Code No: 156AZ **R18**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**B. Tech III Year II Semester Examinations, February/March - 2022**
**FINITE ELEMENT METHODS**
**(Common to ME, MCT)**

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

**Answer any five questions**
**All questions carry equal marks**
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1.a) Explain the step by step procedure for formulating the equations for finite element methods.
b) Draw the Pascal's triangle and Pascal's tetrahedron for the formulation of interpolations functions. Explain the salient features. [7+8]

2.a) What do you understand by the assembly of 1 D bar elements and formulate global stiffness matrix and global load vector.
b) Calculate the nodal displacements and forces for the stepped bar with the stiffness values are 12 kN/m and 8 kN/m and a load of 6 kN is subjected at the end of the stepped bar and other end of the bar is fixed. [7+8]

3.a) Derive the stiffness matrix and load vector for two noded 2 DOF truss element and explain the importance.
b) Calculate the deflection at the center and slopes at the ends of a fixed beam of 2 m length subjected to a UDL of 50 kN/m throughout the length and a point load of 50 kN at the centre. Take $EI = 700 \times 10^5$ N-m$^2$. [7+8]

4.a) The coordinates of the plane truss element is given as 1(0,0) and 2(20,35) mm has the displacement values $\{-0.03 \ -0.01 \ -0.03 \ 0.02\}^T$ mm with the material had Young's modulus of 200 GPa. Calculate the stiffness matrix, load vector and strain energy if the cross sectional area of the truss is 100 mm$^2$.
b) Derive the load vector for two noded beam element subjected to a uniformly distributed load. [7+8]

5.a) Calculate the strain displacement matrix for element with the coordinates 1(4,5), 2(9,2) and 3(6,8) mm. And also calculate load vector, stresses, strains and strain energy for (i) plane stress and (ii) plane strain of triangle whose nodal displacement values are $u_1$=0.3 mm, $v_1$ = 0.3 mm, $u_2$ = 0.2 mm, $v_2$ = -0.4 mm, $u_3$ = 0.3 mm, $v_3$ = 0.5 mm. Take E = 200 GPa, poisons ratio = 0.3 and thickness=2 mm.
b) Derive the stiffness matrix for three noded axisymmetric triangular element from the first principles. [7+8]

6.a) How to make use of Gaussian quadrature method for solving two dimensional integral equations with a suitable example?
b) Explain the finite element formulation for four noded quadrilateral element using isporametric condition. [7+8]

7.a) A composite slab consists of three materials having different thermal conductivities i.e 100 W/m K, 125 W/m K , 75 W/m K of thickness 0.35 m, 0.25 m and 0.5 m respectively. The outer surface is 25 $^0$C and the inner surface is exposed to the convective heat transfer coefficient of 90 W/m $^2$ K, 850 $^0$C. Determine the temperature distribution in the wall.

b) Derive the conductivity matrix for the fin element based on convective boundary condition over the entire surface. [7+8]

8.a) Derive the equilibrium equations by considering the mechanical vibration varying by following sine curve and discuss the salient points.

b) What are the advantages and limitations of ANSYS commercial software over other available finite element software? Explain. [7+8]

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