Code No: 5421AU

R17

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech II Semester Examinations, June/July - 2018
ADVANCED FINITE ELEMENT METHODS
(Thermal Engineering)

Time: 3hrs **Max.Marks:75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 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

5 × 5 Marks = 25

1.a) Explain strong from and weak form. Discuss their relevance in FEM. [5]
b) Explain assembly of stiffness matrix with example. [5]
c) For an axi-symmetric structure subjected to axi-symmetric loading, derive expression for stiffness considering triangular element. [5]
d) Describe heat transfer analysis for composite wall for one dimensional method. [5]
e) Determine the eigen values and associated eigen vectors for the matrix [A] given by $A = \begin{bmatrix} 3 & 4 \\ 4 & -3 \end{bmatrix}$. [5]

PART - B

5 × 10 Marks = 50

2.a) Explain the steps in FEM.
b) What is the difference between Plane stress and Plane strain condition? [5+5]

OR

3.a) Derive element stiffness and load vector using Glerkin's approach.
b) Explain the requirements for the selection of interpolation function. [5+5]

4.a) Derive the stiffness matrix of a beam element in bending using trigonometric functions
b) Find the stresses developed in the various elements of truss shown in figure 1. All dimensions in cm. [5+5]

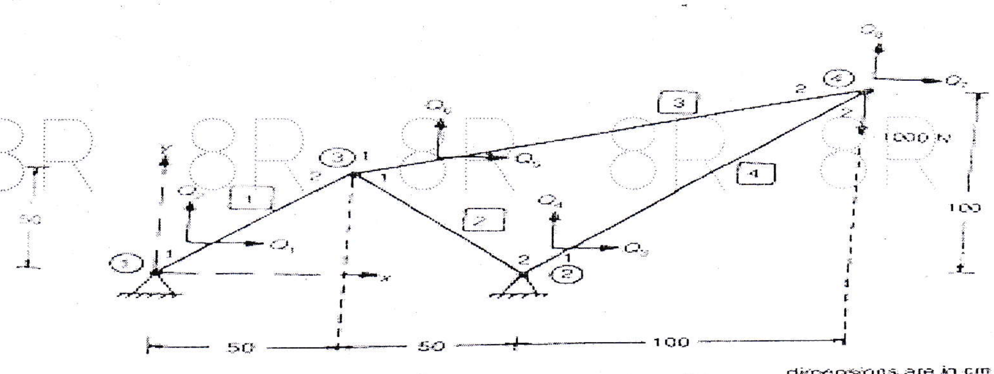


Figure 1

OR

5.a) Derive Expression for element stress and element temperature load for a THREE dimensional truss element

b) Derive stiffness matrix for one dimensional two noded bar element. [5+5]

6.a) What are the properties of constant strain triangle(CST) element explain.

b) Derive shape functions of two dimensional four noded Iso-parametric elements. Plot shape functions. [5+5]

OR

7.a) Derive a stiffness matrix element for a CST using potential energy approach.

b) Determine the shape functions N1, N2, and N3 at the interior point P for the triangular element shown in figure 2. All dimensions in "mm". [5+5]

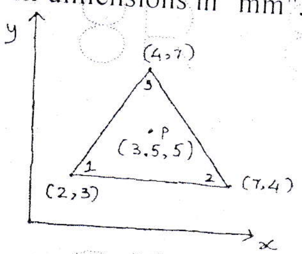


Figure 2

8. Formulate the equations for solving a torsion problem for square shaft using linear triangular elements. Obtain values of stress ϕ and calculate the shear stress in all the elements. Shaft is learning square cross section with side of 10 mm. [10]

OR

9. An aluminum alloy fin of 7mm thick and 50mm long protrudes from a wall, which is maintained at 120^0C. The ambient air temperature is 22^0C. The heat transfer coefficient and thermal conductivity of the fin material are 140 W/m^2 K and 55 W/mK respectively. Determine the temperature distribution of fin. [10]

10.a) Differentiate between the transient dynamic analysis and eigen value analysis

b) Find the natural frequencies of longitudinal vibrations for the stepped bar shown in figure 3 using consistent matrices. [5+5]

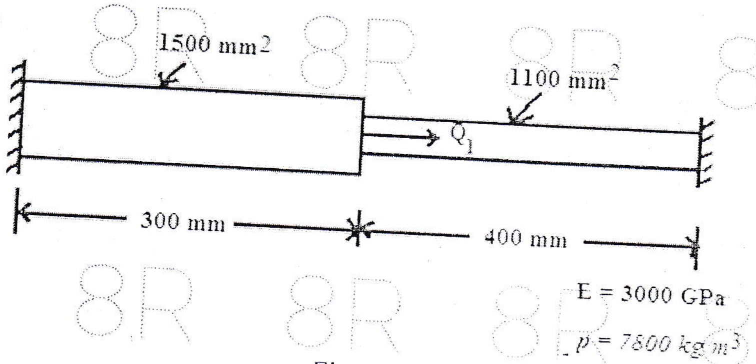
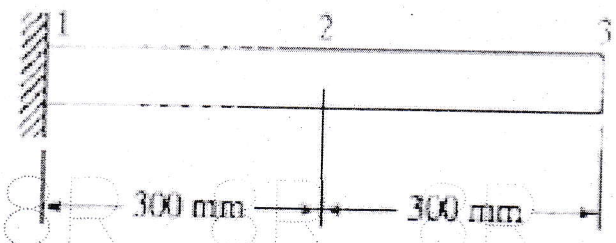


Figure 3

OR

11.a) Discuss the various methods to obtain the eigen values and their corresponding eigen vectors.

b) Evaluate the lowest eigen value and the corresponding eigen mode for the beam shown in figure 4. [5+5]



$E = 200$ GPa

$\rho = 7840$ kg/m^3

$I = 2000$ mm^4

$A = 240$ mm^2

Figure 4

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