uniform energy generation as shown in fig. Assume that there is no temperature variation in z-direction. Take $k=30W/cm^oc$, length $=10cm$, $T_\infty=50^oC$, $q=100W/cm^3$ [10M]



10.a) State the properties of Eigen Values [5M]

b) Determine the eigen values and the associated Eigen vectors of the matrix [A] given by [5M]

$$A = \begin{bmatrix} 3 & 4 \\ 4 & -3 \end{bmatrix}$$

OR

11.a) What are the convergence requirements for a finite element analysis? [5M]

b) How do you choose between hexahedral and tetrahedral elements for a finite element analysis? [5M]

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